Tectonomagmatic evolution and green rock mineral chemistry of Jurassic Bonanza arc rocks at Pemberton Hills, Vancouver Island, British Columbia, Canada

Andrew Jedemann

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Supervisors: Dr. Peter Hollings (Lakehead University)

and Dr. David R. Cooke (CODES – University of Tasmania)

Department of Geology

Lakehead University

Thunder Bay, Ontario

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ABSTRACT

The Pemberton Hills study site is situated in northern Vancouver Island, British Columbia, and forms part of a northwest trending belt of porphyry deposits and prospects within the Wrangellia Terrane. The study site is underlain by late Triassic to middle Jurassic Bonanza Group volcanic rocks, with porphyry-related alteration and mineralization thought to be related to the emplacement of the Jurassic Island Plutonic Suite (181 – 141 Ma).

Whole-rock geochemistry, high precision geochronology combined with trace element and Hf isotope analysis of zircons from various intrusive units has led to an improved understanding of the magmatic evolution of plutonic rocks at Pemberton Hills. The oldest unit is a granodiorite dated at 172.34 ± 0.11 Ma. Following this is a quartz diorite with an age of 172.01 ± 0.17 Ma, which overlaps with a tonalite dyke sample dated at 171.77 ± 0.13 Ma. A second quartz diorite sample yielded the youngest reported age at 171.44 ± 0.25 Ma. These results imply that felsic and intermediate plutonism were broadly synchronous at Pemberton Hills.

Zircon trace element geochemistry reveals contrasting conditions in the felsic and intermediate plutonic magmas, despite broadly similar emplacement ages. The granodiorite and tonalite dyke samples are characterized by higher, overlapping Eu/Eu* (~0.2-0.3) and lower, overlapping Dy/Yb (~0.15-0.2) ratios, whereas the quartz diorite samples show low and increasing Eu/Eu* ratios (~0.1-0.17) as well as high and decreasing Dy/Yb ratios (0.25-0.45) over time. These results suggest that conditions remained stable throughout the emplacement history of the felsic plutonic magmas, but varied during the emplacement of the intermediate magmas. Zircon Hf isotope compositions of the granodiorite (+11.4), tonalite dyke (+11.2), and one of the quartz diorite samples (+9.5) suggest these rocks were derived from a juvenile mantle source that

experienced minimal crustal contamination. Together, zircon chemistry and Hf isotope compositions suggest that the granodiorite and tonalite dyke magmas were the most fertile, meaning that felsic plutonic rocks have the most potential to be associated with a larger and more mineralized porphyry system at Pemberton Hills.

Field mapping combined with detailed petrography have shown propylitic alteration assemblages to be present throughout most of the porphyry environment at Pemberton Hills. Laser ablation inductively coupled mass spectrometry (LA-ICP-MS) analyses of epidote, chlorite, and pyrite have identified that major and trace element variations in these minerals vary systematically across the study site, and can be used to discriminate multiple porphyry-related alteration events at Pemberton Hills more effectively than whole-rock geochemistry.

Distal pathfinder elements displayed the most variation in epidote. Elements such as As and Sb in epidote were highest in a cluster of samples from the center of study site to the northeast of the lithocap. A small group of samples proximal to the southwestern margin of the quartz diorite pluton also displayed high As in epidote. Chlorite displayed clear systematic spatial distribution patterns, illustrated by increasing Ca and Sr concentrations in chlorite from samples moving towards the east from the southeast margin of the quartz diorite pluton. Fertility assessment plots of Sb vs. As in epidote and Zn vs. Mn in chlorite were used to discriminate spatially distinct groups of samples interpreted to relate to discrete porphyry alteration events at Pemberton Hills.

Pyrite mineral chemistry combined with pyrite element maps illustrate a complex paragenetic history at Pemberton Hills. Pyrite in samples located around the southeastern margin of the quartz diorite pluton are enriched in elements such as Au, As, Sb, Te, and Ag, whereas

pyrite from samples overprinted by phyllic alteration assemblages are enriched in Mn, V, and Zn, consistent with abundant silicate micro-inclusions in these pyrites. Pyrite in samples located along the surficial margin of the lithocap are enriched in Re, likely reflecting the overprinting of fluids derived from the lithocap.

Trace element mineral chemistry of epidote, chlorite, and pyrite have proven to be effective at vectoring towards potential porphyry targets in an area with limited geologic context, and as a useful method to discriminate samples from different porphyry alteration events. The results of this study demonstrate the application of mineral chemistry as a tool for exploration in greenfield porphyry environments.

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Chapter 1: Introduction

1.1 Objectives

This study was completed as part of the collaborative AMIRA International P1202 project funded by 14 mining and exploration companies that include: Anglo American, BHP Billiton, Boliden, Codelco, Fortescue, Freeport-McMoRan Exploration Corporation, Glencore, Merdeka, Newcrest Mining Ltd., Newmont, and Rio Tinto Exploration. The P1202 project builds off previous AMIRA programs (P1153, P1060, P765A, P765) that focused on, and were successful in, developing and refining techniques for the application of mineral chemistry as a vectoring tool and expanding the recognizable alteration footprints within porphyry copper, epithermal and orogenic gold systems (i.e., Cooke et al., 2014, 2020; Wilkinson et al., 2015, 2020; Ahmed et al., 2020, Baker et al., 2020; Pacey et al., 2020).

The main objective of this study was to use the methods developed in the previous AMIRA programs and apply them to Pemberton Hills, which is an active porphyry exploration site with no known deposit. The Pemberton Hills study site was selected because it had been the target of only limited exploration, despite the presence of a well-developed lithocap (see Hamilton, in prep) and porphyry prospects in the study area as well as being in proximity to a number of porphyry and epithermal deposits, including the past producing Island Copper mine (345 Mt @ 0.41% Cu, 0.17% Mo, 0.19 g/t Au; Perelló et al., 1995). As such, it provided an excellent opportunity to characterize the alteration assemblages in the porphyry environment, and more importantly to test if propylitic alteration minerals such as epidote, chlorite, and pyrite could be used to vector towards an area(s) of interest. This study site provided an additional opportunity

to combine whole-rock and pyrite mineral chemistry data sets from both porphyry and lithocap settings to better understand the transition between the porphyry and epithermal environments.

A second objective of this study was to evaluate the tectonomagmatic evolution of the Bonanza arc volcanic and plutonic rocks that comprise the study area using a combination of whole-rock geochemistry and high precision geochronology, as well as zircon trace element geochemistry and Hf isotopes. The Bonanza arc rocks on Vancouver Island were emplaced into a Devonian-Triassic arc-oceanic plateau-carbonate succession, and as such represent a sequence that has formed on thick (~22 – 33 km) non-continental crust (D'Souza et al., 2016). This provided an interesting geological setting to study the magmatic evolution of porphyry deposit-related intrusive suites.

1.2 Study Location

The Pemberton Hills study site is located on northern Vancouver Island, British Columbia, Canada. It is situated approximately 20 – 30 km southwest of the town of Port Hardy, and lies directly to the west of the Island Copper mine (Fig. 1.1). The Pemberton Hills area is also an active logging operation with good logging roads, which provides the majority of the access to the study site year-round.

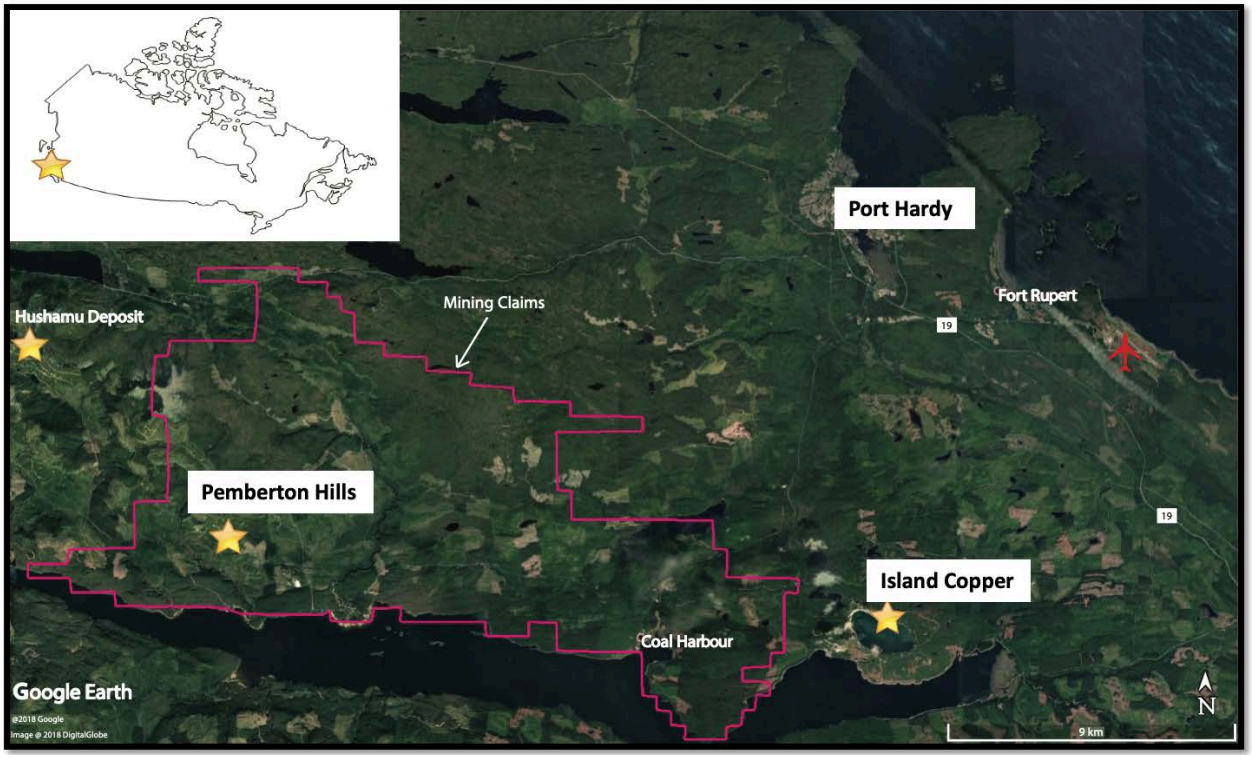


Figure 1.1. Location of the Pemberton Hills study site on northern Vancouver Island with the study location highlighted on a map of Canada in the top left corner of the image. The mining claims for the study site are shown by the solid pink outline. Modified image from google.com/maps.

Chapter 2: Regional Geology

2.1 Wrangellia terrane

The Wrangellia terrane extends along the Pacific margin of North America from Vancouver Island, British Columbia, through to south-central Alaska (Fig. 2.1), and provides a record of tectonic, volcanic and sedimentary processes occurring between the Late Silurian to Early Cretaceous (Jones et al., 1977; Muller, 1977; Wheeler and McFeely, 1991). On Vancouver Island, the basement of Wrangellia is composed of Devonian island-arc volcanic and volcaniclastic rocks of the Sicker Group and associated Early Permian carbonates of the Buttle Lake Formation. Overlying this and forming the main bedrock of Wrangellia are thick sequences of Triassic Karmutsen Formation flood basalts, micritic limestone of the Quatsino Formation, and bedded carbonate-clastic sedimentary rocks of the late Triassic Parson Bay Formation. This succession is a fundamental and distinguishing feature of Wrangellia (Jones et al., 1977). Volcanic, sedimentary, and plutonic assemblages produced during Bonanza arc volcanism at the end of the Triassic and throughout the Early to Middle Jurassic overlie or intrude these units. Lastly, Late Cretaceous sedimentary rocks of the Nanaimo Group unconformably overlie the Jurassic Bonanza Group rocks (DeBari et al., 1999; Nixon and Orr, 2007; Larocque and Canil, 2010).

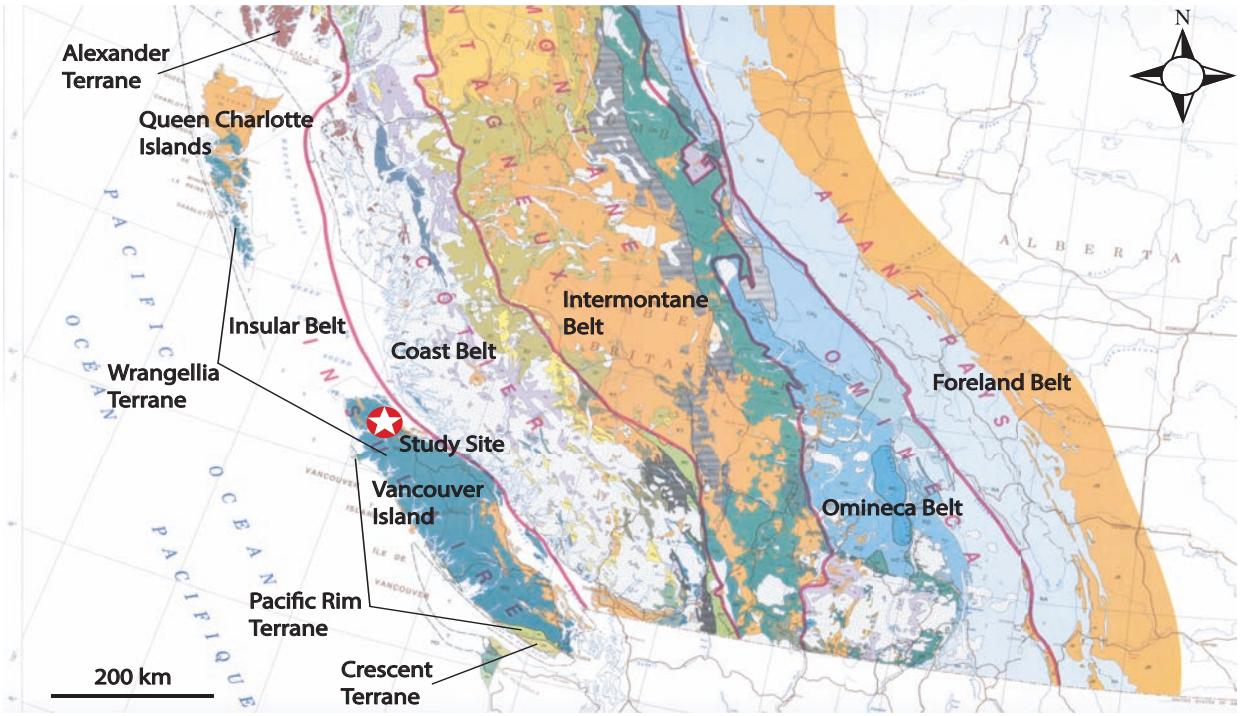


Figure 2.1. Partial terrane map of Western Canada and the Canadian Cordillera. Modified after Wheeler and McFeely (1991).

Wrangellia is thought to have been amalgamated with the Alexander Terrane in the Alaska panhandle to form the Insular Belt as early as the Late Carboniferous. It was subsequently accreted to the inboard terranes of the Coast and Intermontane Belts sometime between the Middle Jurassic and Mid-Cretaceous (Fig. 2.1; DeBari et al., 1999; Nixon and Orr, 2007). Wrangellia is characterized by a northwesterly structural fabric, with northwesterly trending anticlinoria, faults, plutons, and overall distribution of major lithostratigraphic units (Fig. 2.2; Muller, 1977; Yorath et al., 1999). The two dominant anticlinoria on Vancouver Island, referred to as the Buttle Lake and Cowichan Anticlinorium, are inferred to be the product of Late Cretaceous transpression followed by high-angle brittle deformation that produced homoclinal, typically westward dipping fault-bounded blocks (Figs. 2.2 and 2.3; Yorath et al., 1999; Nixon and Orr, 2007; Canil et al., 2013). Numerous parallel and subparallel faults disrupt these anticlinoria,

resulting in a complex stratigraphic discontinuity (Yorath et al., 1999). In northern Vancouver Island, Wrangellia is intruded to the east by the Bonanza arc-related granitoid plutons of the Island Plutonic Suite and fault-bounded to the west by the Pacific Rim Terrane and plutonic rocks of the Westcoast Crystalline Complex (Wheeler and McFeely, 1991; Nixon and Orr, 2007; Nixon et al., 2011a-e). These plutonic units form a key component of this study. Additionally, in the Quatsino Sound region of northern Vancouver Island, extensive northwest trending, high-angle faults have dextrally displaced, dropped down, and folded Jurassic-Cretaceous to early Late Cretaceous clastic rocks (Nixon and Orr, 2007; Nixon et al., 2011a, b; Fig. 2.3).

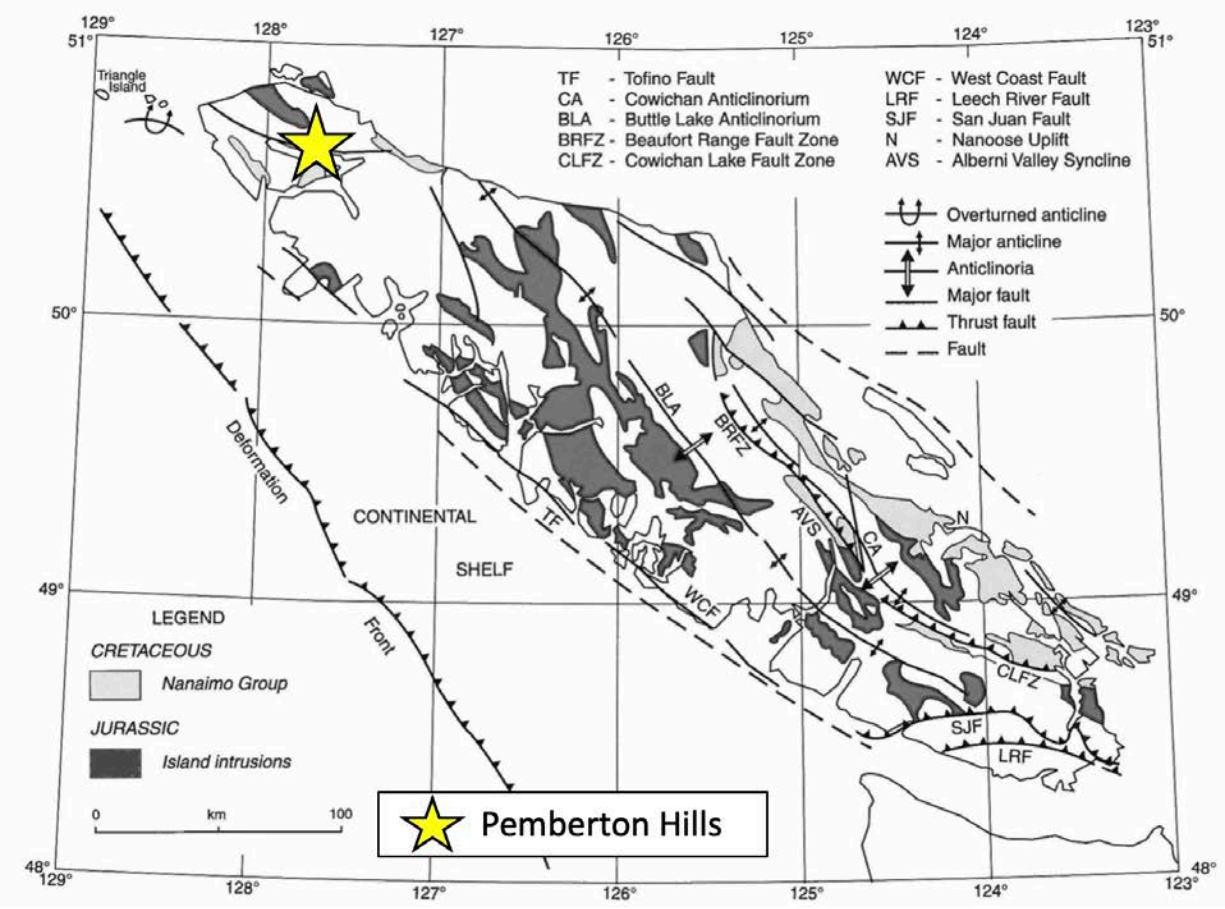


Figure 2.2. Map of Vancouver Island showing major anticlinorium and an overall northwesterly structural gain reflected by the locations of the Jurassic Island intrusions. The yellow star denotes the Pemberton Hills study site. Modified from Yorath et al. (1999).

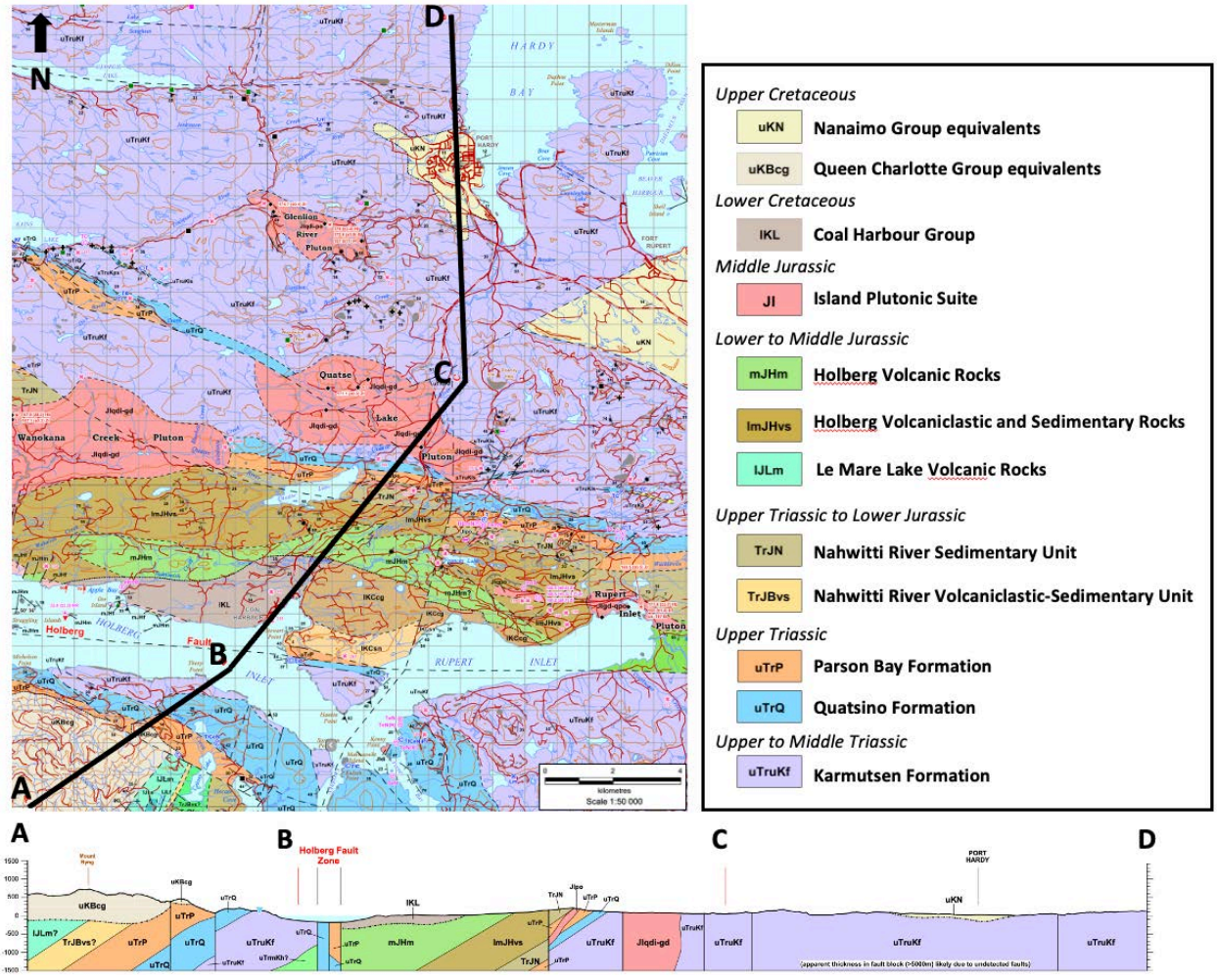


Figure 2.3. Geologic map and cross section of the Quatsino Sound region, northern Vancouver Island. Cross section follows points A – D on the map and highlights westward dipping fault blocks. Modified after Nixon et al. (2011a).

2.1.1 Sicker Group

The basement of Wrangellia, exposed solely on the southern end of Vancouver Island, is dominated by Devonian island-arc volcanic and volcaniclastic rocks of basaltic to intermediate composition of the Youbou Formation, and overlain by Early Permian epiclastic and bioclastic sedimentary sequences of the Buttle Lake Formation, which together form the Paleozoic Sicker Group (Samson et al., 1990; DeBari et al., 1999). The typical metamorphic grade of the Sicker Group volcanic rocks is upper greenschist (epidote-actinolite). However, where exposed as

country rock to the Bonanza arc, grades reach mid-amphibolite facies. Metamorphic and deformational features in these high-grade metamorphic zones such as migmatization (associated with the emplacement of the Westcoast Crystalline Complex, see section 2.1.3) as well as phyllitic and schistose fabrics can be used to differentiate between the Sicker Group arc volcanic rocks and the younger, less deformed Bonanza arc volcanic rocks (DeBari et al., 1999). The only plutonic rocks associated with the Sicker Group are the 365 Ma quartz diorite and quartz-feldspar porphyry plutons of the Saltspring Intrusive Suite (DeBari et al., 1999).

2.1.2 Vancouver Group

Conformably overlying the Sicker Group is the Karmutsen Formation, which together with the Quatsino Formation, comprise the Vancouver Group. The Karmutsen Formation is dominated by ~6000 m of Upper Triassic subaqueous to subaerial tholeiitic flood basalts that form a discontinuous belt from Vancouver Island and the Queen Charlotte Islands, north through southeast Alaska and the Kluane Ranges in southwest Yukon, extending into the Wrangell Mountains and Alaska Range in east and central Alaska (Nikolai Formation; Fig. 2.4; Jones et al., 1977; Muller, 1977; Debari et al., 1999; Greene et al., 2005). This Upper Triassic flood basalt sequence can be divided into three members: (1) a basal unit of pillow lava (2500 $\pm$ 150 m); (2) a middle unit of both locally bedded pillow breccia and hyaloclastites (600 – 1100 m); and (3) an upper unit of subaerial massive basalt, minor pillow breccias, and plagioclase-megacrystic flows intercalated with discrete lenses of limestone and fine-grained carbonate – siliciclastic rocks of the Quatsino formation (2500-3000 m; Carlisle, 1972; Carlisle and Susuki, 1974; DeBari et al., 1999; Greene et al., 2005; Nixon and Orr, 2007). The emergence of these limestone and carbonate – siliciclastic lenses towards the top of the Karmutsen formation has been interpreted

to represent the final stages of Karmutsen volcanism, and the subsequent onset of Quatsino limestone deposition as well as carbonate – siliciclastic detritus derived from erosional processes (Carlisle and Suzuki, 1974; Nixon and Orr, 2007).

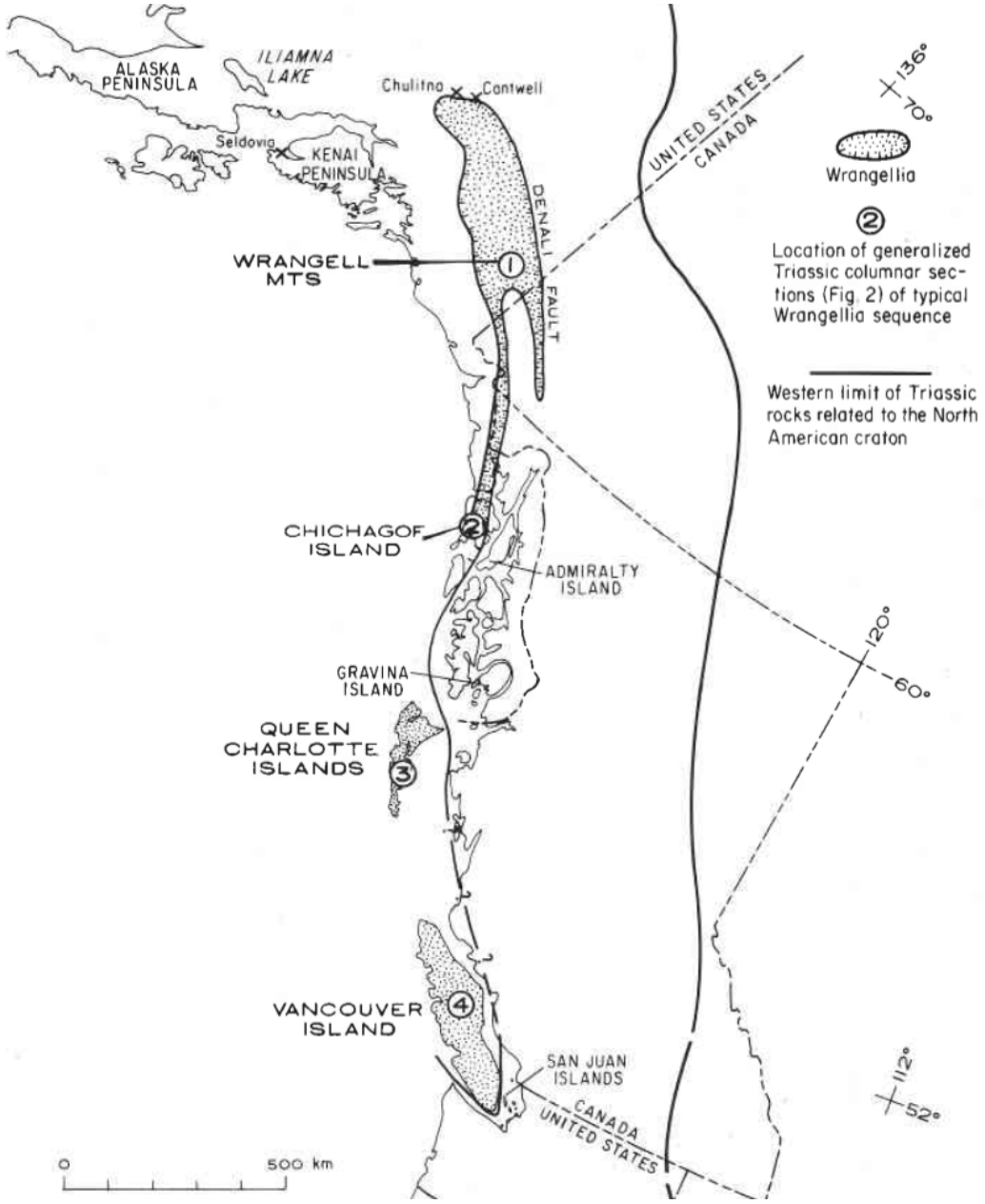


Figure 2.4. Map showing the distribution of Wrangellia and Triassic flood basalts that comprise the Vancouver Group. From Jones et al. (1977).

The lower portion of the Quatsino formation is comprised of a pale grey weathered, predominantly dark coloured micritic limestone, whereas the upper portion of the unit is dominated by thinly laminated to medium or thickly bedded micrite and less commonly calcarenite that locally contains laminae comprised of bioclastic debris (Nixon and Orr, 2007). The basal contact between the Quatsino Formation with the volcanic rocks of the overlying Karmutsen formation has been documented as a paraconformity, and is variable from one location to another. It is described as either massive limestone in sharp contact with basaltic flows, or a thin (<25 cm) intervening layer of weathered, basaltic sandstone and siltstone that displays variable calcareous and clay alteration (Muller et al., 1974; Nixon and Orr, 2007). The upper contact of the Quatsino Formation is conformable and gradational with the Parson Bay Formation of the Bonanza Group, characterized by intervening lenses of pale grey-weathered Quatsino limestone and dark grey, siliceous to sandy limestone, calcareous mudstone and siltstone, as well as fossiliferous black shale of the Parson Bay succession (Carlisle and Suzuki, 1974; Yorath et al., 1999; Nixon and Orr, 2007).

2.1.3 Bonanza Group

Directly overlying the Late Triassic – Early Jurassic shallow- to deep-water carbonate rocks of the Quatsino Formation, and of particular interest to this study is the diverse suite of volcanic, plutonic and sedimentary rocks comprising the Bonanza arc (Fig. 2.5). At the base of the Bonanaza Group and conformably overlying the Quatsino Formation is the Parson Bay Formation (Fig. 2.5), which according to Nixon and Orr (2007) is best represented as two mappable units. These include sedimentary units that are comprised of fine-grained siliciclastic-carbonate sequences, and lesser amounts of volcanic flows and volcaniclastic deposits, which occur as

laterally restricted, intercalated lenses or layers throughout the stratigraphy of the Parson Bay Formation (Nixon and Orr, 2007). The contact with the underlying Quatsino Formation is gradational over a short interval (Yorath et al., 1999).

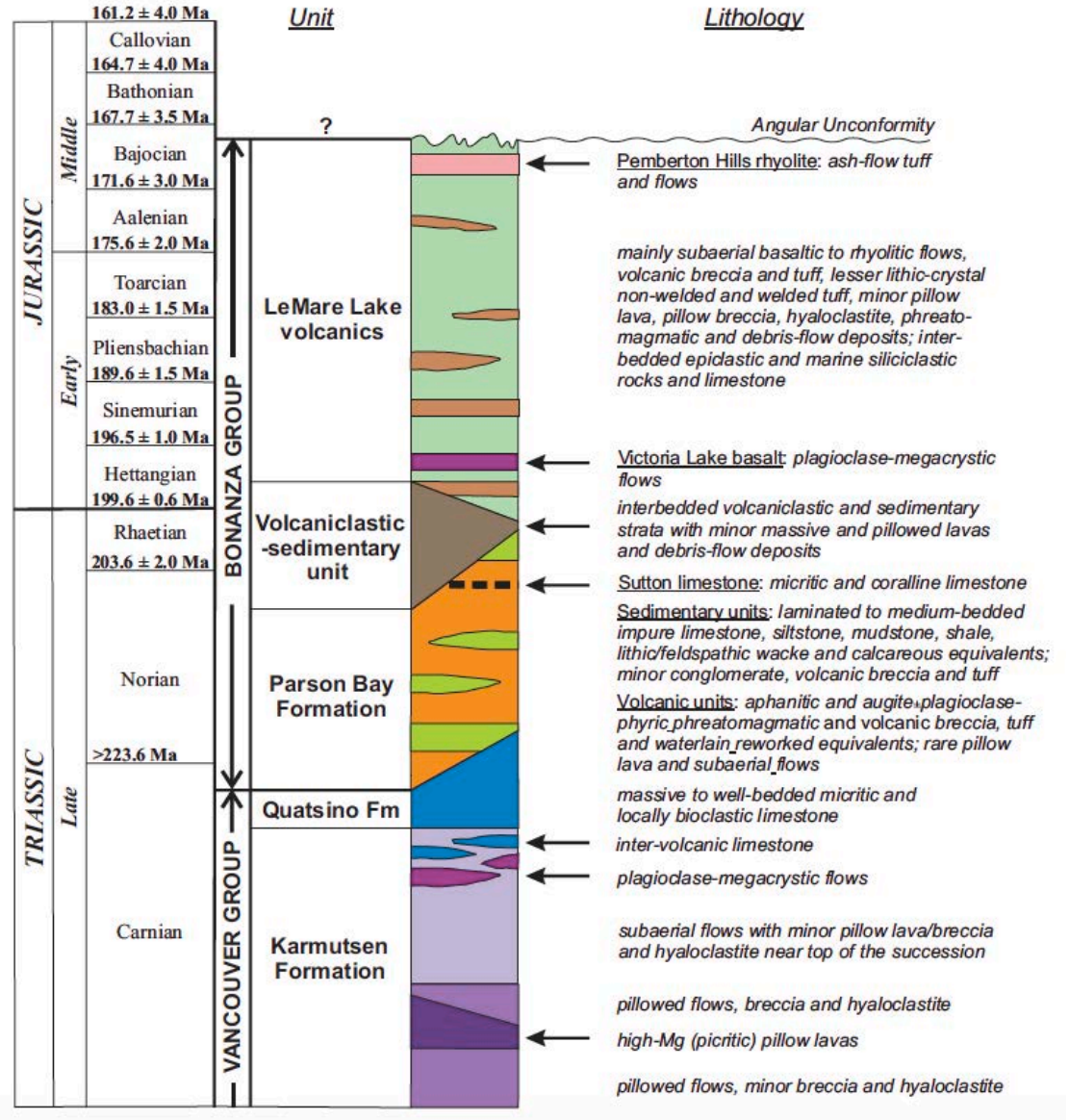


Figure 2.5. Schematic stratigraphic section of Triassic – Jurassic rocks on northern Vancouver Island. Ages are from Gradstein et al. (2004) except for the Carnian-Norian Stage boundary, which is from Furin et al. (2006). From Nixon and Orr (2007).

Sedimentary rocks of the Parson Bay Formation include grey to black, thinly laminated to medium-bedded, impure micritic limestone and calcareous to non-calcareous mudstone,

siltstone and shale (Nixon and Orr, 2007). Subordinate interbedded units include grey-brown to pale buff, fine- to coarse-grained feldspathic sandstone; grey-green lithic volcanic wacke; rare pebble to cobble conglomerate containing volcanic clasts; and thin volcaniclastic breccias and debris-flow deposits (Nixon and Orr, 2007). The sedimentary rock units in the Parson Bay Formation range from carbonate to mainly clastic units, interpreted by Carlisle and Suzuki (1974) to be the result of a turbulent shelf carbonate transition into anaerobic deeper water environments. The sediments of the Parson Bay Formation may also represent an extension of shallow water, starved-basin sedimentation that manifested on the flanks of the Quatsino carbonate platform (Yorath et al., 1999). Although the true thickness of the Parson Bay Formation is difficult to constrain, it is estimated to be approximately 300 m in the Klaskino region on the west coast, and 600 m in the central Alice Lake area (Nixon and Orr, 2007).

Volcanic units of the Parson Bay Formation include volcaniclastic breccia, massive flows, and lesser pillow lavas. These units are predominantly found in the Quatsino – Port Alice area along the Neroutsos Inlet and in Quatsino Sound (Nixon and Orr, 2007). Although related volcanic units are observed in various stratigraphic positions in the Parson Bay Formation, stratigraphic correlation of these volcanic units is difficult due to the limited lateral extent of the units and challenges constraining ages. Despite these complications, the intrinsic relationship between volcanic and sedimentary components of the Parson Bay Formation can be best characterized with reference to work done in the Hecate Cove Formation by Jeletzy (1976) as described by Nixon and Orr (2007). Three intercalated facies have been recognized: 1) a dominant sequence of limestone breccia, water-laid volcanic breccia and mixed volcanic-sedimentary breccia with associated volcanic conglomerate; 2) bedded sequences of tuffaceous limestone, calcareous

argillite, wacke and water-laid tuff; and 3) coarse volcanic breccia, augite-porphyritic lava and volcanic conglomerate.

Stratigraphically above the Parson Bay Formation is what Nixon and Orr (2007) refer to as the Volcaniclastic-Sedimentary Unit (Fig. 2.5). The contact between this unit and the underlying Parson Bay Formation is conformable and occurs where clastic rocks such as wacke, siltstone, and fine volcanic breccia are in greater abundance than the underlying carbonate rocks (Nixon and Orr, 2007). The Volcaniclastic-Sedimentary unit represents a transition from the underlying sedimentary successions of the Parson Bay Formation into the submarine and subaerial volcanic sequences that form the base of the overlying LeMare Lake volcanics, described below. Major rock types within the Volcaniclastic-Sedimentary unit include: dark grey to grey-green, fine- to coarse-grained lithic and feldspathic wacke with locally graded bedding as well as cross laminations and channel features; finer-grained siliciclastic rocks such as siltstone, mudstone, and minor shale; impure limestone and calcareous clastic rocks; heterolithic and monolithic, clast and matrix-supported volcanic breccia, including rhyolitic to basaltic lapilli tuff, tuff breccia, and reworked equivalents (Nixon and Orr, 2007). Minor rock types include: feldspathic arenite; predominantly heterolithic volcanic conglomerate and debris flow breccia; and crystal-vitric tuff and remobilized equivalents as well as minor thin massive flows and pillow lavas. Additionally, abundant dykes and sills related to the overlying volcanic sequences crosscut the Volcaniclastic-Sedimentary unit (Nixon and Orr, 2007). The upper contact between the Volcaniclastic-Sedimentary unit and the overlying LeMare Lake volcanics occurs at the transition between the predominantly epiclastic succession and the sequence of lava flows and associated breccia at the base of the LeMare Lake volcanics.

The most extensive and lithologically complex unit within the Bonanza Group, the LeMare Lake volcanics, represents a period of intense and regionally extensive subaerial volcanism in the Bonanza Group. While constraining the thickness of the unit has been challenging due to faulting and limited stratigraphic markers, Muller et al. (1974) established a minimum thickness of ~2500 m for a measured section near Cape Parkins at the entrance of Quatsino Sound. Limited U-Pb dating of the LeMare Lake Volcanics has yielded the youngest documented age of 169 Ma generated from Pemberton Hills rhyolite, and the oldest age of 202 Ma from a rhyolite on the west coast near Le Mare Lake (Friedman and Nixon, 1995; DeBari et al., 1999; Nixon and Orr, 2007). Unfortunately, the volcanic stratigraphy between these two end member units has no reported radiometric ages, so an inadequate understanding of the relationship between arc volcanism and marine transgression during the Jurassic in the Bonanza arc still exists (Nixon and Orr, 2007).

The main rock types present within the LeMare Lake volcanics include: black to grey-green or reddish grey, aphanitic to plagioclase-phyric, amygdaloidal flows of basaltic to andesitic composition; grey to pink and pale buff, dacitic to rhyolitic flows and flow-dome complexes with aphanitic to feldspar-phyric, flow laminated textures, and localized, well-developed spherulitic devitrification; rhyodacitic to rhyolitic, welded to non-welded, lithic-crystal ash-flow tuff with angular clasts, strongly welded zones defined by collapsed eutaxitic pumice, and rare carbonized wood fragments; and basaltic to rhyolitic volcanic breccia of pyroclastic and autoclastic origin (Nixon and Orr, 2007). Minor volcanic units consist of: rhyolitic and basaltic tuff; pyroclastic surge and explosion breccias of basaltic composition; and thin sequences of basaltic pillow lava, breccia, and hyaloclastite. Sedimentary rocks are typically well-bedded and of non-marine to

marine origin, and include: black to grey-green or reddish brown, variably calcareous siltstone, mudstone and shale, impure limestone, and epiclastic volcanic wacke and breccia. Minor sedimentary units include heterolithic to monolithic conglomerate and debris-flow breccia and lahars (Nixon and Orr, 2007).

One of the few marker units present near the base of the LeMare Lake volcanics are the numerous plagioclase-megacrystic flows of the Victoria Lake basalt (Fig. 2.5). Although quite similar to the megacrystic Karmutsen basalt, this distinct megacrystic unit may occur as discrete or multiple flows within the surrounding stratigraphic succession, and is generally intercalated within the basal part of a thicker sequence of aphanitic, variably amygdaloidal basaltic to andesitic lava (Nixon and Orr, 2007). The flows are black to dark grey-green or reddish grey in colour with a dense to amygdaloidal aphanitic to finely crystalline groundmass and exhibit euhedral to subhedral, lath-shaped to blocky plagioclase crystals up to 2 cm in length that may display a preferred flow orientation. These flows may also be pillowed or fragmented in some areas at the base of the LeMare Lake succession.

Near the top of the LeMare Lake volcanics lies the Pemberton Hills Rhyolite (Fig. 2.5). This unit forms a southeasterly-trending series of prominent hills and ridges that parallels the Holberg Inlet to the south, and extends from Mount McIntosh in the northwest to the Pemberton Hills area in the southeast. Diorite and similar intermediate to felsic intrusive rocks of the Island Plutonic Suite commonly intrude the Pemberton Hills rhyolite on its northern side, particularly in the northwest, whereas the unit disappears and continues underneath the Holberg Inlet to the southeast. Underlying and overlying the Pemberton Hills rhyolite are variable sequences of dark reddish grey to green-grey, aphanitic to pyroxene-hornblende-plagioclase-phyric andesitic flows

with subordinate interbedded crystal-lithic and lapilli tuff, volcanic sandstone and epiclastic breccia. Contacts between the Pemberton Hills rhyolite and the surrounding volcanic units are rarely exposed (Nixon and Orr, 2007).

The Pemberton Hills Rhyolite is dominated by a pale grey to buff or white-weathered, rhyolitic to rhyodacitic, crystal-lithic ash-flow tuff and aphanitic lava that represent flow-dome complexes. Minor units include interbedded porphyritic andesite flows, heterolithic volcanic breccia and vitric tuff. Locally intense acid-sulphate leaching and associated silicification, also referred to as advanced argillic alteration, has destroyed many of the primary textural attributes of this unit (Nixon and Orr, 2007).

The formation of the Bonanza arc and overall onset of arc magmatism in the Early Jurassic has primarily been interpreted to be the result of eastward-directed subduction of the Pacific Ocean lithosphere during the Early to Middle Jurassic, and has an emplacement age of between ~203 and ~164 Ma (Armstrong, 1988; DeBari et al., 1999; D'Souza et al., 2016). Alternatively, the formation of the Bonanza arc has been related to subduction of a west-dipping slab that underwent slab roll back (D'Souza et al., 2016 and references therein). Contemporaneous with arc volcanism and plutonism was an "unroofing" of the arc that began with the erosion of Bonanza Group volcanic rocks to form Middle Jurassic and Early Cretaceous conglomerates, as well as Late Cretaceous graphitic black shales and granitoid-volcanic conglomerates (Muller et al., 1974; Debari et al., 1999). The coeval volcanic, plutonic, and sedimentary rocks that characterize the Bonanza arc represent a 15 km thick crustal section divided into various structural levels, and form a 500-km-long, northwest-trending belt on western Vancouver Island,

as well as extending for approximately 250 km along the west and east coasts of Queen Charlotte Islands (Debari et al. 1999 and references therein; Canil et al., 2013).

The Jurassic Bonanza arc has been determined to be geochronologically related to, and is believed to represent, the southern extension of the Jurassic Talkeetna arc in Alaska, however, there are some key distinctions between the two arcs (DeBari et al., 1999; Larocque and Canil, 2010; D'Souza et al., 2016). One fundamental difference is that although the Jurassic Bonanza arc on Vancouver Island is thought of as a typical island arc built on oceanic crust, it was built upon a Devonian-Triassic arc-oceanic plateau-carbonate succession, and thus represents an island arc that has formed on thick non-continental crust (D'Souza et al., 2016). Another critical distinction between the two arcs is the absence of garnet-bearing cumulate rocks in the Bonanza arc, which are present in the Talkeetna arc section (D'Souza et al., 2016). For the purpose of this study, Bonanza Group rocks are defined as calc-alkaline volcanic rocks with minor interbedded sedimentary rocks of Jurassic age. Associated Bonanza arc related plutonic (and metamorphic) rocks can be divided into two separate units: The Westcoast Crystalline Complex (WCC); and the Island Plutonic Suite (IPS; Debari et al., 1999; Yorath et al., 1999; Larocque and Canil, 2010; Canil et al., 2013).

2.1.3.1 Bonanza arc-related intrusive rocks

The Westcoast Crystalline Complex (WCC) is an assemblage of predominantly diorite, quartz diorite, granodiorite and late-stage leucotonalite, as well as amphibolite. The degree of deformation throughout the unit is variable, and can vary at the outcrop scale where the level of strain may vary over meters (Debari et al., 1999; Larocque and Canil, 2010; Canil et al., 2013). Assemblages of hornblende gabbro, olivine pyroxenite, and peridotite with cumulate textures

have been classified and mapped as subunits of the WCC, and occur as decameter- to rarely kilometer-scale conformable but discontinuous intrusions (Isachesen, 1987; DeBari et al., 1999; Canil et al., 2013 and references therein; Fig. 2.6A). The country rock to the WCC commonly exhibits amphibolite-grade metamorphism, displaying partial-melting features in the form of migmitization. Debari et al. (1999) proposed that the amphibolitized and migmatized country rock to the WCC has been petrographically determined to be Sicker Group volcanic and sedimentary rocks, which suggests that the WCC only intruded into the deepest levels of the stratigraphic section (Fig. 2.6B). Further supporting this is Al-in-hornblende geobarometry work carried out by Canil et al. (2010) that suggests an emplacement or equilibration depth of 10 – 17 km for the rocks of the WCC.

Emplaced higher in the stratigraphy, the Island Plutonic Suite (IPS) defines a belt of northwest aligned batholiths, plutons, and stocks consisting of unfoliated quartz diorite, hornblende diorite, and granodiorite, with lesser tonalite and granite (Debari et al., 1999; Larocque and Canil, 2010; Canil et al., 2013; Fig. 2.6A, B). While differentiating between subunits of the IPS and WCC can be challenging without the presence of any deformational features, there are differences that help distinguish them from each other. For instance, the WCC displays gneissic foliation that is not observed in the IPS (Muller et al., 1981). Contacts between the IPS and surrounding country rock are generally sharper than those of the WCC, as well as the fact that the surrounding host rocks to the IPS do not normally exhibit metamorphic grades higher than greenschist facies. Additionally, the IPS typically only intrudes into the volcanic rocks of the Karmutsen formation and Vancouver Group as opposed to the Sicker Group (Debari et al., 1999;

Fig. 2.6B). Al-in-hornblende geobarometry work on the IPS by Canil et al. (2010) indicates a shallower level of equilibration of between 2 – 10 km compared to 10 – 17 km for the WCC.

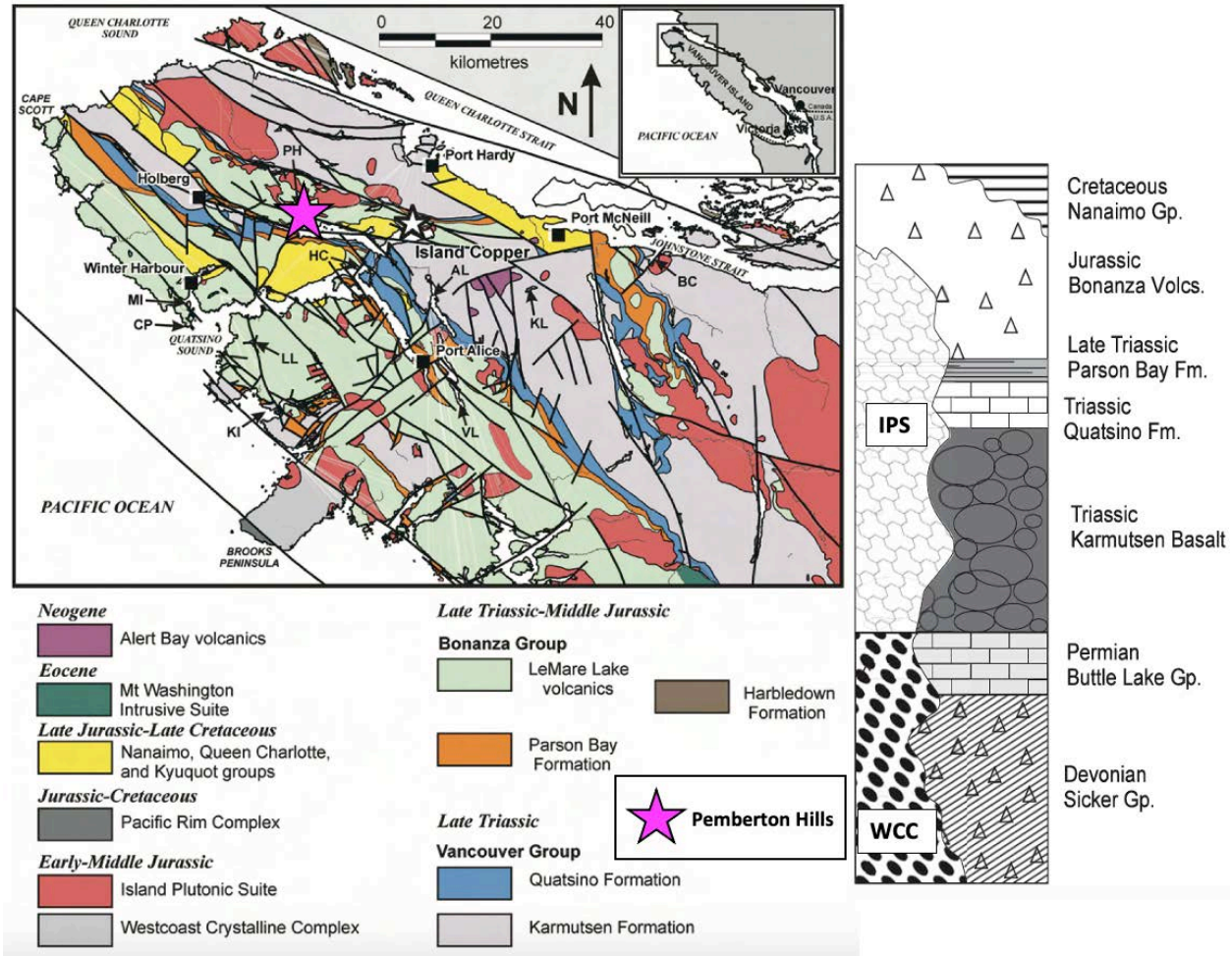


Figure 2.6. (A) Regional geology map showing the distribution of the Island Plutonic Suite (IPS) and Westcoast Crystalline Complex (WCC) throughout northern Vancouver Island; and (B) stratigraphic section for Wrangellia on Vancouver Island, highlighting the intrusive units of the Bonanza arc. Regional geology map modified from Nixon and Orr (2007) after Massey et al. (2005). Stratigraphic section modified from Canil et al. (2013), after Larocque and Canil (2010).

Despite these distinctions, D'Souza et al. (2016) suggest that some of these differences are difficult to decipher in the field, and interpretations can be further complicated due to both the WCC and IPS having subunits with very similar bulk chemistry. Newly determined U-Pb ages together with ages from previous studies suggest that plutonic rocks of the Bonanza arc range in

age from 193 Ma to 168 Ma (Canil et al., 2013). Ages older than 184 Ma have not been documented in the IPS, and ages younger than 174 Ma have not yet been reported for rocks of the WCC. The overlap in these ages suggests contemporaneous plutonism of the IPS and WCC throughout the various structural levels of Wrangellia, and the Bonanza arc itself.

2.1.4 Alteration and mineralization in the Pemberton Hills region

Northern Vancouver Island has long been an area of interest for exploration companies in search of base and precious metals attracted by reports of regionally-extensive porphyry-, skarn- and epithermal-related alteration and associated mineralization assemblages. The mineralization and alteration in the area is exemplified by a northwest trending belt of porphyry and epithermal prospects, deposits and mines that roughly parallel the Holberg Inlet, proximal to the town of Port Hardy, British Columbia (Fig. 2.7). Sites currently of most relevance to this study include the Island Copper Mine (Cu-Au-Mo-Re), the Hushamu deposit (Cu-Au-Mo), the Red Dog deposit (Cu-Au), and the Pemberton Hills property (this study), which are all currently owned by NorthIsle Copper and Gold Inc. (Cargill, 1975; Witherly, 1979; Koyanagi and Panteleyev, 1993; Panteleyev and Koyanagi, 1994; Dasler et al., 1995; Leitch et al., 1995; Perelló et al., 1995; Arancibia and Clark, 1996). Table 2.1 summarizes current resource estimations and past production of the sites mentioned above.

Table 2.1. Summary of current and past resources for porphyry-epithermal properties in northern Vancouver Island.

Property Name	Deposit Type	Current Resource Estimation (Mt)[1]	Past Production (Mt)[1]	Principal Commodities[1]
Island Copper	Porphyry	N/A	345	Cu (0.41%), Mo (0.17%), Au (0.19 g/t)
Hushamu	Porphyry/Epithermal	304	N/A	Cu (0.21%), Mo (0.1%), Au (0.29 g/t), Re (0.55 g/t)
Red Dog	Epithermal	23.6	N/A	Cu (0.32%), Au (0.46 g/t)
Pemberton Hills	Porphyry/Epithermal	N/A	N/A	N/A

[1] From Tahija et al. (2017)

Most literature on the region acknowledges that structural controls play a fundamental role in the overall distribution of mineralizing plutons and associated alteration domains (Fig. 2.7; Dasler et al., 1995; Perelló et al., 1995; Tahija et al., 2017). The dominant regional structures in the area are a result of east- to northeast-directed compression, which produced extensive northwest-trending, steeply dipping fault systems. The Holberg Fault, which follows the Holberg and Rupert Inlets is the best example of this, in addition to the Nahwitti and Hushamu Faults (Perelló et al., 1995; Tahija et al., 2017). A second episode of deformation is noted as a north-directed compressional event, which generated northwest-trending strike-slip faulting, and may have offset some of the earlier-formed porphyry systems (Tahija et al., 2017). Lastly, a north- to north-northwest extensional event resulted in sets of east-northeast-trending faults that splay off the northwest-trending sets. These faults have created offsets in the order of several hundred metres. It has also been suggested that the intersections of these northeast- and northwest-trending fault sets played a crucial role in the distribution of the copper-gold occurrences at Hushamu, Red Dog, and the Island Copper mine (Dasler et al., 1995; Tahija et al., 2017).

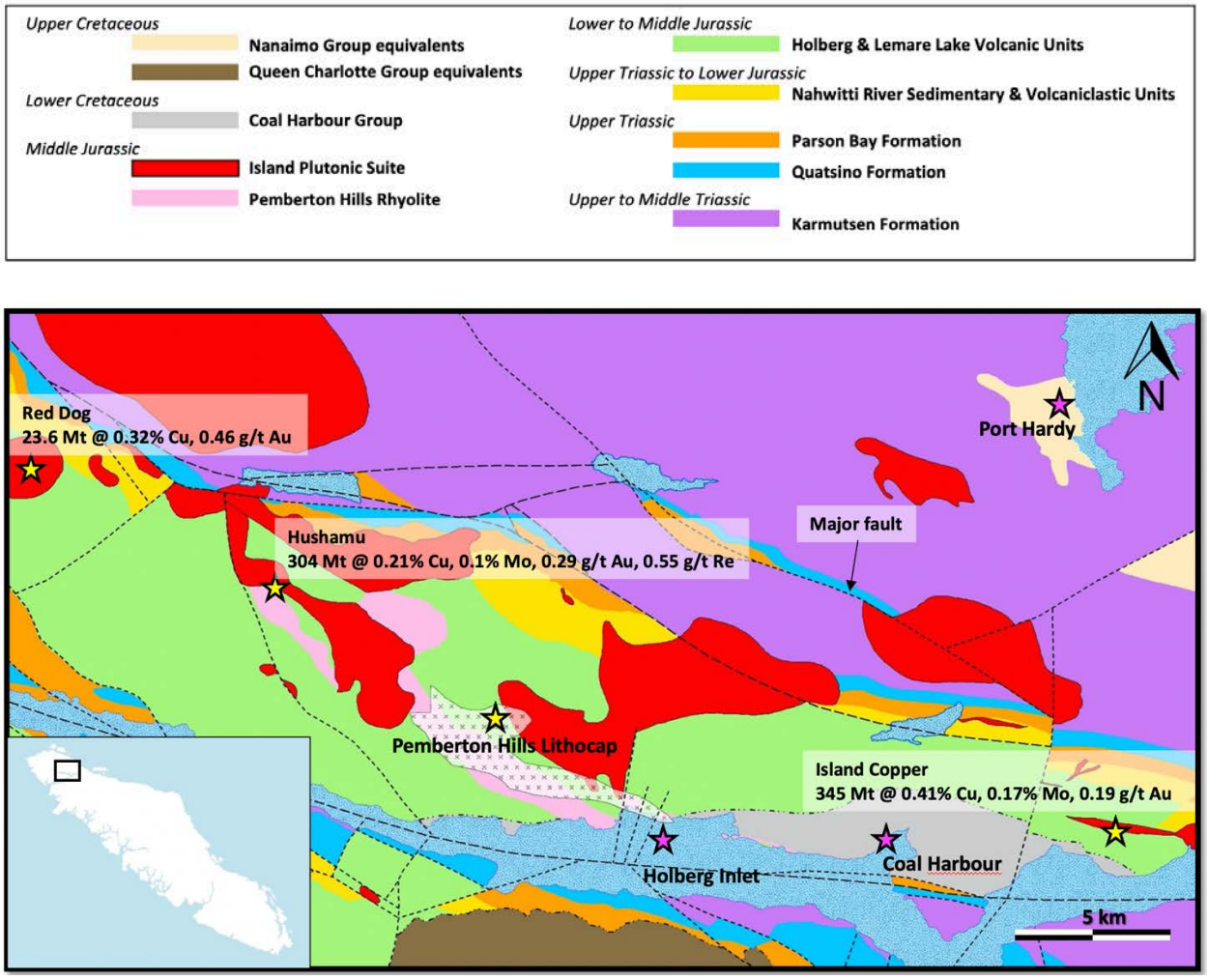


Figure 2.7. Regional geology map highlighting the northwest trending belt of porphyry and epithermal properties (yellow stars) as well as geographical points of interest (pink stars) in the Pemberton Hills region. Dashed lines indicate major fault systems. The Inset map of Vancouver Island in bottom left corner shows the area comprising the regional geology map denoted by the black box. From Hamilton (in prep) after Nixon et al. (2011a, b).

The most thoroughly characterized and studied porphyry deposit in northern Vancouver Island is the Island Copper Mine, which is located approximately 16 km south of the town of Port Hardy, and 15 km to the west-southwest of the Pemberton Hills property (Fig. 2.7). Last operated by BHP Minerals Canada Limited until its closure in August 1995, the mine produced approximately 345 million tonnes of ore, with average grades of 0.41% Cu, 0.017% Mo, 0.19 g/t Au, and 1.4 g/t Ag (Perelló et al., 1995). Previous workers classified the Island Copper mine as

part of a group of five porphyry Cu-Au-Mo systems on the property that trend in a northwest direction towards Quatse Lake, termed the Island Copper Cluster (ICC). The Island Copper mine, however, is the only economic orebody in the group (Perelló et al., 1995). Major rock units at the mine site include lithic tuff, interbedded andesitic and basaltic flows, igneous and hydrothermal breccias, and a rhyodacitic porphyry unit that has been interpreted as both single (Cargill, 1975; Cargill et al., 1976) and multiphase intrusions (Arancibia and Clark, 1996; Perelló, 1987). Although there is disagreement in the literature with respect to the genesis and temporal evolution of the various alteration assemblages observed at the deposit, there is (some) consensus regarding the alteration assemblages themselves and stages of mineralization on the property resulting from the emplacement of a series of rhyodacitic intrusions into the Bonanza Group substrate (Perelló et al., 1995; Ross et al., 1996).

The earliest phase of alteration at Island Copper is related to the initial emplacement of the rhyodacitic porphyry and is interpreted to comprise four discrete and roughly concentric alteration domains (Perelló et al., 1995; Fig. 2.8). The inner zone is dominated by an assemblage of quartz, magnetite, actinolite, and albitic plagioclase, characterized by stockwork veining that occurs along the contact between the dominant porphyry intrusion and Bonanza Group volcanic rocks. The stockwork can be intense, with multiple generations of veins and veinlets containing variable combinations of the minerals stated above (Perelló et al., 1995). Surrounding this inner core is a pervasive to hairline fracture- and veinlet-filled biotite-magnetite zone with associated albitic plagioclase, amphibole, and potassium feldspar, comprising the potassic zone. This domain is host to the bulk of the copper-gold mineralization at Island Copper. A zone of chlorite and magnetite grades outwards from the inner biotite-magnetite domain, followed by an epidote-

bearing propylitic halo (Perelló et al., 1995). Calcite and pyrite are also common in the propylitic environment, in addition to minor albitic plagioclase, amphiboles, and magnetite (Perelló et al., 1995).

The second or intermediate stage of alteration at Island Copper is defined by numerous generations and variations of quartz, sericite, kaolinite, illite, chlorite, and pyrite, as well as molybdenite and minor chalcopyrite, collectively referred to as phyllic alteration (Leitch et al., 1995; Perelló et al., 1995; Fig. 2.8). This stage of alteration is texturally-destructive and overprints the earlier formed alteration and mineralization assemblages where present, and is most strongly developed in the porphyry intrusions (Leitch et al., 1995). The overall distribution of the phyllic alteration is controlled by faults, stockworks, and hydrothermal breccias, and is characterized by two main styles of formation: structurally controlled quartz-sericite-pyrite, and more pervasive sericite-illite-chlorite-pyrite (Perelló et al., 1995). Arancibia and Clark (1996) suggested that the assemblage of sericite-illite-chlorite represents an intermediate argillic alteration assemblage that formed locally and/or episodically before and after the main quartz-sericite-pyrite or "phyllic" event, rather than occurring simultaneously, although this still appears to be largely unresolved. In the main ore zone, the sericite-illite-chlorite-pyrite assemblage has both partially and completely replaced biotite, amphibole, and feldspar, and has also been noted to produce hematization of magnetite, as well as potentially remobilizing some of the initially deposited copper and gold (Perelló et al., 1995).

The final stage of alteration according to Perelló et al. (1995) is defined by an advanced-argillic alteration assemblage of pyrophyllite, quartz, sericite, kaolinite, and dumortierite with trace tourmaline (Fig. 2.8). Similar to the phyllic alteration, the advanced argillic alteration is also

texturally destructive, and is confined to the “pyrophyllite breccia” in the western domain of the Island Copper system, but can also be observed in the porphyritic and volcanic rocks directly adjacent to the breccia. In addition to this late-stage advanced argillic alteration, later and lower-temperature alteration phases of ankerite-calcite, zeolites, and remobilized carbon-bearing organic compounds in veins and veinlets are observed cross-cutting all pre-existing alteration assemblages (Panteleyev and Koyanagi, 1994; Perelló et al., 1995).

The mineralization at Island Copper is intimately associated with the alteration assemblages, demonstrated by numerous generations of copper- and molybdenite-veinlets related to different stages of alteration across the deposit. The vast majority of the copper mineralization at Island Copper is found within the (magnetite)-biotite or “potassic” alteration domain, in the form of stockwork quartz-chalcopyrite-magnetite-pyrite, quartz-chalcopyrite-pyrite-biotite +/- K-feldspar, and chalcopyrite-pyrite +/- magnetite +/- molybdenite veins and veinlets (Panteleyev and Koyanagi, 1994; Leitch et al., 1995; Perelló et al., 1995; Arancibia and Clark, 1996). The relationship between the copper mineralization and biotite alteration suggests a strong temporal relationship between these early-stage events. This stage of mineralization preceded the main introduction of molybdenum in quartz-molybdenite-pyrite-chalcopyrite veinlets with quartz-sericite vein selvages, followed by molybdenite-pyrite-chalcopyrite veinlets. Average grades of <0.3% and <0.1% Cu are observed in the chlorite and epidote zones, respectively (Perelló et al., 1995).

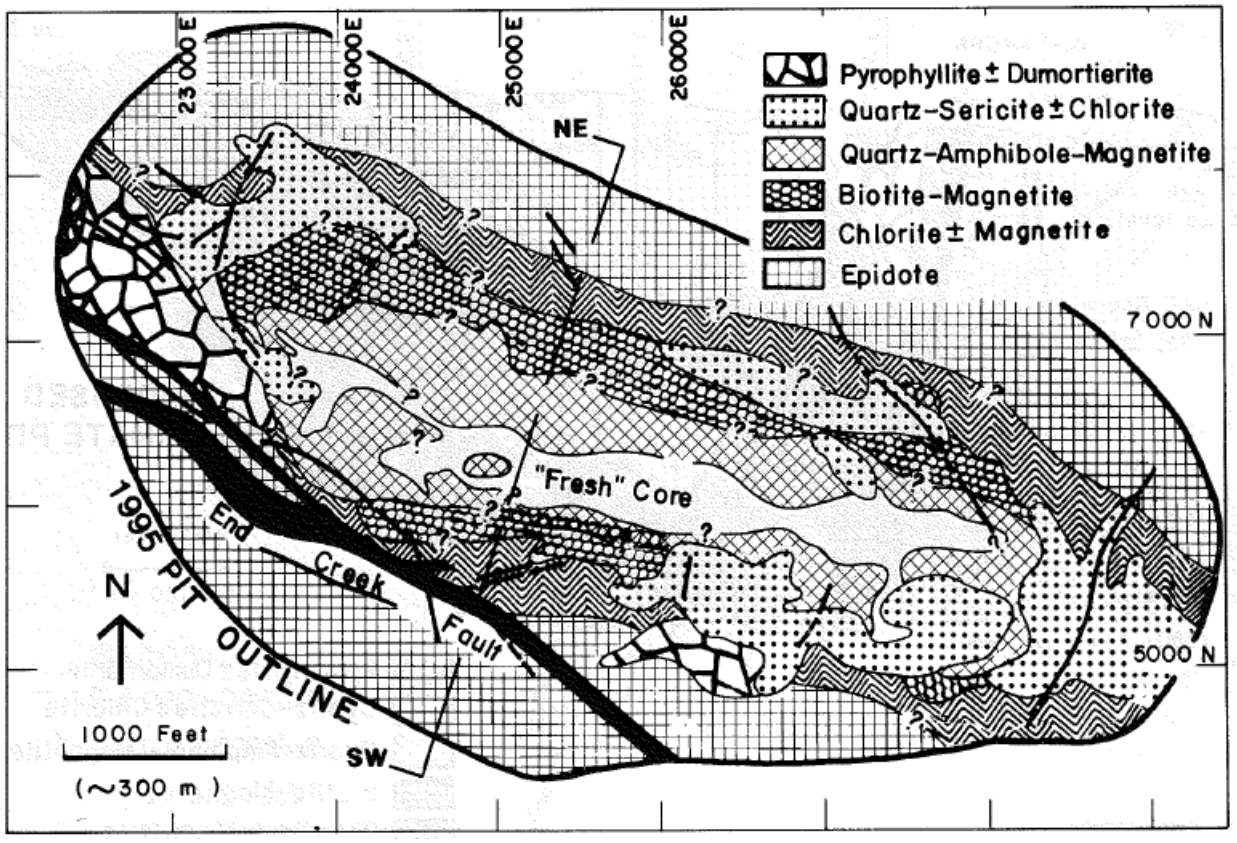


Figure 2.8. Plan view of the alteration assemblages at the Island Copper mine (from Perelló et al., 1995).

Similar to copper, much of the gold mineralization at Island Copper occurs with the magnetite-bearing and biotitized volcanic rocks comprising the potassic zone (Perelló et al., 1995). Scanning electron microscope studies show a close spatial relationship between the gold grains and biotite, suggesting a temporal relationship with both the copper and gold (Perelló et al., 1995). Higher gold grades of >0.4 g/t are locally observed with the quartz-sericite stockworks in the porphyritic and adjacent volcanic rocks, but whether or not this gold was introduced with the phyllic alteration assemblage or remobilized from pre-existing gold mineralization in the potassic zone is not well constrained (Perelló et al., 1995). Unlike the copper, which achieves a relatively constant grade with depth, gold content decreases with depth (Perelló et al., 1995).

A U-Pb geochronology study on zircon conducted by Ross et al. (1996) from the rhyodacite quartz-feldspar porphyry dyke complex that hosts the Island Copper ore was completed in order to constrain the timing of mineralization. An early porphyry phase interpreted to pre-date mineralization yielded an age of 168.5 +0.3/-1.7 Ma. An intramineral porphyry phase associated to the main mineralization event yielded an age of 168.5 ± 0.6 Ma. A late porphyry phase understood to post-date mineralization was dated at 166.2 ± 0.7 Ma.

Approximately 30 km to the northwest of the Island Copper mine lies the Hushamu Deposit (Fig. 2.7) with a current mineral resource estimation of 304,270,000 tonnes grading 0.21% Cu, 0.29 g/t Au, 0.10% Mo, and 0.55 g/t Re for a copper equivalent grade of 0.45% Cu, making it roughly similar in size, metal content, and grade to Island Copper (Tahija et al., 2017). Previous workers have referred to the property as the Hushamu-McIntosh porphyry copper-gold system based on the spatial distribution of the various alteration and mineralization domains observed (Fig. 2.9; Panteleyev and Koyanagi, 1994; Dasler et al., 1995). The Hushamu deposit sensu-stricto refers to the deeper porphyry copper-gold environment directly overlying the mineralizing quartz-feldspar porphyry intrusion, whereas McIntosh Mountain refers to a prominent hill directly to the south on the property that contains the epithermal mineralization and alteration assemblages. The most recent work on the property refers to McIntosh Mountain as Hushamu Mountain, and it will be referred to as such herein (Tahija et al., 2017).

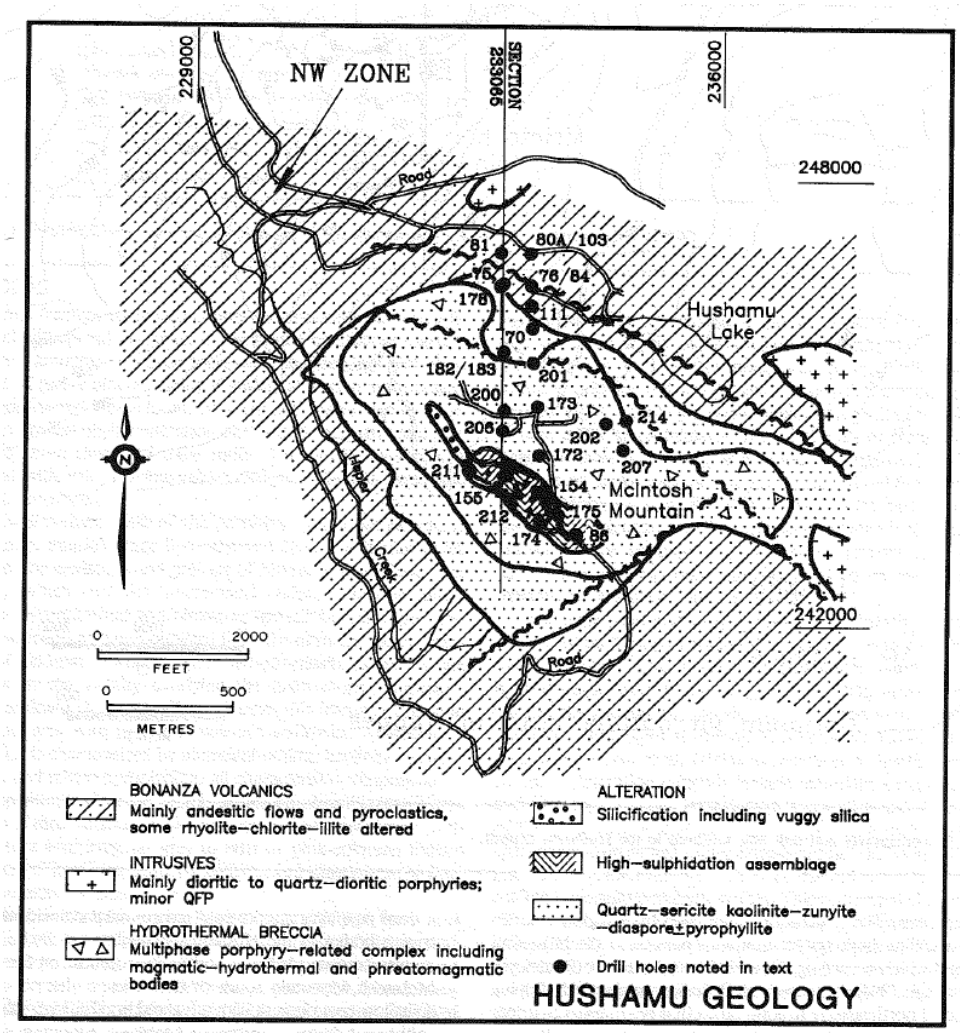


Figure 2.9. Plan view of the lithology and alteration types at the Hushamu deposit. From Dasler et al. (1995).

There are five major rock types recognized on the Hushamu property including: diorite, quartz-feldspar porphyry, hydrothermal breccia, a late breccia, and a massive andesite unit. The massive andesite unit can be further subdivided into an amygdaloidal unit, a feldspar-phyric unit, and a tuffaceous unit, which are the main units that host the copper-gold mineralization on the property (Fig. 2.9; Dasler et al., 1995; Tahija et al., 2017). Similar to the Island Copper mine and other surrounding porphyry copper-gold deposits, the alteration and mineralization on the Hushamu property is related to the emplacement of Jurassic Island Plutonic rocks into Bonanza

Group volcanic rocks. The main intrusive body on the Hushamu property is the Hushamu Creek Pluton, which is an extensive northwest-trending fine- to medium-grained pluton consisting of diorite to quartz diorite and associated quartz-feldspar porphyry. The quartz-feldspar porphyry occurs as dykes and irregular bodies that occur at the southern margin of the northwest-trending diorite stocks. This unit consists of coarse-grained, subhedral quartz and feldspar phenocrysts in a very fine-grained matrix, and often contain xenoliths of diorite and/or andesite. The diorite and quartz-feldspar porphyry are mostly unmineralized (Dasler et al., 1995; Tahija et al., 2017).

The following alteration types at the Hushamu deposit are from Tahija et al. (2017), which include: silica-clay-pyrite, silica-clay-zunyite, chlorite-magnetite, and chlorite-epidote-calcite assemblages. Additionally, structurally controlled phyllic alteration is present in the northwest region of the deposit and is characterized by quartz, sericite, pyrite and minor clays. These assemblages are essentially analogous to the advanced argillic, intermediate and propylitic assemblages described by Dasler et al. (1995; Fig. 2.9). The alteration phase that hosts the dominant Cu-Au-Mo mineralization is a chlorite-magnetite assemblage with minor amounts of albitic plagioclase, illitic clays and local remnants of pre-existing biotite-bearing K-silicate alteration phases. These remnant K-silicate phases are interpreted to represent a pre-existing potassic alteration environment that has largely been overprinted by an intermediate chlorite-magnetite-illite assemblage, which grades out into a distal propylitic assemblage of chlorite and epidote with cross-cutting carbonate veins (Dasler et al., 1995).

Advanced argillic alteration assemblages on the Hushamu property are represented by multi-stage hydrothermal breccia complexes that are constrained to the intermediate and uppermost levels of the porphyry system, and are thus only observed on the upper slopes of

Hushamu Mountain. These texturally destructive advanced argillic alteration assemblages are present in the form of silica-clay-pyrite alteration, characterized by quartz, sericite, kaolinite, pyrophyllite, diaspore and dickite in varying combinations, with pyrite generally comprising 10 to 20% of the rock by modal abundance (Dasler et al., 1995; Tahija et al., 2017). Overprinting the silica-clay-pyrite alteration is a similar assemblage of silica-clay-zunyite, which essentially lacks pyrite but contains zunyite; however, these assemblages have been noted to grade into each other over short distances (Tahija et al., 2017). Zones of the most intensely altered rocks exhibit a "mottled" texture with irregular grey to buff pink-coloured patches of kaolinite, zunyite, dickite, and diaspore in a fine-grained siliceous cement (Dasler et al., 1995). The uppermost level of Mount Hushamu is characterized by a leached zone that forms a prominent ridge at the top of Mount Hushamu, defined by the presence of abundant vuggy quartz and associated advanced argillic alteration (Dasler et al., 1995; Tahija et al., 2017).

The mineralization at the Hushamu deposit is described by Dasler et al. (1995) and is summarized as follows. The main porphyry copper-gold mineralization occurs as multi-generation quartz-magnetite-chalcopyrite-pyrite stockwork veining, disseminated chalcopyrite, and hairline fracture-controlled mineralization hosted predominantly in the chlorite-magnetite altered andesitic volcanic rocks, and to a lesser extent the feldspar porphyry. Phyllic alteration that locally overprints the main chlorite-magnetite zone contain veins, hairline-veinlets, and disseminated pyrite with minor chalcopyrite. The hydrothermal breccia complex and associated advanced argillic alteration that dominate Mount Hushamu are also host to significant mineralization on the property, and contain mineralized fragments of volcanic rock, in addition to being crosscut by high-level, structurally-controlled, quartz-veined and weakly mineralized

feldspar porphyry bodies, as well as pyrite-rich phreatomagmatic pebble breccia dykes and late rhyolite dykes. Copper- and gold-bearing sulphide minerals in the breccia complex include covellite, bornite, chalcocite, chalcopyrite, and minor enargite. Zones of supergene mineralization have been observed in the breccia complex where a weakly developed chalcocite-covellite supergene alteration assemblage overprints pyrite and bornite grains, as well as partially to completely replacing enargite. This supergene zone is typically located at depths of 60 to 90 m, but has been observed 200 m below surface in fractured rocks (Tahija et al., 2017).

The lesser studied Red Dog deposit lies approximately 10 km northwest of the Hushamu deposit, and has a current indicated resource estimation of 23.6 million tonnes grading 0.32% Cu, 0.46 g/t Au and 0.007% Mo (Tahija et al., 2017). The mineralization at Red Dog is associated with a hydrothermal-quartz breccia and stockwork complex that formed directly to the south of a quartz-feldspar porphyry intrusion of diorite to tonalite composition, as well as a separate quartz monzonite intrusion to the west (Tahija et al., 2017; Fig. 2.10). The hydrothermal breccias and stockworks are characterized by quartz and magnetite +/- pyrite, or quartz and pyrite +/- hematite, with chalcopyrite present as the dominant copper-bearing sulphide mineral (Panteleyev and Koyanagi, 1994; Tahija et al., 2017). Surrounding the southern margin of the quartz-magnetite breccia is an intermediate argillic alteration assemblage of chlorite, magnetite, quartz, and sericite, with variable amounts of pyrite and chalcopyrite, which is positioned against an advanced argillic assemblage of quartz, kaolinite, pyrophyllite, diaspore, pyrite, and minor topaz, alunite, and zunyite to the south by a steep southward dipping fault (Tahija et al., 2017). Recent drilling by NorthIsle Copper and Gold Inc. demonstrated increasing copper and gold grades with depth underneath the advanced argillic alteration, potentially suggesting the

presence of a buried porphyry copper-gold system at depth (Tahija et al., 2017). Enveloping the advanced argillic alteration is a laterally extensive propylitic halo of chlorite, epidote, pyrite, and minor actinolite. Late-stage calcite and laumontite veins are last to form around the periphery of the deposit.

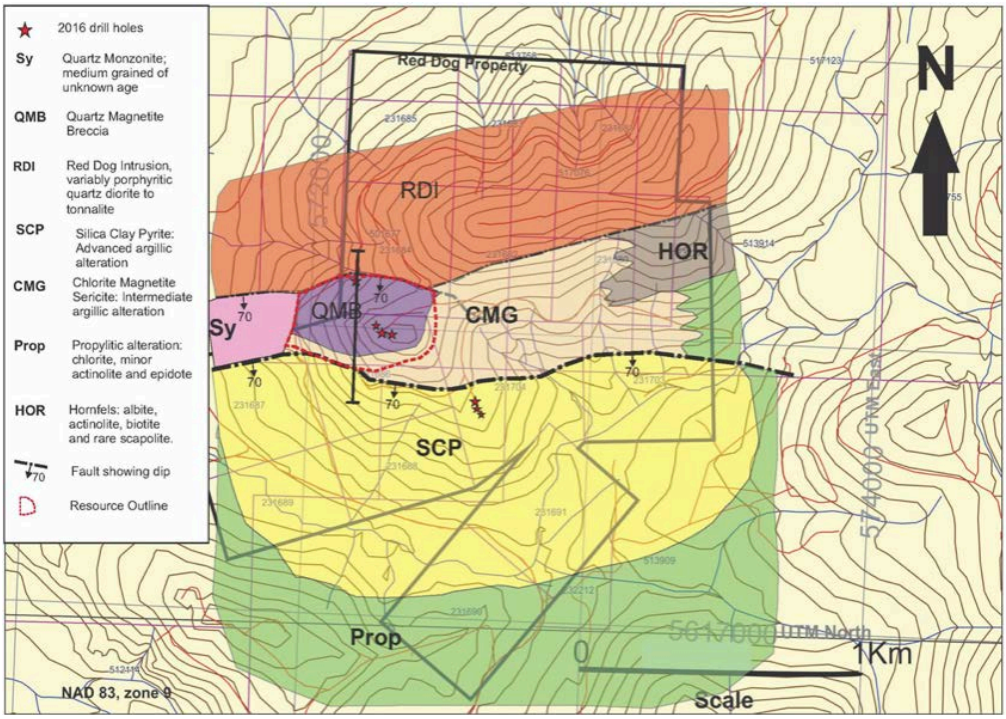


Figure 2.10. Map of alteration assemblages at the Red Dog deposit. From Tahija et al. (2017).

Lastly, and one of the least well-studied and understood porphyry-epithermal systems in northern Vancouver Island is the Pemberton Hills property (referred to as the “Pemberton Hills Lithocap” on Fig. 2.7), which is the study site for this MSc thesis. Much of the (limited) exploration focus at Pemberton Hills has been centered on its extensive advanced-argillic alteration that occurs as prominent northwest-trending rhyolite-ridges that form topographic highs, which are capped by intense quartz-cemented breccias and zones of “leached” vuggy quartz (Panteleyev and Koyanagi, 1994). This is very similar to the hydrothermal breccia complex observed at Mount Hushamu, where a leached zone of vuggy quartz forms a northwest-trending ridge with

associated quartz-cemented breccias that acts as a cap on the porphyry-epithermal system (Dasler et al., 1995).

The majority of the advanced argillic assemblages at Pemberton Hills beneath the silicified caps is characterized by quartz, alunite, kaolinite, pyrophyllite, diaspore, and zunyite, with associated acid-sulphate assemblages present as alunite, jarosite, gypsum, anhydrite, barite, and melanterite (Fig. 2.11; Koyanagi and Panteleyev, 1993; Panteleyev and Koyanagi, 1994). Panteleyev and Koyanagi (1994) have also documented two dominant styles of pyrite mineralization associated with the advanced argillic alteration. The first constitutes quartz-pyritic breccias and stockworks that crosscut the host rhyolite and underlying intermediate to mafic volcanic rocks that envelop the rhyolite, and the adjacent, potentially causative dioritic to monzonitic intrusions to the northeast. The second style is characterized by stratabound pyritic replacement of fragmental volcanic beds at the base of the rhyolite and its underlying tuffaceous sequences, where pyrite can be locally observed in massive to semi-massive textures. A distal propylitic halo of epidote-chlorite-zeolite-pyrite surrounding the advanced argillic alteration has also been documented by Panteleyev and Koyanagi (1994), in addition to rare zones of phyllic alteration consisting of quartz and sericite (Fig. 2.11).

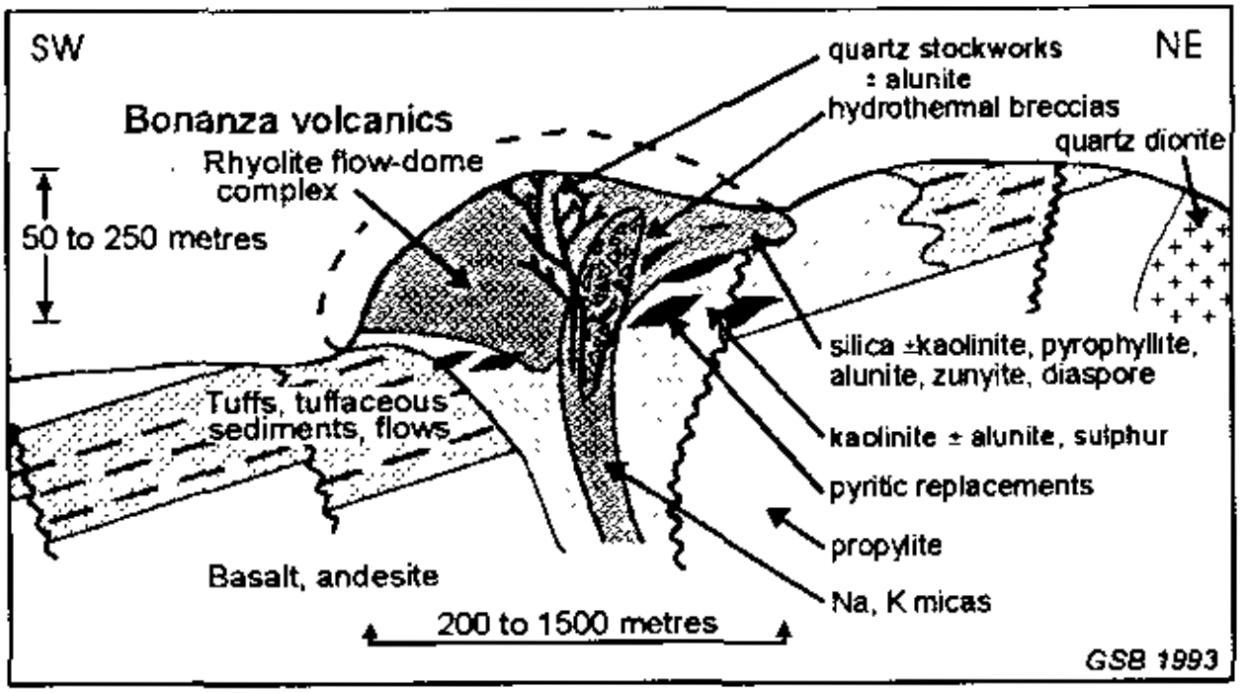


Figure 2.11. Schematic illustration of the Pemberton Hills rhyolite flow-dome complex (lithocap) and associated alteration assemblages (from Panteleyev and Koyanagi, 1994).

Chapter 3: Methodology

3.1 Field mapping and sample collection

Sampling at the Pemberton Hills study site was conducted over a three-week period from the end of September to mid-October 2018. A total of 113 outcrop samples were collected. Steep topography and dense bush conditions limited field traversing and resulted in the sample distribution being mainly controlled by road accessibility and outcrop availability. Sampling was mainly focused and spaced closer together in the more central regions of the study site proximal to the Pemberton Hills lithocap based on the presence of strong hydrothermal alteration and ongoing mineral exploration work in this area at the time of sample collection (Fig. 3.1). A larger sample spacing was used towards the eastern and western areas of the study site.

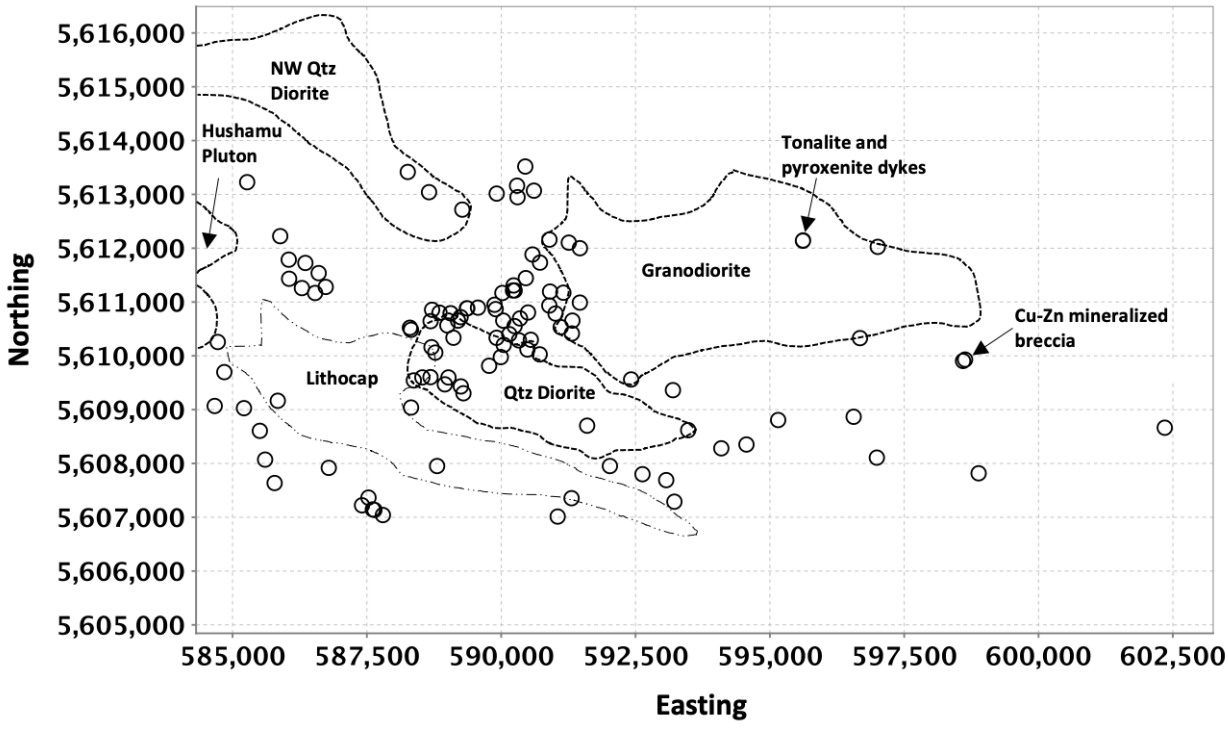


Figure 3.1. Map of whole-rock sample distribution at Pemberton Hills. Outlines of plutonic units modified after Nixon et al. (2011a, b). Map uses the universal transverse mercator (UTM) grid system.

Sample distribution was also influenced by the presence of alteration minerals of interest (i.e., epidote, chlorite, pyrite) in outcrop material, however, additional samples containing other alteration minerals were collected in order to develop a better understanding of the porphyry environment. A simplified alteration map was created based on the sampling in this study in order to illustrate the dominant alteration types in the study area (Fig. 4.8).

3.2 Whole-rock geochemistry

A total of 113 surface samples from Pemberton Hills were analysed for their major and trace element compositions. Sample locations are shown in Figure 3.1 and elemental concentrations are reported in Appendix A. Whole-rock geochemical analyses were completed at Bureau Veritas Mineral Laboratories in Vancouver, Canada. Samples were jaw-crushed, split, and pulverised to <0.074 mm diameter (200 mesh) and then dried at 105°C. Loss on ignition (LOI) was calculated from changes in sample weight before and after heating. Major element oxides (SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, MnO, Cr_2O_3) and trace elements (Ba, Sc, Cs, Ga, Hg, Nb, Rb, Sn, Sr, Ta, Th, U, V, W, Zr, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho Er, Tm, Yb, Lu) were analysed using lithium borate fusion package LF200. A 0.2-g powdered sample was fused in a graphite crucible with 1.5 g of $LiBO_2/LiB_4O_7$ flux at 980°C for 30 min and then dissolved in 5% HNO_3. Major elements were determined using a Jarrel Ash AtomComp Model 975/Spectro Ciros Vision ICP-ES. Trace elements were analysed using a Perkin-Elmer Elan 6000 or 9000 inductively coupled plasma mass spectrometer. Other trace elements including chalcophile elements (Mo, Cu, Pb, Zn, Ag, Ni, Co, Mn, As, Au, Cd, Sb, Bi, Cr, B, Tl, Hg, Se, Te, Ge, In, Re, Be, Li, Pd, Pt) were analysed by aqua regia digest package AQ252 with ICP-MS. Trace level F was analyzed by specific ion electrode and total C and S were analysed by Leco analysis TC003. Digested standards were

run every 68 samples, and a digestion duplicate run every 15 samples, with recalibration of the instrument every 68 samples in accordance with laboratory quality assurance and quality control procedures.

3.3 Mineral chemistry

3.3.1 Epidote and chlorite

Epidote and chlorite trace element compositions were determined by LA-ICP-MS at the CODES facility at the University of Tasmania. Samples were observed under reflected light during LA-ICP-MS analysis. A total of 43 elements were analyzed at each spot. The ablation spot size was set between 20 to 30 µm, frequency 10 Hz, energy 85 mJ and fluence 14 J/cm. The analysis time for each sample was set to 90 s, the initial 30 s measured the gas background with the laser turned off and the remaining 60 s of signal analysis with the laser switched on. The primary calibration standard used was NIST612 and was accompanied by standards GSD-1G and BCR-2G, which were used to correct for plasma-loading effects, if present, and Ca was used as the internal standard element. These standards were run at the beginning and end of each LA-ICP-MS session as well as at hourly intervals during analysis. Typically, between 25 to 30 spots were analysed on each mineral (epidote and chlorite) per sample. Data was processed on site at CODES using in house software (LADR). Data reduction was done by visually inspecting each spectrum and removing time intervals that contained large variation or spikes in the trace element chemistry so that they were not included in the integration process.

3.3.2 Pyrite

Pyrite trace-element chemistry was determined by LA-ICP-MS analysis at the CODES facility at the University of Tasmania. Sample mounts were etched with sodium hypochlorite prior

to analysis and observed using reflected light microscopy to determine if zonation was present within the pyrite grains. Typically, between 25 to 30 spots were selected for analysis per sample. A total of 41 isotopes were measured for each analysis. In coarser grained pyrite, laser ablation spots were selected in different domains (i.e., core, rim) within the pyrite grain. The ablation spot size used was set between 20 to 30 µm with a laser repetition of 5 Hz, and energy of 54 mJ and beam fluence of ~ 4 J/cm. The analysis time for each spot was 90 s with the first 30 s of analysis measuring gas background (laser off), and the remaining 60 s of signal analysis with the laser on. Three standards were used to ensure quality of the data. Standards GSD-1G and STDGL3 were used for the pyrite analyses as the control with Fe as the internal standard element. The PeruPy standard was also used as a baseline for Fe values. These standards were run at the start and end of each analytical session and were also run throughout the analysis after every 15 spot analyses. Data was processed on site at CODES using in house software (LADR). Data reduction was done by visually inspecting each spectrum and removing time intervals that contained large variations in the trace element chemistry so that they were not included in the integration process.

3.4 Whole-rock carbon and oxygen isotopes

Whole-rock carbon and oxygen isotope compositions for carbonate-bearing rocks were determined at the Central Science Laboratory (CSL) at the University of Tasmania. The isotopic composition for $\delta^{13}C$ and $\delta^{18}O$ was determined on a MultiFlow headspace analyser coupled to an Isoprime 100 continuous flow isotopic ratio mass spectrometer. Between 0.3 and 0.4 mg of material was weighed into a 5 mL vial and placed on a sample tray at 70°C. The vial was then flushed with helium, after which 200 mL of water free H_3PO_4 were added. After complete digestion (18 hours), the evolved CO_2 was cleaned up on a GC column at 80 °C and then fed into

the mass spectrometer. Stable isotope abundances are reported in delta (δ) values as the deviations from conventional standards in parts per mil (‰) from the following equation:

$$\delta X\ (‰) = [(R_{sample}/R_{standard} - 1) \times 1000]$$

where X = ^{13}C or ^{18}O and R = the ratio $^{12}C/^{13}C$ or $^{16}O/^{18}O$. Carbon delta values are reported respective to the Vienna Pee Dee Belemnite (VPDB) scale, oxygen values against both, VPDB and Vienna Standard Mean Ocean Water (VSMOW) scale. For conversion from PDB to SMOW scale, IUPAC recommended equations of Tylor Coplen (1994) were applied. Each batch of 60 samples included at least 12 standards, eight of which were Certified Reference Materials NBS 18, NBS 19 and Takaka marble, the remaining four were laboratory standards Anu M1 and Anu PRM2. External precision was 0.06 $^{0}/_{00}$ for carbon and 0.10 $^{0}/_{00}$ for oxygen isotopic values, respectively. Homogeneity was assessed by repetition of randomly selected samples (n=5), where standard deviations of 0.077 and 0.079 for carbon and oxygen results were obtained.

3.5 Zircon geochronology, trace element geochemistry, and Hf isotopes

3.5.1 Zircon CA-TIMS U-Pb geochronology

A total of four samples were submitted for zircon U-Pb geochronology at the Pacific Centre for Isotopic and Geochemical Research, University of British Columbia. Chemical abrasion thermal ionization mass spectrometry (CA-TIMS) procedures described here are modified from Mundil et al. (2004), Mattinson (2005) and Scoates and Friedman (2008). After rock samples underwent standard mineral separation procedures zircons were handpicked in alcohol. The clearest, crack- and inclusion-free grains were selected, photographed and then annealed in quartz glass crucibles at 900˚C for 60 hours. Annealed grains were transferred into 3.5 mL perfluoroalkoxy alkane (PFA) screw-top beakers, then ultrapure HF (up to 50% strength, 500 mL)

and HNO_3 (up to 14 N, 50 mL) were added and caps were closed finger tight. The beakers were placed in 125 mL PTFE liners (up to four per liner) and about 2 mL HF and 0.2 mL HNO_3 of the same strength as acid within beakers containing samples was added to the liners. The liners were then slid into stainless steel Parr™ high-pressure dissolution devices, which were sealed and brought up to a maximum of 200˚C for 8-16 hours (typically 190˚C for 12 hours). Beakers were removed from the liners and zircons were separated from leachate. The zircons were rinsed with >18 MΩ.cm water and subboiled acetone. Following this, 2 mL of subboiled 6N HCl was added and the beakers were set on a hotplate at 80˚-130˚C for 30 min and again rinsed with water and acetone. Masses were estimated from the dimensions (volumes) of grains. Single grains were transferred into clean 300 mL PFA microcapsules (crucibles), and 50 mL 50% HF and 5 mL 14 N HNO_3 were added. Each was spiked with a $^{233\text{-}235}U$-^{205}Pb tracer solution (EARTHTIME ET535), capped and again placed in a Parr liner (8-15 microcapsules per liner). HF and nitric acids in a 10:1 ratio, respectively, were added to the liner, which was then placed in Parr high pressure device where zircon dissolution was achieved at 220˚C for 40 hours. The resulting solutions were dried on a hotplate at 130˚C, and 50 mL 6N HCl was added to the microcapsules. Fluorides were dissolved in high pressure Parr devices for 12 hours at 180˚C. HCl solutions were transferred into clean 7 mL PFA beakers and dried with 2 mL of 0.5 N H_3PO_4. Samples were then loaded onto degassed, zone-refined Re filaments in 2 mL of silicic acid emitter (Gerstenberger and Haase, 1997).

Isotopic ratios were measured with a single collector VG 54R thermal ionization mass spectrometer equipped with analogue Daly photomultiplier. Analytical blanks were 0.1 pg for U and up to 0.9 pg for Pb. Uranium fractionation was determined directly on individual runs using

the EARTHTIME ET535 mixed $^{233-235}$U-^{205}Pb isotopic tracer and Pb isotopic ratios were corrected for fractionation of 0.25 ± 0.04%/amu (54R), based on replicate analyses of NBS-982 reference material and the values recommended by Thirlwall (2000). Data reduction employed the excel-based program of Schmitz and Schoene (2007). Standard concordia diagrams were constructed and regression intercepts, weighted averages calculated with Isoplot (Ludwig, 2003). Unless otherwise noted all errors are quoted at the 2 sigma or 95% level of confidence. Isotopic dates are calculated with the decay constants l_{238}=1.55125E-10 and l_{235}=9.8485E-10 (Jaffey et al, 1971) and a ^{238}U/^{235}U ratio of 137.88. EARTHTIME U-Pb synthetic solutions were analyzed on an on-going basis to monitor the accuracy of results.

3.5.2 Zircon LA-ICP-MS trace element geochemistry, U-Pb geochronology and Hf isotopes

The LA-ICP-MS trace element geochemistry combined with U-Pb geochronology of zircon was determined at Guangdong Provincial Key Laboratory of Marine Resources and Coastal Engineering (SYSU) with a 193 nm ArF Excimer Laser Ablation system (Geolas Pro) coupled with an Agilent 7900 ICP-MS. The ablation site was set with 18 s background, 45 s for sample ablation and 20 s for washout. A 32 μm spot size was used with an energy density of 5 J/cm^2 and a repetition rate of 5 Hz. The trace element compositions were calibrated against the standard NIST610 (Pearce et al., 1997), using Si determined by electron probe microanalyzer (EPMA) as the internal standard. Zircon 91500 (Wiedenbeck et al., 1995) was used as the external standard for the zircon U–Pb dating. The Plešovice zircon standard used to monitor the zircon dating yielded a concordia age of 338.4 ± 3.9 Ma, consistent with the published data (Slama et al., 2008). The data reduction was performed using the software Iolite V4.4.5 (Kemp et al., 2007; Hellstrom et al., 2008; Paton et al., 2011). Mass bias and instrument drift were corrected by setting a linear

fit with a selected standard calibration for each mapping run. IsoplotR software (Ludwig 2003; Vermeesch 2018) was used to construct the Wetherill and Tera-Wasserburg diagram.

Hafnium isotopic ratios of zircon were conducted by laser ablation multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS) at Nanjing FocuMS Technology Co. Ltd, China. An Australian Scientific Instruments *RESOlution LR* laser-ablation system and Nu Instruments *Nu Plasma II* MC-ICP-MS were combined for the experiments. The 193 nm ArF excimer laser, homogenized by a set of beam delivery systems, was focused on the zircon surface with fluence of 4.5J/cm^2. Each acquisition incorporated 20 s background (gas blank), followed by spot diameter of 50 μm at 9 Hz repetition rate for 40 s. Helium (370ml/min) was applied as carrier gas to efficiently transport aerosol out of the ablation cell, and was mixed with argon (~0.97 L/min) via a T-connector before entering the ICP torch. The Integration time of the *Nu Plasma II* was set to 0.3 s (equating to 133 cycles during the 40 s). Standard zircons (including GJ-1, 91500, Plešovice, Mud Tank, Penglai) were used as quality control every fifteen unknown samples.

3.6 Epidote and garnet U-Pb geochronology

3.6.1 Epidote geochronology

U-Pb epidote ages for one sample at Pemberton Hills were determined by LA-ICP-MS at the CODES facility at the University of Tasmania, using the same methods as described in section 3.3.1. The epidote age was generated using 41 spot analyses with a 29 μm spot diameter. A concordia diagram was constructed by plotting ^{207}Pb/^{206}Pb vs. ^{236}U/^{206}Pb values and regression intercepts and weighted averages were calculated with Isoplot (Ludwig, 2003). Three standards were used including a primary standard for Pb/U ratios (YE16AA063), a primary standard for Pb isotopes and trace element concentrations (NIST610), and a secondary reference epidote treated

as an unknown (LB15DC052). All ages from standard materials overlapped within error of their reported values.

3.6.2 Garnet geochronology

U-Pb garnet ages for one sample at Pemberton Hills were determined by LA-ICP-MS at the CODES facility at the University of Tasmania, using the same methods as described in section 3.3.1. The garnet age was generated using 35 spot analyses with a 110 μm spot diameter. A concordia diagram was constructed by plotting $^{207}Pb/^{206}Pb$ vs. $^{236}U/^{206}Pb$ values and regression intercepts and weighted averages were calculated with Isoplot (Ludwig, 2003). Three standards were used including a primary standard for Pb/U ratios (Willsboro Garnet), a primary standard for Pb isotopes and trace element concentrations (NIST612), and three secondary reference garnets treated as unknowns (LB16AG015, Verde Antique Garnet, and 1891 Garnet). All ages from standard materials overlapped within error of their known values.

3.7 SEM-EDS

Backscattered electron (BSE) imaging and energy-dispersive x-ray spectrometry (EDS) were carried out on a Hitachi SU-70 field emission scanning electron microscope (SEM) located at the Central Science Laboratory, University of Tasmania. The instrument is fitted with a Hitachi photo diode BSE detector and an Oxford AZtech 3.3 EDS system with XMax80 silicon drift detector. Conditions were 15kV accelerating voltage, around 3nA beam current, and 14.8 mm working distance. The Point & ID mode was used with 10 s live spectrum acquisition time, 3 s process time, 2048 channels, and total energy range of 20 keV. Typical count rates were around 40,000 counts per second and total spectrum counts >1,000,000. Elements were calibrated on a range of natural and synthetic materials. An indirect beam current calibration was performed by

measuring the Co K x-ray series intensity on Co metal. Prior to SEM-EDS analysis the samples were coated with around 20nm of carbon using a Ladd 30000 carbon evaporator. A coating correction was performed in the Aztec software.

3.8 Cathodoluminescence imaging

Cathodoluminescence (CL) imaging was carried out on a Hitachi SU-70 field emission scanning electron microscope (SEM) located at the Central Science laboratory, University of Tasmania using a Gatan ChromaCL2 colour CL system with integrated backscattered electron detector (iBSED). Conditions were 10 kV accelerating voltage, around 9 nA beam current, around 12.2 mm working distance, and pixel dwell times between 75 and 175 us. The Gatan Digital Micrograph 3 software was used for data acquisition and processing.

Chapter 4: Field Observations and Petrography

This chapter aims to characterize lithologies, alteration, and mineralization assemblages observed in the porphyry environment at Pemberton Hills. These results are primarily based on field observations and correlative hand samples, detailed petrography, as well as semi-quantitative and qualitative SEM analysis. Given the broad range in alteration types (i.e., sodic-calcic, potassic, phyllic, propylitic, argillic, advanced argillic) commonly produced during the formation of porphyry deposits, a considerable spectrum of major and minor accessory hydrothermal alteration minerals is typically present, often at very fine-grained to sub-microscopic scales, making classification difficult.

4.1 Lithologies

Primary lithologies at Pemberton Hills are highly variable and at times difficult to discern as a result of locally intense potassic, propylitic, phyllic, argillic and advanced argillic alteration assemblages across the property (see section 4.2). When alteration is intense, it may partially or even completely destroy any pre-existing textural attributes of the rock type and change the chemical composition of the rock. Primary lithological classification consequently relies heavily on macroscopic and microscopic mineralogical and textural identification in conjunction with whole-rock geochemistry. Where lithological identification was not feasible due to destruction of primary textures, alteration mineralogy was used to aid in constraining the initial composition and lithology of the rock in question (i.e., mafic alteration minerals will tend to be more common in mafic rocks).

4.1.1 Plutonic rocks

Plutonic rocks sampled at Pemberton Hills are largely constrained to the Wanakana pluton, which was previously reported and mapped as a ~12 km long (E-W) by ~8 km wide (N-S) irregularly shaped Island Plutonic Suite-related intrusion cropping out in the centre of the property (Nixon et al., 2011a, b). Sampling from this study coupled with interpretation of regional geophysical data has led to the re-classification of the Wanakana pluton into a discrete northern granodiorite pluton, and a separate southern quartz diorite pluton (Fig. 4.1). This was accomplished by interpretation of reduced to pole (RTP) magnetic data from the British Columbia Geological Survey (BCGS) that indicated strong magnetic differences between the southern and northern regions of the Wanakana pluton. This was consistent with sampling from this study that showed the southern region of the Wanakana pluton to be made up of magnetite-bearing quartz diorite and the northern regions of the Wanakana pluton to be composed of magnetite-deficient granodiorite. Structural interpretations associated with the reclassification of the Wanakana pluton based on the RTP data are described by Hamilton (in prep). Other plutonic rocks in the study area are quartz diorites from a separate pluton in the northwest of the property (Fig. 4.1). Based on rock compositions, field mapping and geophysical interpretation, this northwest diorite pluton appears to be discrete from the adjacent northern Wanakana pluton. Sampling across the Wanakana pluton was predominantly limited to road access, which resulted in a portion of the interior of the pluton not being sampled. As a result of this, lithologies within this interior region can only be inferred based on samples taken from the eastern and western margins of the pluton.

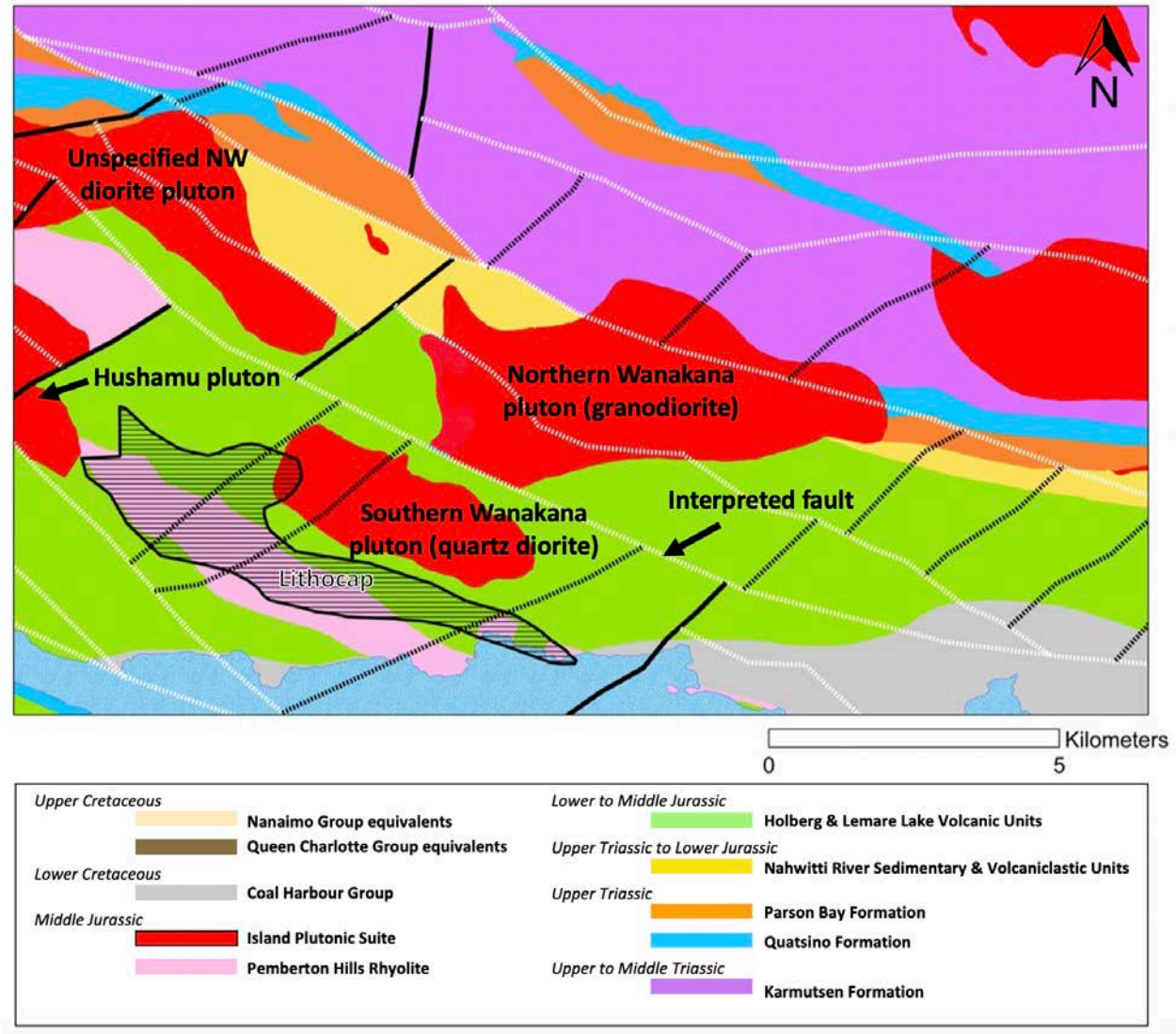


Figure 4.1. Lithology map of the Pemberton Hills region. Note the differentiation of the Wanakana pluton into discrete southern quartz diorite and northern granodiorite intrusions. Modified from Hamilton (in prep) after Nixon et al. (2011a, b).

Felsic plutonic rocks were only observed in the northern Wanakana pluton, with samples taken along the western and northeastern margins of the intrusion. Felsic plutonic rocks are granodiorites, characterized by medium- to coarse-grained subhedral to less common euhedral and porphyritic plagioclase feldspar (~35%), anhedral, medium-grained quartz (~25%), which commonly exhibits a myrmekitic texture together with plagioclase feldspar, and lesser proportions of medium-grained, anhedral to subhedral alkali feldspar (~15%; Fig. 4.2A-E). Strong

oscillatory zoning is commonly observed in plagioclase feldspar grains where present (Fig. 4.2C). Fine- to medium-grained subhedral hornblende occurs as stubby, equant to elongate bladed grains that constitute ~20% of these rocks (Fig. 4.2B). Accessory minerals include very fine- to fine-grained, often subhedral to rarely euhedral titanite and apatite, as well as fine-grained magnetite.

Centimeter-scale medium-grained mafic xenoliths are a common feature of the granodiorite (Fig. 4.2D, E). Petrographic analysis of samples PM18AJ273 and PM18AJ287 reveal two texturally discrete xenoliths. The first type is a fine-grained xenolith comprised of ~65% mostly subhedral, very fine- to fine-grained plagioclase with ~30% interstitial amphibole that has been altered to biotite. Very fine- to fine-grained magnetite comprises ~5% of the xenolith. Hematite is also present along the outer margin of the xenolith in contact with the granodiorite material. The second is a coarser grained xenolith with a nearly identical composition of ~65% fine-grained, subhedral plagioclase feldspar and ~25-30% fine- to nearly medium-grained elongate, bladed amphibole. Very fine- to fine-grained magnetite comprises ~5% of this xenolith.

A tonalite dyke from the northeastern domain of the northern Wanakana pluton constitutes the only felsic dyke sampled at Pemberton Hills (Fig. 4.2F). The dyke is ~10 cm wide and intrudes roughly parallel to bedding planes in the adjacent sedimentary host rocks, with some minor splays off the main dyke showing increased discordance. Petrographic analysis of the dyke reveals a primary composition of mainly plagioclase (largely altered to prehnite and lesser epidote) and quartz, which commonly exhibit a myrmekitic texture.

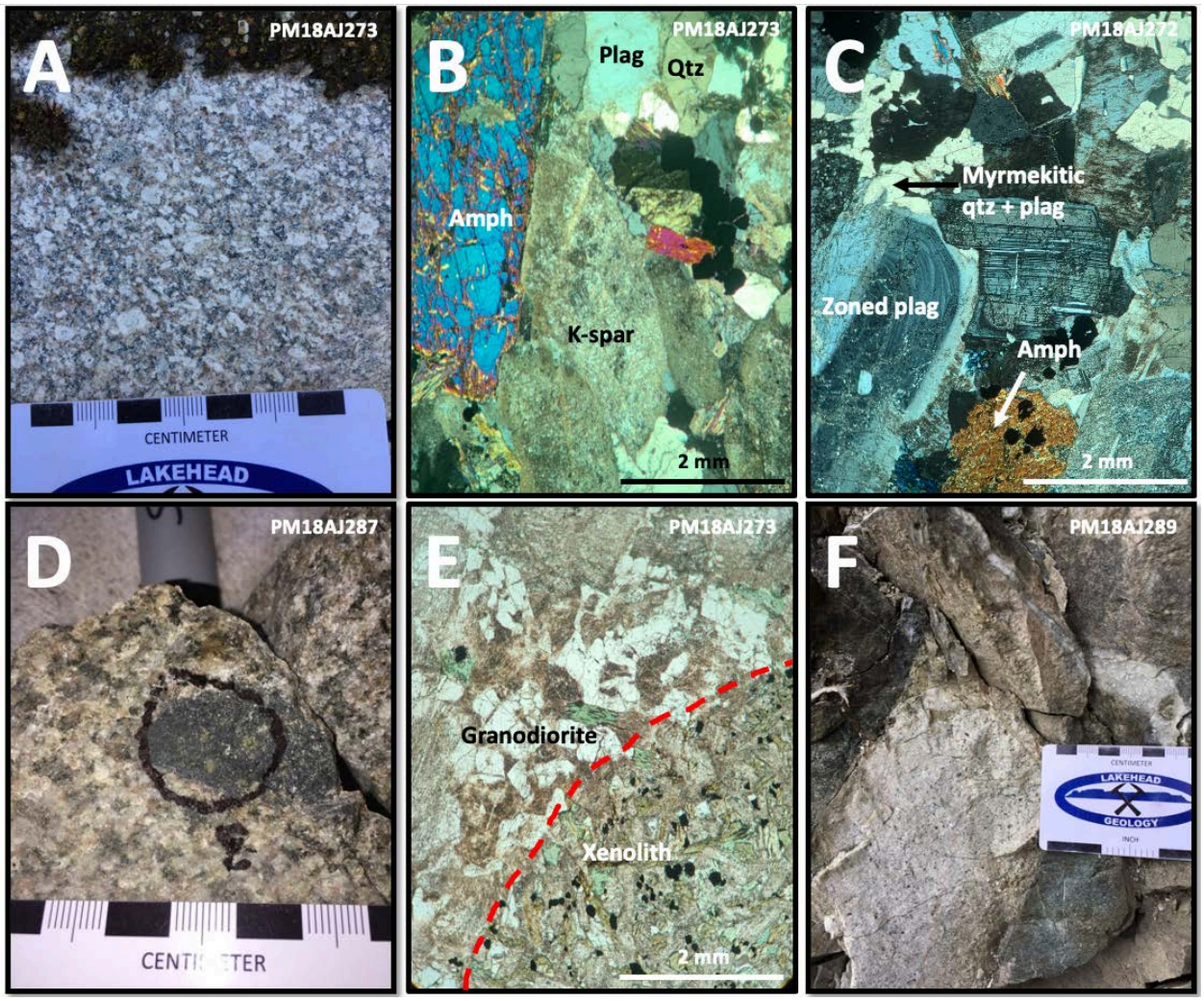


Figure 4.2. (A) Outcrop photograph of quartz-feldspar-porphyry (granodiorite); (B) Transmitted light photomicrograph (XPL) showing primary amphibole (amph), plagioclase (plag), quartz (qtz), and secondary potassium feldspar (K-spar) in a sample of granodiorite; (C) Transmitted light photomicrograph (XPL) highlighting oscillatory zoning in plagioclase and myrmekitic quartz and plagioclase intergrowth; (D) Hand sample of granodiorite that contains a ~3 cm long mafic xenolith; (E) Transmitted light photomicrograph (PPL) of the contact between granodiorite and an fine-grained mafic-intermediate xenolith; and (F) Outcrop photograph of ~15 cm wide tonalite dyke.

Intermediate quartz diorites make up the bulk of intrusive rocks sampled at Pemberton Hills (Fig. 4.3A-C). The majority were sampled from the southern Wanakana pluton, however, three samples of quartz diorite were also taken from a discrete quartz diorite intrusion in the northwest region of the study area. Samples of least altered quartz diorite are composed of ~55% subhedral, tabular plagioclase feldspar, ~30% interstitial to less commonly subhedral tabular

hornblende, ~10% interstitial quartz that exhibits a myrmekitic texture with plagioclase, and ~5% fine-grained subhedral magnetite that is often intimately associated with hornblende (Fig. 4.3B). Samples are typically medium-grained, but finer or coarser grained versions are not uncommon. The finer grained versions present a particular problem for lithological classification, as they may resemble surrounding intermediate porphyritic volcanic host rocks. In the southwestern domain of the southern Wanakana pluton, this problem is compounded by an intense overprinting of phyllic and to a lesser extent propylitic alteration, which partially or fully obliterates any primary textural attributes of the rock (see section 4.2.3). It was difficult to resolve if finer grained versions of the hornblende diorite are the product of a chill margin to the surrounding host rocks, if locally intense alteration results in a finer grained appearance, or some combination of the two. This complication has resulted in a degree of ambiguity in defining the pluton boundary in this area, especially given the absence of any apparent contacts.

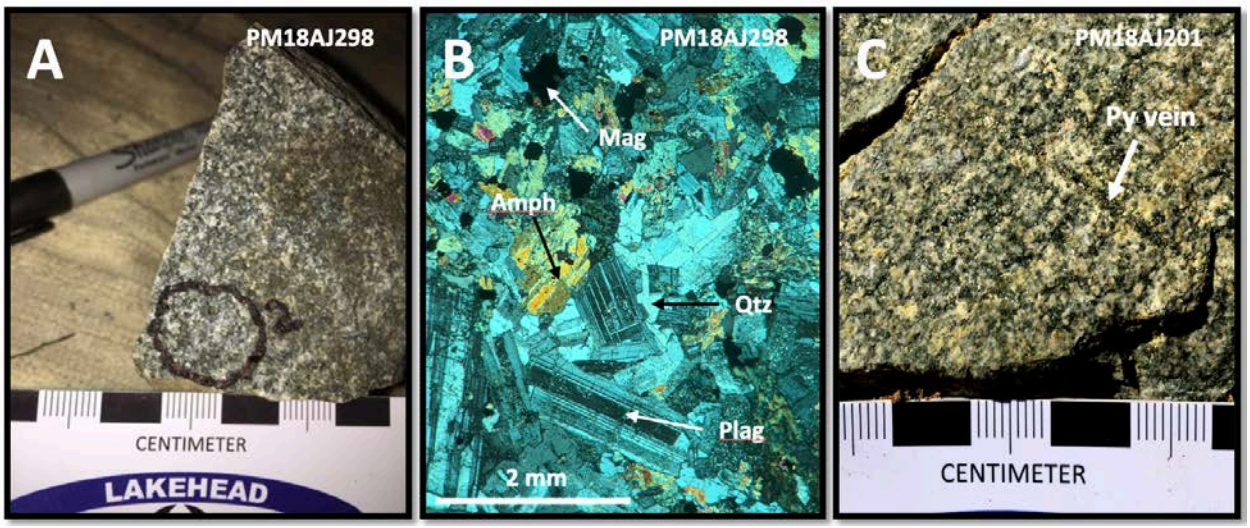


Figure 4.3. (A) Quartz diorite hand sample; (B) XPL photomicrograph of typical quartz diorite mineral assemblage consisting of subhedral to euhedral plagioclase (Plag), interstitial quartz (Qtz), subhedral amphibole (Amph), and disseminated magnetite (Mag); (C) Outcrop photograph of a chlorite, actinolite, and pyrite altered quartz diorite with a cross-cutting pyrite (Py) vein.

Two mafic dykes were observed in the northeastern domain of the northern granodiorite Wanakana pluton, taken from same outcrop that the tonalite dyke was located. The sample taken for this study was from the larger of the two pyroxenite dykes at outcrop, which measures ~30 cm at its widest (Fig. 4.4A-C). The dyke is composed of almost entirely euhedral, very fine- to less common medium-grained stubby hedenbergite with minor, blebby pyrrhotite occurring sporadically throughout. Similar to the tonalite dyke, the pyroxenite dykes appear to have intruded roughly parallel to bedding planes in the adjacent sedimentary host rocks. The smaller of the pyroxenite dykes appears to have intruded along the boundary of the tonalite dyke and the sedimentary host rock, or alternatively the tonalite dyke intruded along it. The contact between the dyke and sedimentary unit is fairly sharp, as is the contact between the smaller pyroxenite dyke and the tonalite dyke (Fig. 4.4B and C, respectively). The dykes intruded post-granodiorite emplacement.

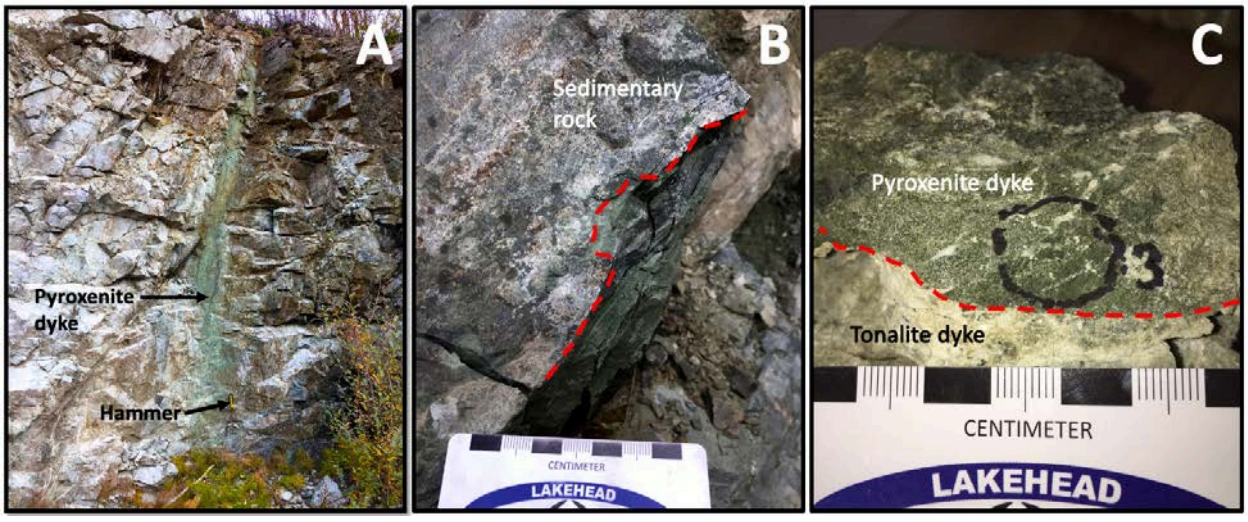


Figure 4.4 (A) Outcrop photograph of pyroxenite dyke intruding along the contact between granodiorite (right) and sedimentary rock (left). Hammer for scale in the bottom right of the photograph; (B) Outcrop photograph showing contact between pyroxenite dyke (right) and sedimentary host rock (left); (C) Photograph of hand sample showing contact between pyroxenite dyke and tonalite dyke.

4.1.2 Volcanic rocks

Volcanic rocks are the most abundant rock type sampled at Pemberton Hills. With the exception of one sample of Karmutsen formation (Triassic) basalt and one sample of a pyroxenite dyke, all other volcanic rocks sampled have been interpreted to be part of the LeMare Lake Volcanic sequence. There is substantial variation in the volcanic rock observed across the property including (porphyritic) andesites and basalts, volcanic breccias, volcaniclastics, volcanic tuffs, mafic volcanic flows, and mafic dykes. The porphyritic andesites and basalts being the dominant volcanic rock types sampled.

The porphyritic andesites and basalts are often strongly affected by locally intense alteration, and commonly exhibit some destruction of primary textures. Porphyritic andesites are far more prevalent than their massive counterparts, but can often only be distinguishable in thin section by the presence of relict plagioclase phenocrysts in a typically altered groundmass. Based on petrographic analysis of least altered samples, the porphyritic andesites are composed of fine- to predominantly medium-grained subhedral to rarely euhedral tabular plagioclase feldspar phenocrysts within a very fine-grained to aphanitic groundmass of plagioclase, amphibole, minor quartz and magnetite (Fig. 4.5A-C). Rarely, samples of porphyritic andesite may display a glomero-porphyritic texture with respect to plagioclase feldspar and/or pyroxene phenocrysts (4.5A). Samples of porphyritic basalt are generally composed of fine- to medium-grained subhedral to rarely euhedral tabular plagioclase feldspar phenocrysts and fine- to medium-grained subhedral to rarely euhedral stubby clinopyroxene phenocrysts (Fig. 4.5B) in a very fine-grained groundmass of plagioclase feldspar, pyroxene and/or amphibole and magnetite.

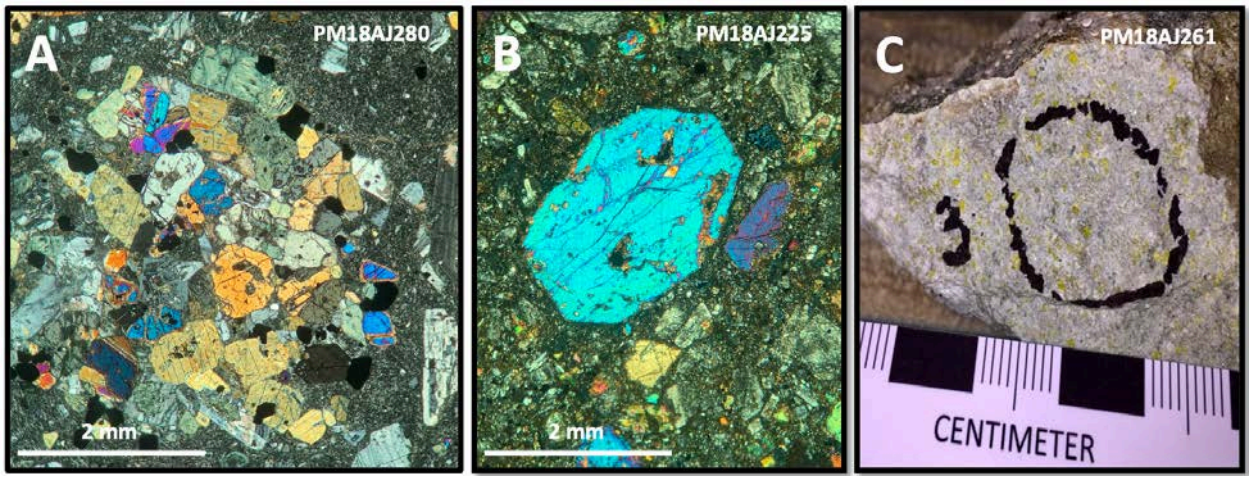


Figure 4.5. (A) Transmitted light photomicrograph (XPL) showing glomeroporphyritic texture in a porphyritic basalt; (B) Transmitted light (XPL) photomicrograph showing an equant, euhedral clinopyroxene phenocryst within a very fine- to fine-grained groundmass; (C) Hand sample photograph of porphyritic andesite with selective epidote replacement of feldspar phenocrysts.

Volcanic breccias are ubiquitous at Pemberton Hills. They may comprise entire outcrops but are more commonly observed as localized brecciated domains within more massive volcanic units. They are both autolithic and less commonly heterolithic, and contain rounded to angular clasts ranging from mm's to tens of cm's in size (Fig. 4.6A). Intermediate volcanic rocks tend to be the dominant lithology of the breccia matrix and clast composition, but clasts of volcanic flows were also observed. Volcanic breccias tend to be severely altered across the study site.

Three samples (PM18AJ255, PM18AJ256, PM18AJ257) of volcaniclastic rocks were collected at Pemberton Hills and were all found within ~300m of each other in the southwestern region of the property on the south side of the lithocap. They are easily recognizable and defined by the presence of lapilli and block fragments (Fig. 4.6B, C). The lapilli and block fragments are dense, and exhibit a relatively stronger magnetism than the corresponding matrix. Similar to the volcanic breccias, the volcaniclastic samples are roughly intermediate in composition, and show

evidence for localized brecciation. The volcanic breccias are strongly altered to a variety of clay, chlorite and zeolite assemblages.

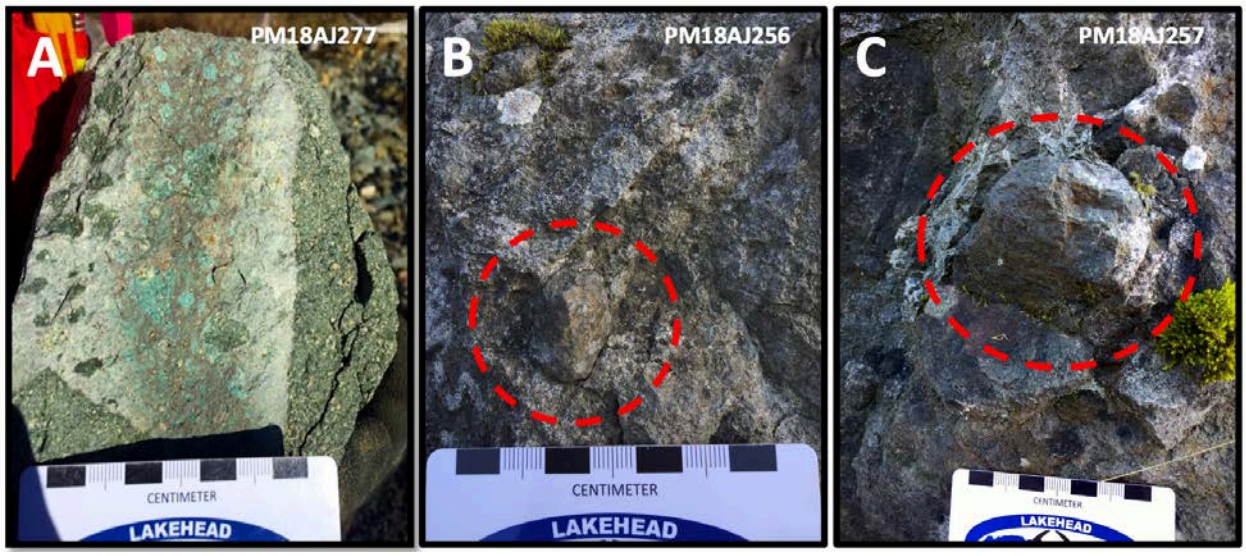


Figure 4.6. (A) Photograph of hand sample showing selective chlorite, white mica, and clay alteration of a volcanic flow clast contained in a larger volcanic breccia; (B) Outcrop photograph showing lapilli-size fragment (~2 cm) within volcaniclastic rock; (C) Outcrop photograph of a bomb-size fragment (~8 cm) within volcaniclastic rock.

Two samples have been classified as mafic volcanic flows, taken within ~250m of each other in the north-central region of the property adjacent to the western margin of the northern Wanakana pluton. These samples are distinct from other volcanic units in the field area, characterized by alternating cm- to 10's cm-scale wide layers of medium- to very coarse-grained relict pyroxenes and/or amphiboles within a presumably initial plagioclase matrix that is now mostly secondary epidote (Fig. 4.7A, B). Petrographic analysis reveals intense propylitic alteration despite preservation of macroscopic textures. Coarser rounded mafic clasts distinct from the relict pyroxenes is rarely observed within some of the beds. The layering dips ~45° to the southwest.

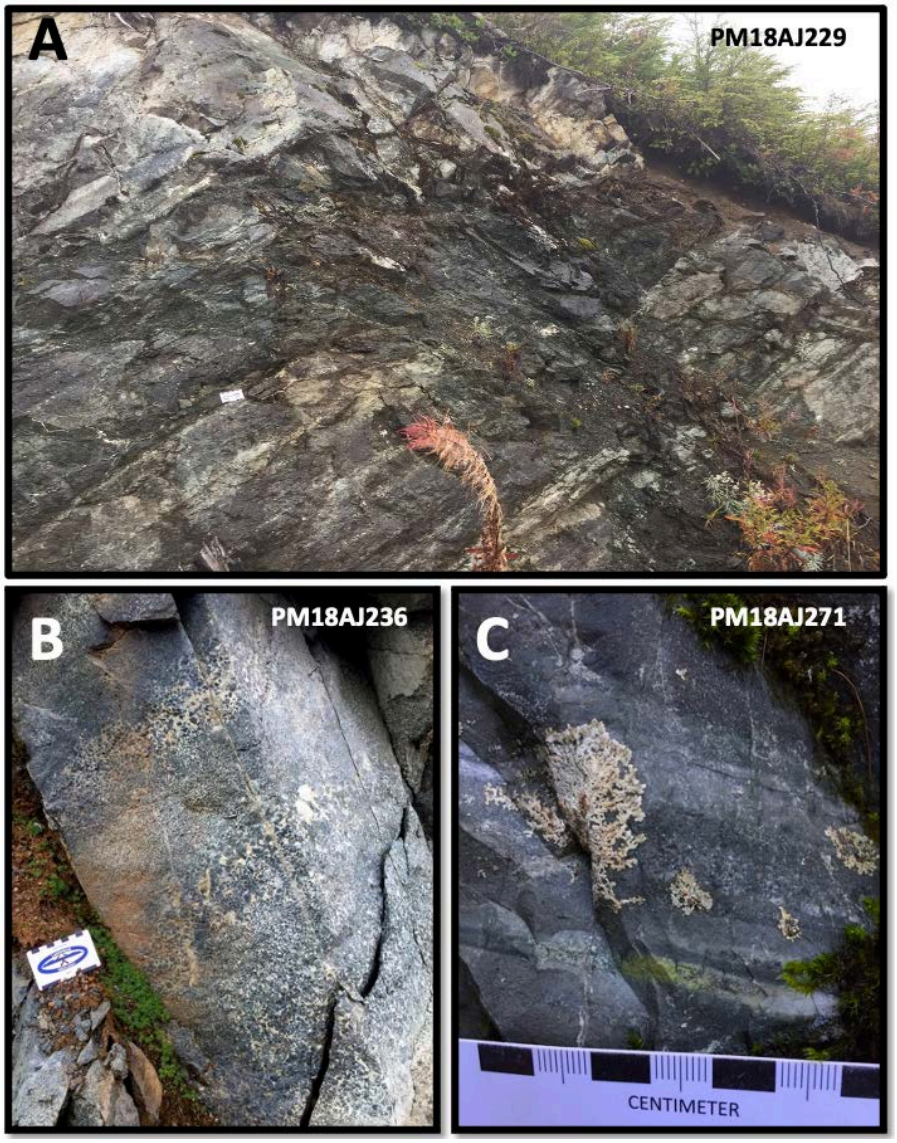


Figure 4.7. (A) Outcrop photograph of alternating dark and light-coloured layers in moderately dipping mafic flow; (B) Outcrop photograph of alternating fine- to very coarse-grained layers in a mafic flow; (C) Outcrop photograph of very fine- to fine-grained bedded volcanic tuff showing selective epidote replacement along a bedding plane.

Only one sample of volcanic tuff was observed at Pemberton Hills, from near the western boundary of the northern Wanakana pluton. In outcrop, this unit consists of alternating darker and lighter coloured aphanitic to less commonly fine-grained volcanic beds ranging from mm's to tens of cm's in thickness (Fig. 4.7C). The sample is mafic in composition, composed of very fine-grained relict plagioclase phenocrysts with the majority of primary mafic minerals having

been altered to secondary actinolite. In thin section, chalcopyrite, pyrrhotite and pyrite occur along selective bedding planes (Fig. 4.18D).

4.2 Alteration

Porphyry- and epithermal-related hydrothermal alteration is ubiquitous across the study area (Fig. 4.8). This alteration is interpreted to be related to the emplacement of the felsic to intermediate intrusive rocks that comprise the surrounding Island Plutonic Suite (IPS). The study site is also host to the Pemberton Hills lithocap (advanced argillic alteration that is largely stratabound within the Pemberton Hills rhyolite), which includes a broad range of epithermal-related alteration assemblages (see Hamilton, in prep), in addition to a less well constrained "transition zone" between the main porphyry- and epithermal environments. As the primary scope of this project relates to using propylitic alteration minerals such as chlorite, epidote, and pyrite to generate vectors within the porphyry environment, propylitic alteration was inherently the main focus of sampling and characterization at Pemberton Hills. However, other major porphyry-related alteration types including potassic and phyllic alteration, that commonly overlap with propylitic alteration, have also been described to develop an understanding of the genetic and temporal relationships between intrusive units and the alteration.

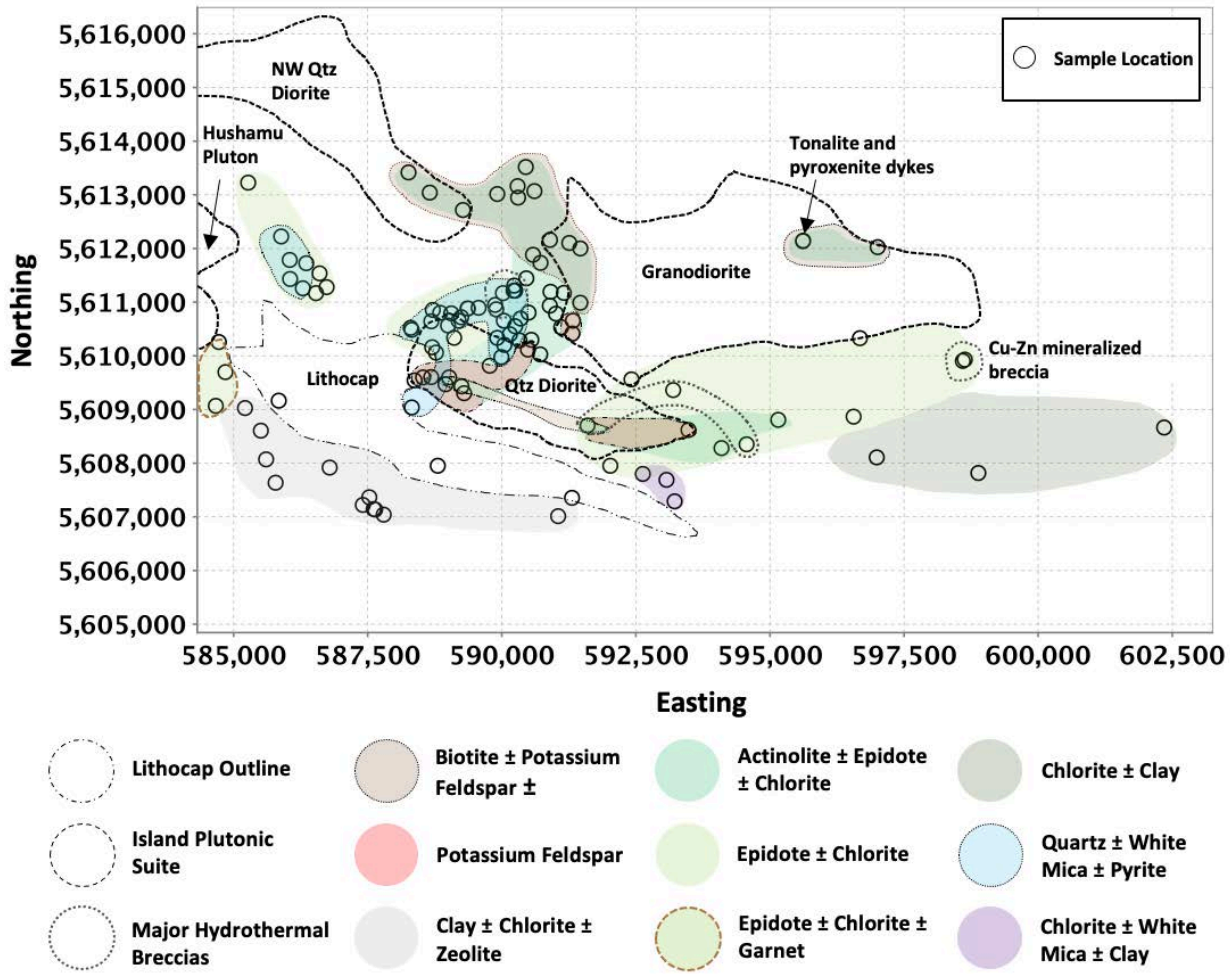


Figure 4.8. Map of alteration types with sample locations at Pemberton Hills. Outlines of plutonic units modified after Nixon et al. (2011a, b).

4.2.1 Propylitic alteration

Propylitic alteration is the most abundant alteration type sampled at Pemberton Hills and displays considerable lateral continuity across the property (~15 km). The classification of propylitic alteration used here follows that outlined by Cooke et al. (2014) who subdivided propylitic alteration into three main sub-zones with associated accessory minerals. This includes an inner, higher temperature actinolite ± epidote ± chlorite sub-zone, a medial epidote ± chlorite sub-zone, and a distal, lower temperature chlorite sub-zone. Propylitic alteration at Pemberton

Hills is most intense in the north-central samples along the western boundary of the northern Wanakana pluton and in samples centered around the southeastern margin of the quartz diorite pluton. Rocks in these areas commonly display pervasive alteration to a variety of propylitic assemblages.

Actinolite alteration often occurs as replacement of primary amphibole and/or pyroxene grains, as well as in veins with or without the presence of quartz or magnetite (Fig. 4.9A, C), but can also manifest as more unusual textures such as clots/clusters within volcanic groundmass (Fig. 4.9B), partial clast replacement or as rims around epidote cement in volcanic breccias (Fig. 4.10A). It commonly manifests as very fine- to fine-grained bladed or acicular grains, but may occur as coarser grains in radial clusters in some larger veins (Fig. 4.9A).

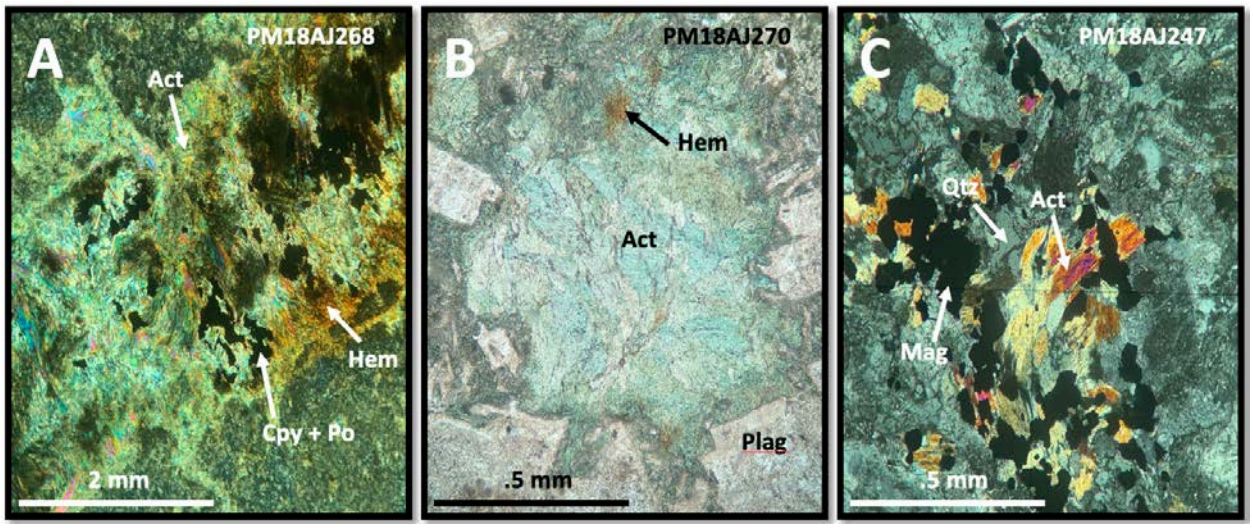


Figure 4.9. (A) Transmitted light photomicrograph (XPL) of ~3.5 mm wide actinolite (Act) vein with hematite (Hem) staining and interstitial chalcopyrite (Cpy) and pyrrhotite (Po); (B) Transmitted light photomicrograph (PPL) of clotty subhedral actinolite (Act) with some minor hematite (Hem) staining surrounded by subhedral to euhedral tabular plagioclase (Plag); (C) Transmitted light photomicrograph (XPL) of a magnetite (Mag), quartz (Qtz) and actinolite vein within quartz diorite.

Epidote occurs as a broad range of textures and styles across the property, predominantly as veins/veinlets, clots, as well as selective replacement of plagioclase grains or phenocrysts, but can also occur as patchy groundmass replacement, cement in volcanic or hydrothermal breccias, clast replacement, inclusions within later formed minerals (i.e., pyrite), and as amygdule infilling (Fig. 4.10A-D). Epidote ranges from very fine- to fine-grained anhedral grains that are more prominent as replacement textures, and as subhedral to euhedral very fine- to medium-grained stubby-prismatic grains that may occur in radial clusters (Fig. 4.11A, B). Euhedral epidote grains, often forming in strong propylitic altered samples and in open-space crystallization environments (i.e., veins, clots, pseudomorphs, breccias) frequently exhibit oscillatory or sector growth zoning that may preserve protracted and complex propylitic-related hydrothermal activity (Fig. 4.11C).

Chlorite alteration occurs primarily as replacement of both mafic (amphibole, pyroxene, secondary biotite) and felsic (plagioclase) minerals. It commonly manifests as veins, patchy or clotty groundmass replacement, grain replacement, selective clast replacement, and as radial clusters that generally form in more open-space environments (i.e., veins, clots, pseudomorphs, breccias; Fig. 4.12A-C).

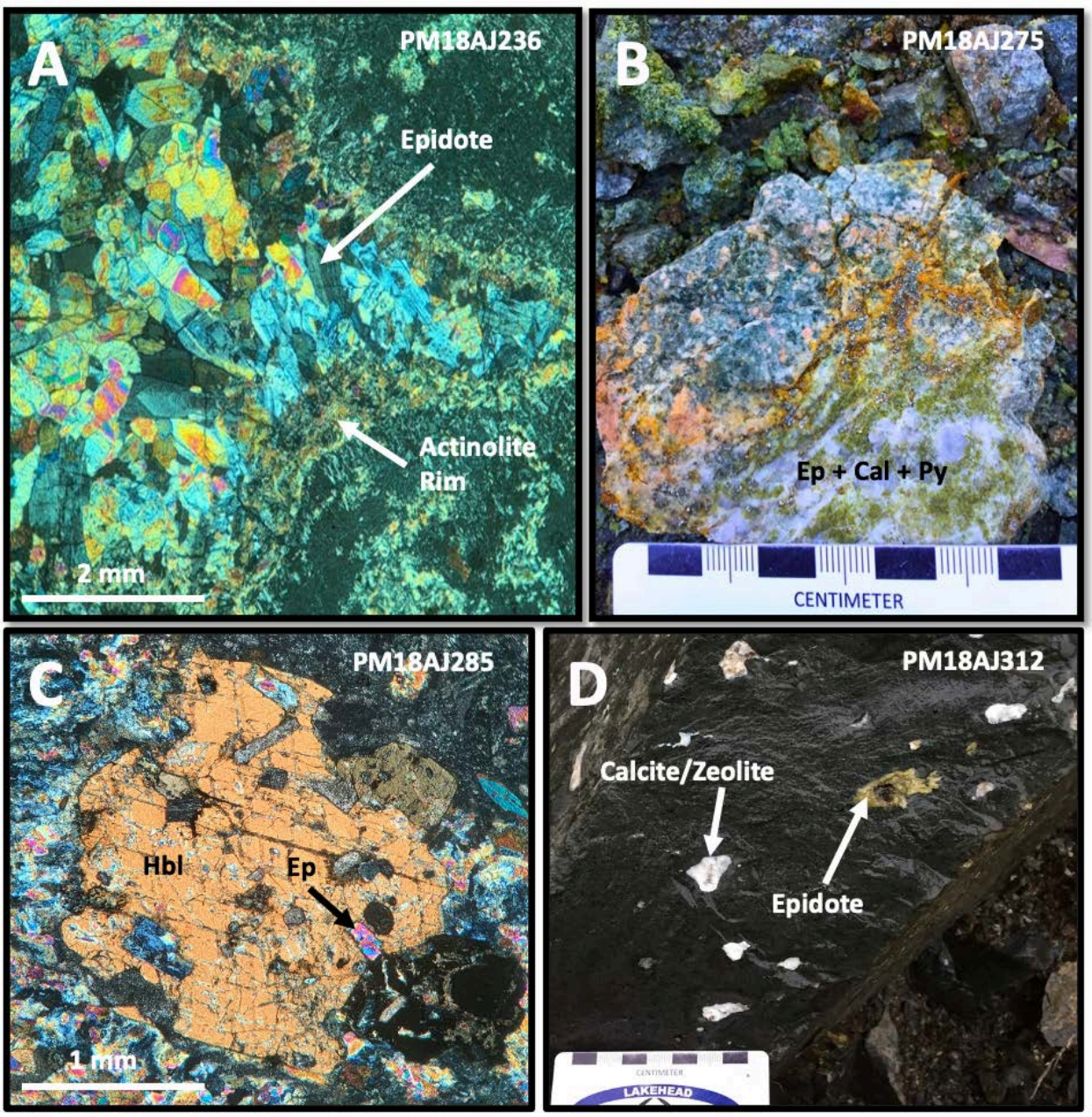


Figure 4.10. (A) Transmitted light photomicrograph (XPL) of epidote-cemented volcanic breccia with an actinolite rim; (B) Hand sample photograph showing an epidote (ep), calcite (cal) and pyrite (py) vein in quartz diorite; (C) Transmitted light photomicrograph (XPL) of plagioclase inclusions that have been altered to epidote (ep) within a medium-grained hornblende (Hbl) phenocryst in mafic volcanic rock; (D) Outcrop photograph of amygdules being replaced by calcite, zeolite, and epidote in an amygdaloidal basalt.

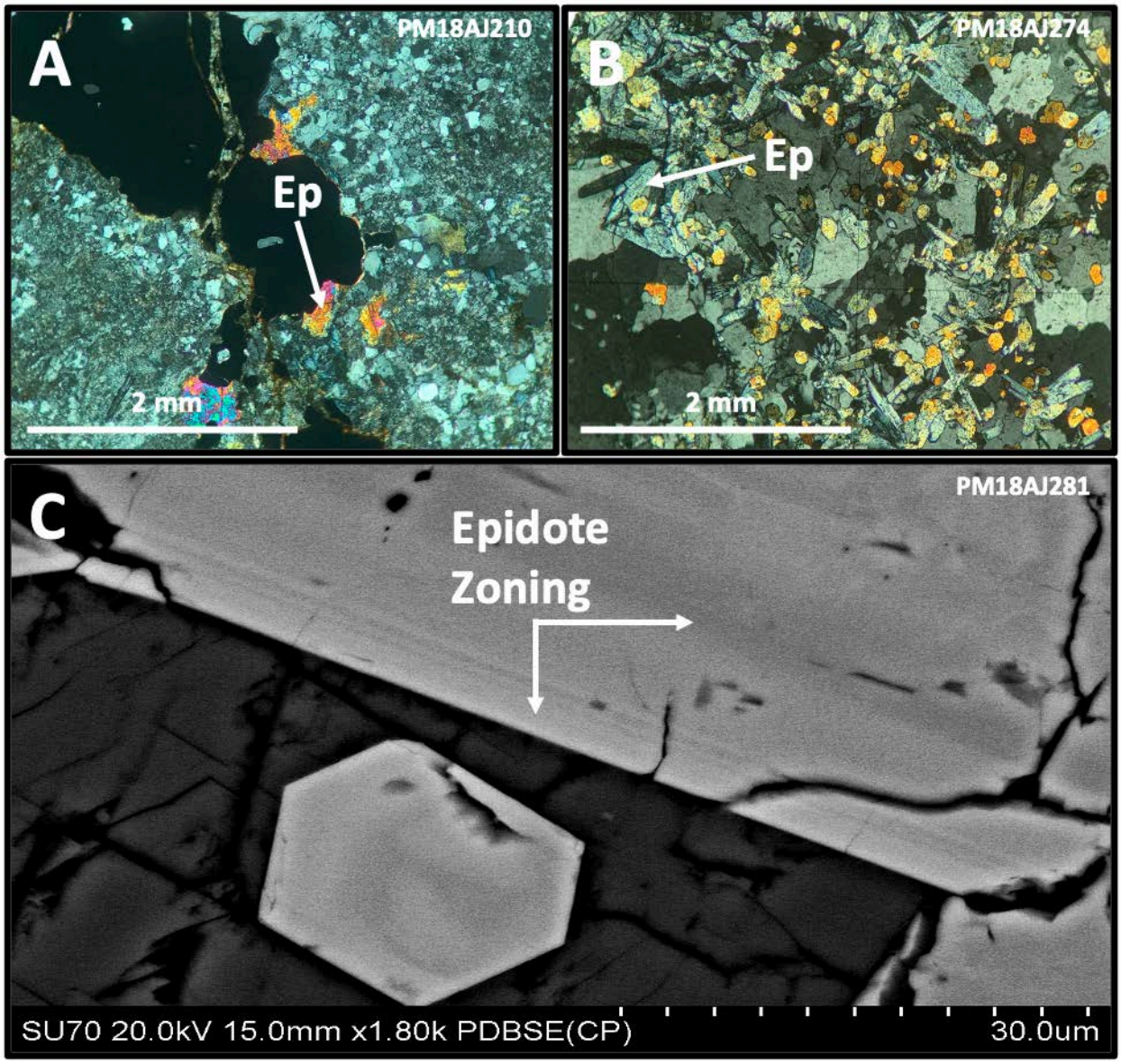


Figure 4.11. (A) Transmitted light photomicrograph (XPL) showing anhedral to subhedral epidote (Ep) replacement of groundmass material in a phyllic overprinted intermediate volcanic rock; (B) Transmitted light photomicrograph (XPL) highlighting euhedral, prismatic epidote in a quartz-epidote vein; (C) SEM image showing growth zoning between the rim and core of a prismatic epidote grain in a pervasively propylitic altered granodiorite.

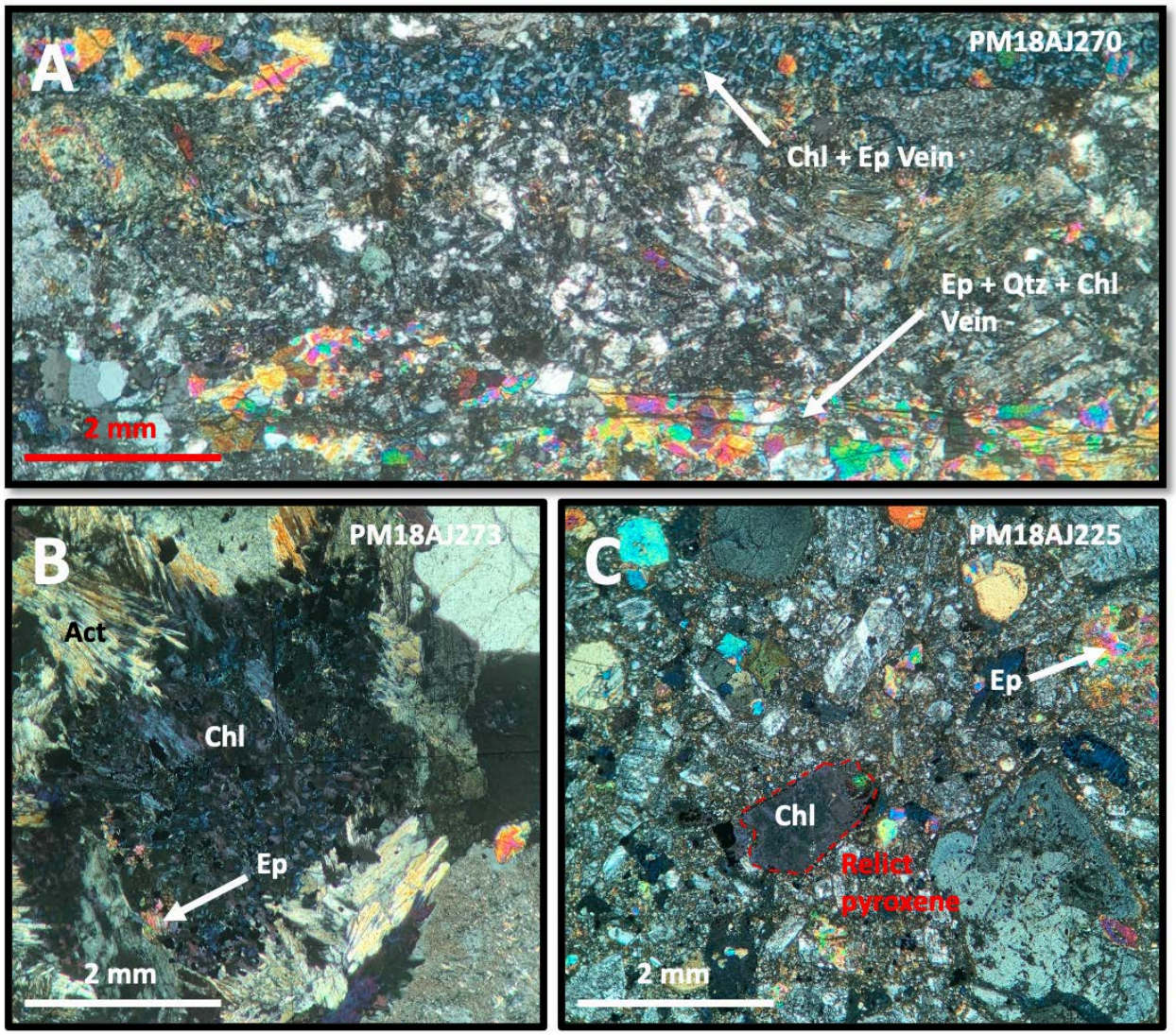


Figure 4.12. (A) Transmitted light photomicrograph (XPL) of a thin chlorite (Chl) and epidote (Ep) vein and an epidote, quartz (Qtz) and chlorite vein in weakly porphyritic andesite; (B) Transmitted light photomicrograph (XPL) showing patchy chlorite replacement with associated epidote and actinolite (Act) in granodiorite; (C) Transmitted light photomicrograph (XPL) highlighting a relict pyroxene grain that has been completely replaced by chlorite in a porphyritic basalt.

A wide range of major and minor accessory propylitic alteration minerals have been observed in this study including quartz, calcite, pyrite, albite, prehnite, pumpellyite, zeolite, magnetite, apatite, titanite, and hematite. Minerals such as quartz, calcite, and to a lesser extent albite, pyrite and hematite were found across different lithologic domains, albeit in varying intensities. Other propylitic accessory minerals such as magnetite, apatite, titanite, and zeolite

can also be found as accessory minerals within other alteration types, and therefore have complex paragenetic histories that cannot be easily differentiated based on petrography alone. Quartz is a particularly important propylitic accessory mineral and often occurs with epidote and less commonly chlorite veins (Fig. 4.12A).

The actinolite ± epidote ± chlorite sub-zone at Pemberton Hills is broadly divisible into three areas: 1) a large, roughly north trending zone that spans from the northeastern margin of the lithocap to the northwest quartz diorite pluton 2) a small subset of samples taken in the northeast extremity of the northern Wanakana pluton, and 3) an east trending zone around the southeastern margin of the quartz diorite pluton (Fig. 4.8). Given the sampling gaps between these three areas, it is possible that the actinolite sub-zone is more laterally continuous than currently interpreted. Actinolite alteration is strongest in the mafic volcanic rocks adjacent to the western margin of the granodiorite pluton, where pervasive actinolite alteration is generally accompanied by strong epidote and chlorite alteration.

The epidote ± chlorite sub-zone can also be subdivided into three main areas: 1) an extensive east trending domain in the southeast of the study site around the southeast margins of the granodiorite and quartz diorite plutons, 2) a small zone to the northeast of the lithocap, and 3) a northwest-trending domain that encompasses samples directly to the east of the Hushamu pluton (Fig. 4.8). Epidote alteration within the epidote ± chlorite sub-zone is strongest in the samples centered around the southeastern margin of the quartz diorite pluton. There is more variability in the epidote ± chlorite alteration in the samples in the areas where phyllic alteration can be seen overprinting and even completely replacing some pre-existing propylitic alteration. The chlorite sub-zone is defined wholly by a propylitic assemblage consisting of only

chlorite, calcite and clay minerals, encompassing only three samples within the very eastern domain of the study area (Fig. 4.8).

4.2.2 Potassic alteration

Potassic alteration at Pemberton Hills is fairly extensive, covering a considerable amount of the study site (Fig. 4.8). It can be divided into a biotite ± potassium feldspar ± quartz ± magnetite assemblage and a potassium feldspar ± quartz ± magnetite assemblage.

Biotite associated with potassic alteration at Pemberton Hills is generally characterized by a “shreddy” textural appearance, evident in the samples from the northwest diorite pluton and the northern granodiorite Wanakana pluton where it commonly replaces coarser grained primary amphibole (Fig. 4.13A). In some cases, a later stage chlorite can be seen replacing the shreddy biotite (Fig. 4.13A). Potassium feldspar alteration is much more variable in terms of its texture and degree of intensity illustrated by cobaltinitrite staining completed on 13 samples, which was useful given the difficulties with distinguishing the presence of potassium feldspar based on petrography and field identification (Fig. 4.14). Cobaltinitrite staining as well as petrographic and SEM analysis highlights potassium feldspar alteration occurring as replacement along plagioclase and anorthite grain boundaries, pervasive alteration, veins, veinlets, and vein halos, as well as more cryptic alteration (Fig. 4.13B and 4.14). In the field, pink laumontite veins and pervasive replacement can often suggest the presence of potassium feldspar alteration where it is in fact not present.

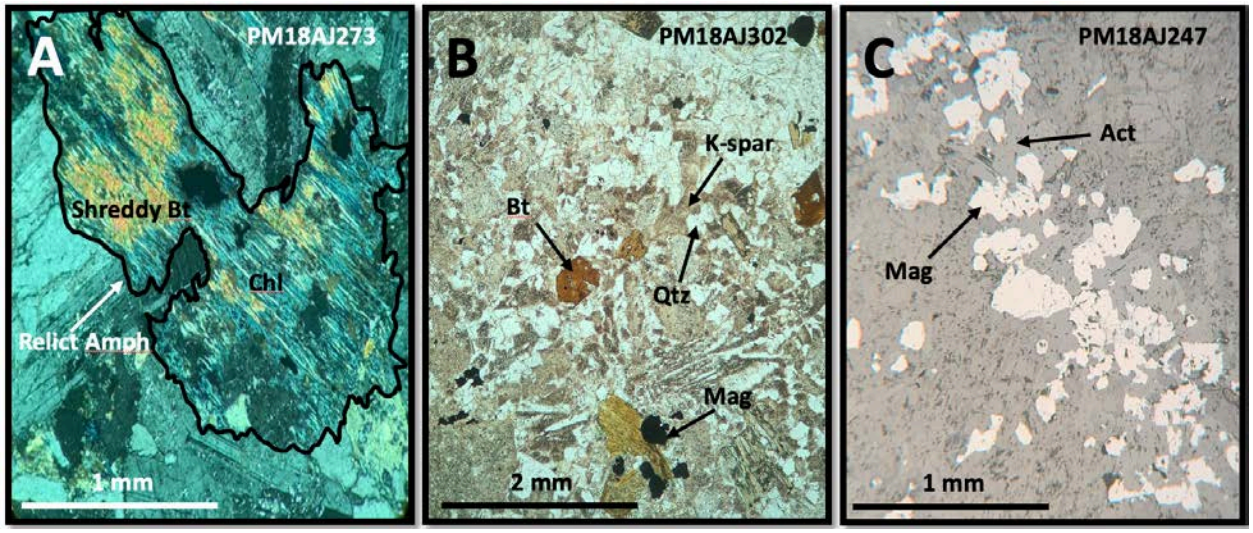


Figure 4.13. (A) Transmitted light photomicrograph (XPL) of a relict amphibole grain replaced by shreddy biotite (Bt), which is replaced by chlorite (Chl) in granodiorite; (B) Transmitted light photomicrograph (PPL) illustrating the micrographic texture between quartz (Qtz) and potassium feldspar (K-spar) that characterizes pervasively potassium feldspar altered samples, as well as associated biotite and magnetite (Mag); (C) Reflected-light photomicrograph of a magnetite and actinolite (Act) vein in quartz diorite.

Magnetite associated with potassic alteration is less well constrained due to the presence of both primary and potassic magnetite in many samples. However, differentiation of magmatic vs. potassic-related magnetite is easier in samples that contain appreciable magnetite content beyond what would be reasonably expected for an intermediate or felsic plutonic rock, when magnetite manifests as hydrothermal features such as veins or clots (Fig. 4.13C), or shows close genetic relationships to other hydrothermal alteration minerals. Veining and clotty magnetite are relatively rare in the study area, and appear to be restricted to samples near the center of the southern quartz diorite pluton. Similar to magnetite, quartz associated with potassic alteration can also be difficult to identify given its ubiquity in felsic and some intermediate rocks, as well as its association with propylitic and phyllic alteration. Despite this, potassic-related quartz can be seen in samples with pervasive potassium feldspar and quartz alteration (i.e., PM18AJ302; Fig 4.14). Potassic-related quartz can also be identified based on the presence of quartz-potassium

feldspar veins, although the latter are rare and quartz veins are commonly observed with propylitic alteration. Quartz veins associated with potassic alteration are overall thinner and occur more often as veinlets than quartz veins associated with propylitic alteration.

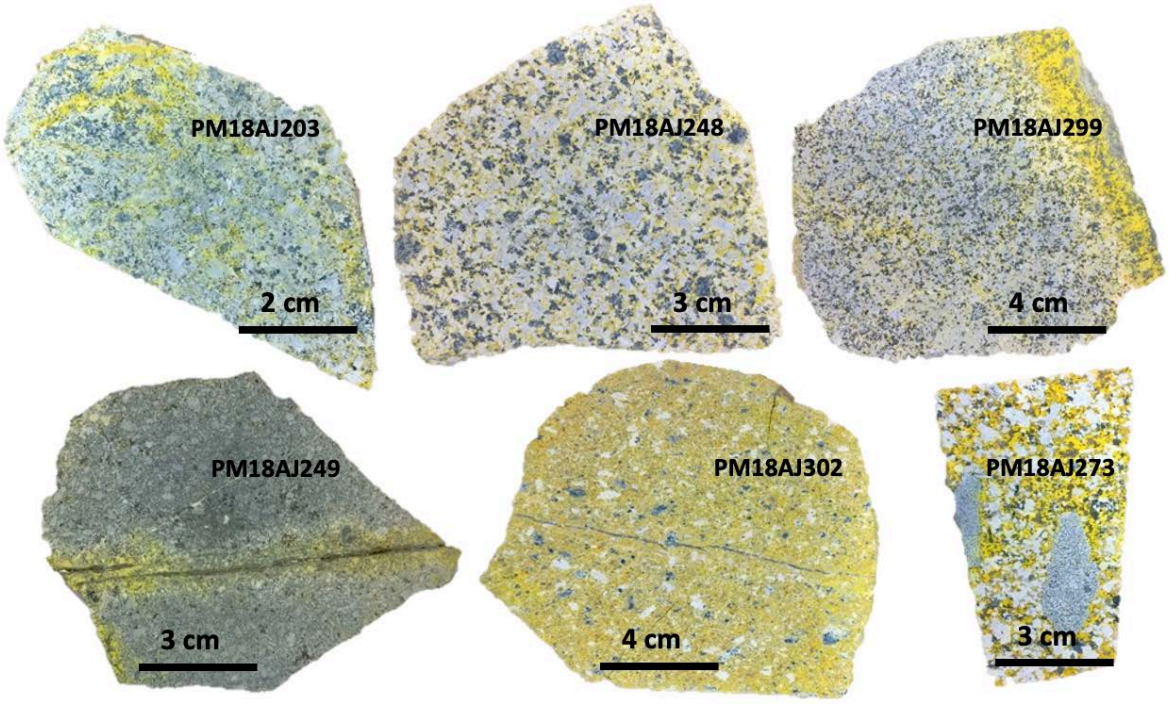


Figure 4.14. Hand samples of various intrusive units highlighting the presence of potassium feldspar alteration (yellow colouring) in varying styles and degrees of intensity as a result of cobaltnitrite staining.

The biotite ± potassium feldspar assemblage occurs in three main areas: 1) a thin northwest trending domain confined to the central parts of the southern quartz diorite pluton, 2) a large zone that extends from the northwestern margin of the northern Wanakana pluton, through adjacent volcanic rock and into the northwest quartz diorite pluton, and 3) a small subset of samples taken from the northeastern extremity of the northern Wanakna pluton (Fig. 4.8). Similar to the actinolite sub-zone, it is possible that the biotite ± potassium feldspar assemblage extends across the entirety of the northern Wanakana pluton given its presence in the western and eastern extremities. Biotite alteration in the southern quartz diorite pluton is quite weak and

is only present in trace amounts where intense magnetite alteration is also present, as opposed to the northwest quartz diorite and granodiorite plutons, which are dominated by intense biotite alteration.

The potassium feldspar ± quartz ± magnetite assemblage can be found in two main areas: 1) a small cluster of samples in the southwestern corner of the granodiorite pluton, and 2) irregular domains centered around biotite alteration in the eastern and western sides of the southern quartz diorite pluton (Fig. 4.8). It is possible that potassium feldspar alteration extends throughout the middle of the southern Wanakana pluton. Potassium feldspar alteration is most intense in the southwestern corner of the northern Wanakana pluton, characterized by pervasive and texturally destructive potassium feldspar and quartz alteration (Figs. 4.13B and 4.14).

4.2.3 Phyllic alteration

Phyllic alteration is defined here as varying proportions of late-stage white mica, quartz and pyrite with associated illite $\pm$ montmorillonite. The term white mica herein denotes the presence of muscovite and/or paragonite. Two discrete domains of phyllic alteration characterize the porphyry environment at Pemberton Hills: 1) a larger domain extending northeast from the northeast margin of the lithocap and 2) a smaller domain encompassing a small group of samples to the east of the Hushamu pluton (Fig. 4.8). Based on structural interpretation of the property using regional magnetic survey data, the larger phyllic domain appears to be strongly controlled by northeast trending faults that extend outwards from the northeast margin of the lithocap, with the northeast extent of phyllic alteration limited by a northwest trending fault. Phyllic alteration at Pemberton Hills variably overprints potassic and propylitic alteration assemblages. In many cases the phyllic alteration is texturally destructive, leaving only traces of pre-existing

alteration assemblages or even primary lithological textures. In some instances, pre-existing alteration minerals such as epidote are overprinted by late-stage phyllic-related illite.

Phyllic alteration is variable even at outcrop scale, as exemplified by sample PM18AJ210, which is characterized by a texturally destructive quartz and pyrite rich assemblage, taken only a few meters from sample PM18AJ209, which exhibits a white mica dominant assemblage with relict phenocrysts or plagioclase grains still discernable (Fig. 4.15A-C). At outcrop scale, strong phyllic alteration is typified by a grey to turquoise coloured and fine-grained appearance, often containing appreciable pyrite. Phyllic quartz can often be differentiated from propylitic and potassic quartz by its very fine-grained and locally massive appearance in thin section. White mica associated with phyllic alteration is more difficult to identify, as it shows no obvious textural or grain size variation between different alteration domains, however, it is often more abundant in rocks with phyllic quartz and pyrite. Pyrite in contrast exhibits a range of textures across the property, forming as very fine- to medium-grained anhedral to euhedral disseminations and locally semi-massive patches, veins and veinlets, as well as partial to complete grain replacements, but shows no obvious relationship between texture and alteration type. Pyrite is generally more abundant in phyllic altered rocks. Lastly, illite can be found in a range of alteration domains and assemblages across the property, but is characteristically most prominent and intense when found with phyllic quartz, white mica and pyrite.

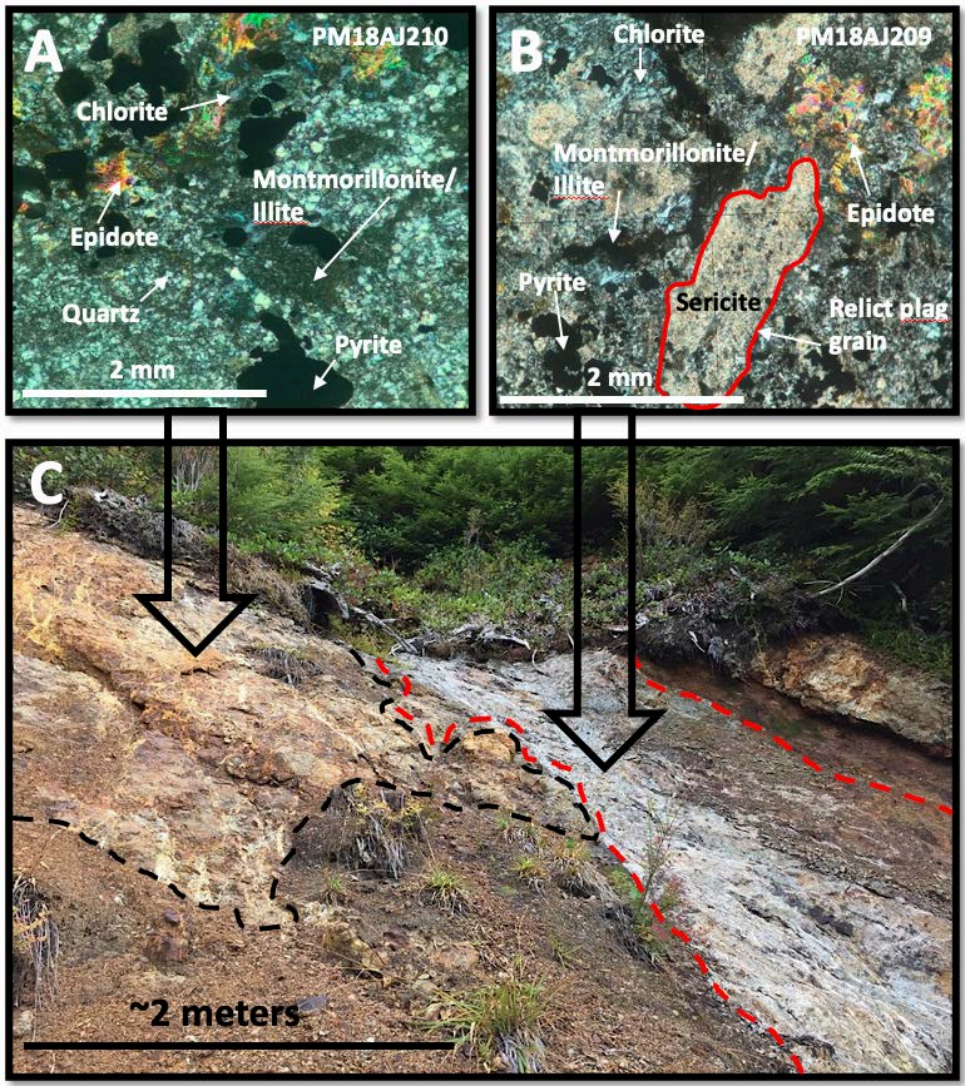


Figure 4.15. (A) Transmitted light photomicrograph (XPL) highlighting a texturally destructive quartz- and pyrite-rich phyllic alteration assemblage with associated montmorillonite and/or illite that overprints previously formed epidote and chlorite alteration; (B) Transmitted light photomicrograph (XPL) showing a less texturally destructive sericite- and chlorite-rich phyllic alteration assemblage where relict plagioclase (plag) grains are replaced by sericite. Montmorillonite and/or illite overprints previously formed epidote; (C) Outcrop photograph denoting the locations of where the samples from photos A and B were taken, illustrating that differences in the degree of phyllic alteration are apparent at outcrop scale.

4.2.4 Hydrothermal breccias

Hydrothermal breccias are common at Pemberton Hills. They occur as discrete, centimeter- to meter-scale vein-like breccias, or constitute entire outcrops over tens of meters. The breccias are mainly composed of quartz, calcite and zeolite, which can occur together. One

example of carboniferous-quartz-epidote breccia with significant Zn and Cu mineralization was observed (PM18AJ309; Fig. 4.18A).

While hydrothermal breccias are widely observed across the property, two discrete areas have been outlined based on a localized increase in the abundance and intensity (Fig. 4.8). The first area encompasses samples around the eastern margin of the southern diorite pluton, exemplified by quartz ± calcite ± epidote ± zeolite hydrothermal breccias that are at times tens of meters in size, comprising entire outcrops (Fig. 4.16A, B). They may contain pervasive epidote altered clasts, or clasts of weakly propylitic altered porphyritic andesite, as well as potassic and propylitic altered quartz diorite (Fig. 4.16A, B). The second area comprises a cluster of samples in the center of the property to the north of the southern diorite pluton and to the west of the northern Wanakana pluton comprises strong quartz ± calcite ± breccias containing clasts of phyllic and propylitic altered porphyritic andesite (Fig. 4.16C).

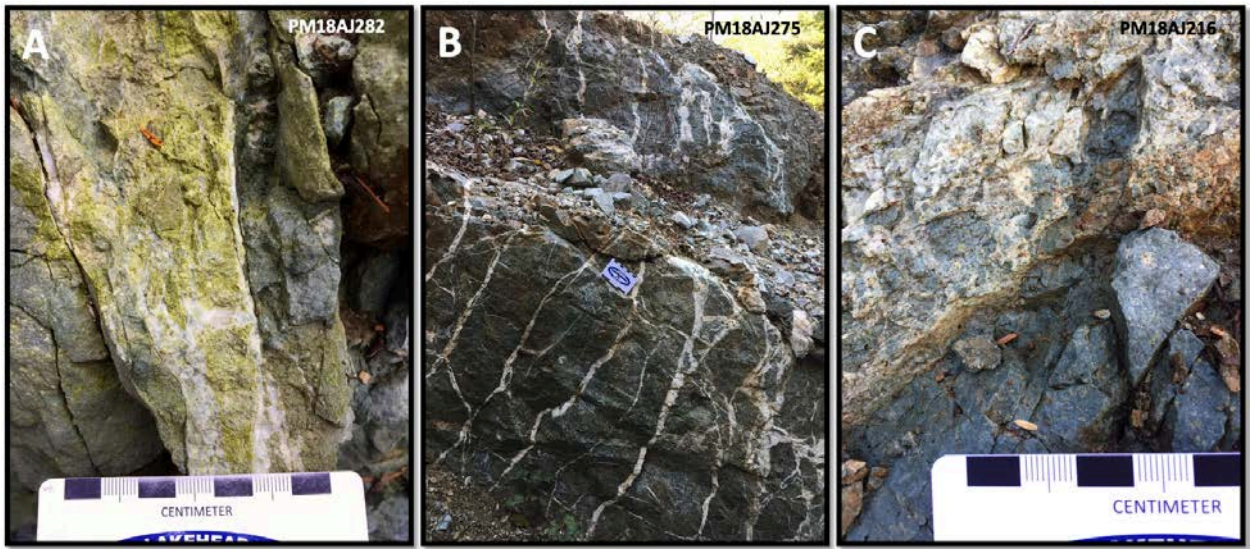


Figure 4.16. (A) Outcrop photograph of a quartz-hydrothermal breccia comprised of intensely epidote altered clasts; (B) Outcrop photograph of a series of roughly parallel quartz-calcite-zeolite breccia-veins that contain clasts of the surrounding quartz diorite; (C) Outcrop photograph of a quartz-hydrothermal breccia that includes clasts of phyllic and propylitic altered porphyritic andesite.

4.2.5 Magmatic-hydrothermal breccias

Only one magmatic-hydrothermal breccia has been documented in this study, occurring in the center of the property to the north of the southern Wanakana pluton and to the west of the northern Wanakana pluton, where hydrothermal breccias are also present. The breccia is an ~2 m wide pipe that has vertical contacts with the surrounding porphyritic andesite (Fig. 4.17A). The breccia consists of a very fine-grained chlorite and white mica dominated matrix with sporadic fine-grained epidote as well as albite altered phenocrysts occurring throughout. Fine- to medium-grained intermediate to mafic xenoliths or clasts that exhibit strong albite-epidote alteration are also present (Fig. 4.17C). Of particular interest here is the contrast in different alteration assemblage observed in the adjacent host rock, which is dominated by euhedral pyrite, illite, and white mica with clotty epidote scattered throughout (Fig. 4.17B).

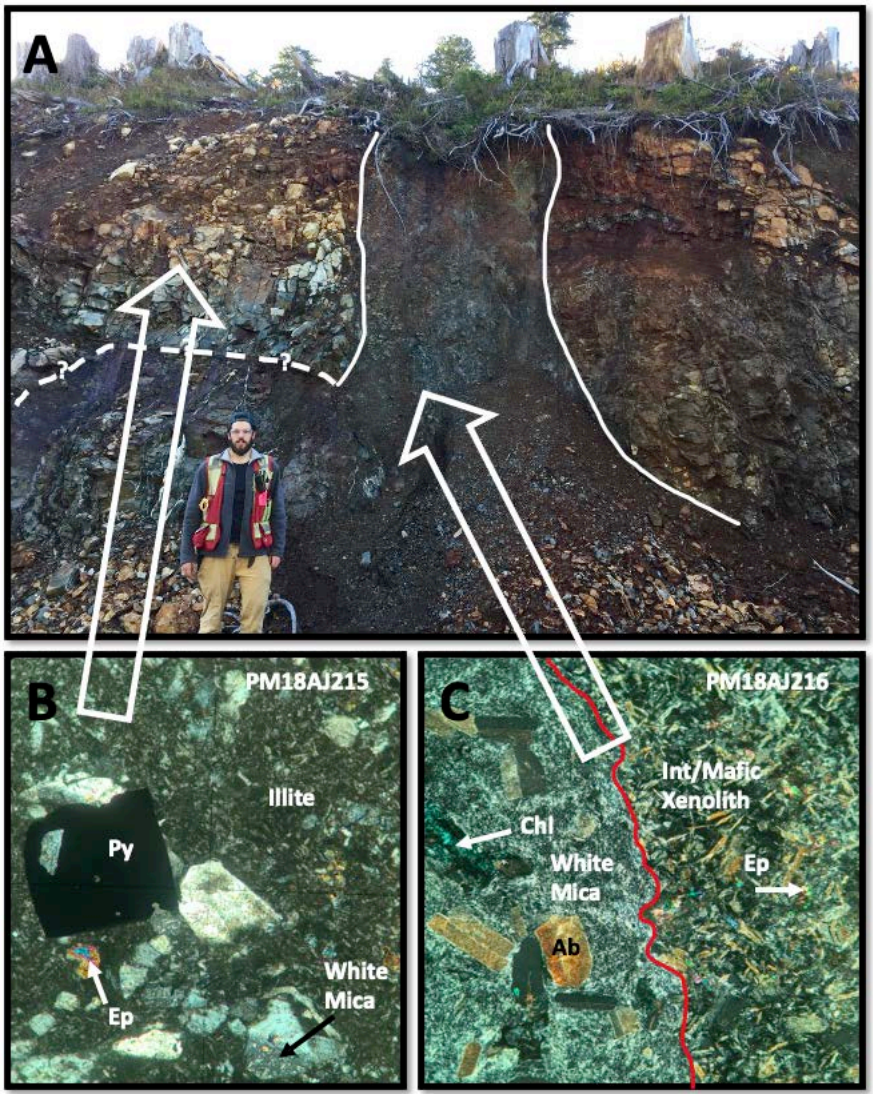


Figure 4.17. (A) Outcrop photograph of the magmatic-hydrothermal breccia with arrows denoting the relative locations of where the samples in photos B and C were taken; (B) Transmitted light photomicrograph (XPL) of strong illite, white mica, and pyrite (Py) alteration in (porphyritic andesite?) host rocks adjacent to the magmatic-hydrothermal breccia; (C) Transmitted light photomicrograph (XPL) of strong white mica, chlorite (Chl), albite (Ab), and epidote (Ep) alteration in the magmatic-hydrothermal breccia sample (PM18AJ216). The red line highlights the boundary between the breccia matrix and an intermediate to mafic xenolith.

4.3 *Sulphide phases and Cu, Zn, and Au occurrences*

Results from this project highlight the presence of a number of sulphide phases and minor, but locally significant Cu, Zn, and Au occurrences that may only be recognized on a sample-to-sample basis with the aid of petrographic and SEM analysis (Fig 4.18A-E). The most common

sulphide observed across the study site was pyrite. Pyrite is most abundant in the center of the study area to the north of the lithocap, where it occurred in greatest concentrations in the phyllic altered rocks, but also in the phyllic and propylitic altered samples to the east and southeast of the Hushamu pluton, as well as in samples throughout the southern quartz diorite pluton and in the epidote and distal chlorite altered samples to the east of the study area (Fig. 4.19). Pyrite was less common in the potassic altered samples from the northern granodiorite and northwestern quartz diorite plutons and not found in the clay-chlorite-zeolite altered samples to the south of the lithocap. Pyrite occurs as fine-grained euhedral disseminations, coarser grained subhedral grains, aggregates, veins, and replacement (Fig. 4.18C, D).

The second most common sulphide observed in the study area is chalcopyrite. It typically occurs as very fine- to fine-grained disseminations within the groundmass of various alteration assemblages and frequently occurs with pyrite (Fig. 4.19). Chalcopyrite can also be found as coarser grains within actinolite ± magnetite ± quartz ± pyrite veins (Fig. 4.18C), with bornite in an epidote vein (PM18AJ279; Fig. 4.18B), as blebby grains within pervasive propylitic alteration (PM18AJ281), with sphalerite in a carboniferous hydrothermal breccia (PM18AJ309; Fig. 4.18A), and along selective bedding planes in a volcanic tuff (Fig 4.18D).

Pyrrhotite was only identified in two samples in the north-central area of the study site. It occurs with chalcopyrite in an actinolite vein (PM18AJ268) and forms along bedding planes with chalcopyrite in a sample of volcanic tuff (PM18AJ271; Figs. 4.18D, 4.19). Medium-grained euhedral sphalerite occurs within a quartz-calcite vein in the center of the study site (PM18AJ219), and as fine- to medium-grained disseminations in a Zn-Cu mineralized carbon-cemented hydrothermal breccia (PM18AJ309), in which the sphalerite grains exhibit

"chalcopyrite disease", characterized by the exsolution of chalcopyrite as micro-blebs (Fig. 4.18A). Bornite was only observed in one sample as partial replacement of chalcopyrite with very-fine grained covellite within an epidote vein (PM18AJ279; Figs. 4.18B, 4.19). SEM analysis revealed the presence of electrum (Au-Ag), occurring as a discrete bleb between euhedral epidote grains in a pervasively epidote altered sample (PM18AJ281; Figs. 4.18E, 4.19).

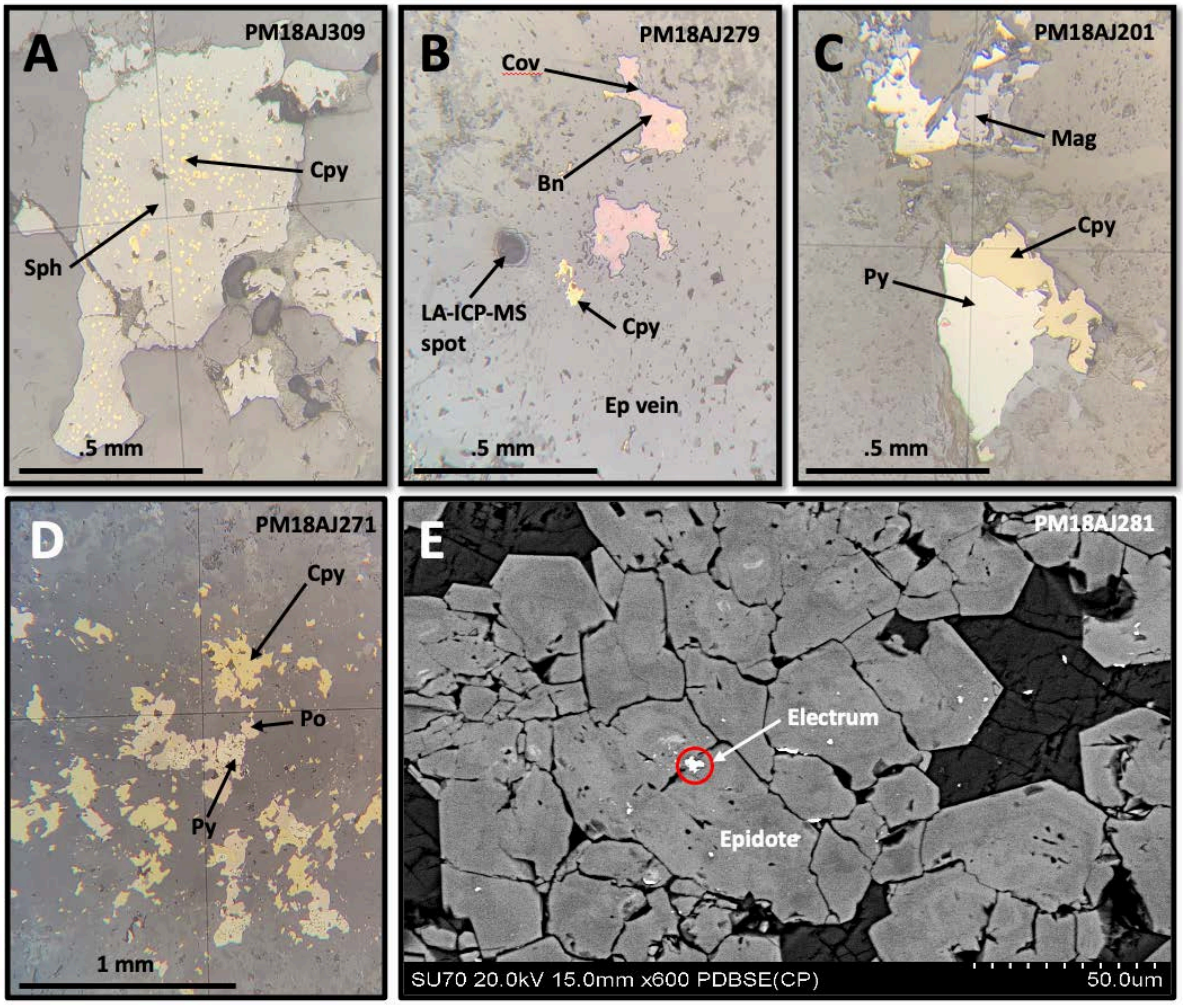


Figure 4.18. (A) Reflected-light photomicrograph showing chalcopyrite (Cpy) disease (exsolution) within a fine-grained sphalerite (Sph) grain in a carboniferous-quartz-epidote-hydrothermal breccia; (B) Reflected-light photomicrograph of covellite (Cov) exsolution along bornite (Bn) grain boundaries, which have replaced chalcopyrite grains within an epidote vein in porphyritic basalt. Note the ~30-micron LA-ICP-MS spot in the epidote vein; (C) Reflected-light photomicrograph of a magnetite (Mag), chalcopyrite, vein with pyrite (Py) replacing magnetite (Mag) within quartz diorite; (D) Reflected-light photomicrograph of chalcopyrite, pyrrhotite (Po), and pyrite selectively occurring along a discrete layer in volcanic tuff; (E) SEM photomicrograph of an electrum grain occurring along the boundary of epidote crystals.

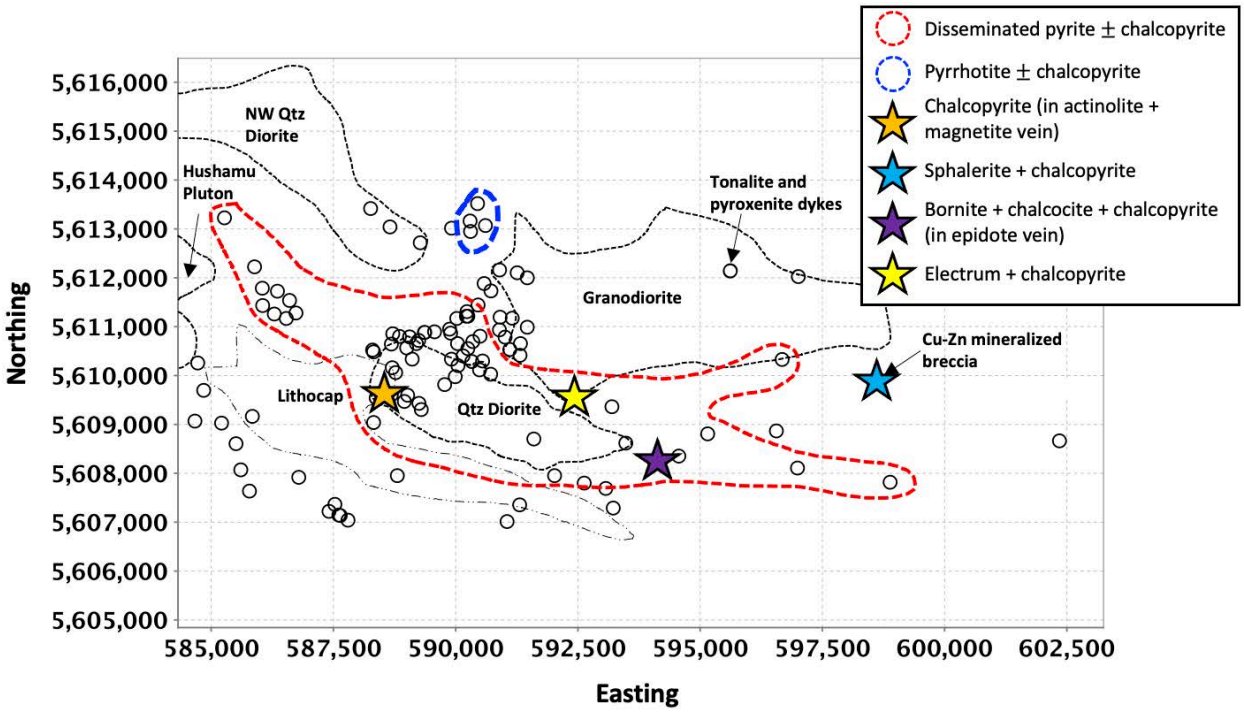


Figure 4.19. Map of whole-rock sample distribution highlighting important sulphide occurrences. The dotted red line indicates the boundary that disseminated pyrite ± chalcopyrite was mainly observed in. The dotted blue line indicates the boundary where pyrrhotite was observed in. Outlines of plutonic units modified after Nixon et al. (2011a, b).

Chapter 5: Tectonomagmatic Evolution of Bonanza Arc Rocks and Implications for Porphyry Deposit Formation at Pemberton Hills

5.1 Results

5.1.1 Whole-rock major and trace element geochemistry

One hundred and thirteen outcrop samples from Pemberton Hills were analyzed for whole-rock major and trace element geochemistry in order to characterize plutonic and volcanic units sampled across the property (Fig. 5.1). Four samples classified as hydrothermal breccias have been excluded from this chapter as they do not provide direct insights into the magmatic evolution of the study area. Additionally, one sample of Triassic-aged basalt has been excluded on the basis that it is not part of the Bonanza arc sequence. Given that nearly all of the samples submitted for geochemical analyses exhibit some form of hydrothermal alteration, samples with loss on ignition values of >3.5% are illustrated as open circles on major and trace element diagrams, and samples with loss on ignition values of <3.5% are shown as solid circles with their respective lithological colour. Loss on ignition values of <3.5% have been suggested by Loucks (2014) as acceptable analyses for sample selection criteria when used for discrimination purposes with porphyry-related magmas. Additional screening for alteration has been accomplished using detailed petrography and cobaltinitrite staining of intrusive samples to highlight the presence of secondary K-feldspar. Mineralogical and lithological descriptions can be found in Chapter 4 and major, trace and rare earth element concentrations of representative samples and their coordinates are provided in Appendix A.

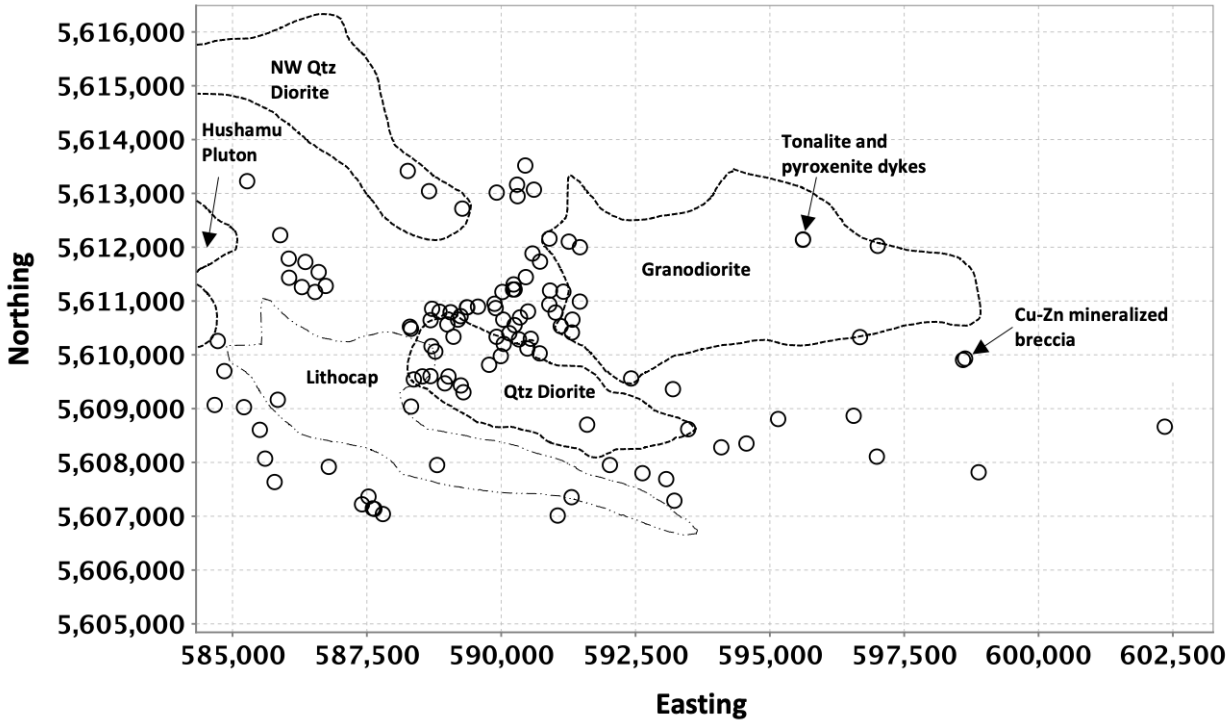


Figure 5.1. Map of whole-rock sample distribution at Pemberton Hills. Outlines of plutonic units modified after Nixon et al. (2011a, b).

Samples at Pemberton Hills have been classified into seven discrete rock groups including granodiorite, quartz diorite, tonalite dyke, pyroxenite dyke, intermediate volcanic rock, mafic volcanic rock, and volcanic breccia. These groups were created based on mineralogical and textural differences observed in hand samples and petrographic analysis in conjunction with major and trace element geochemistry. Plutonic rock types at Pemberton Hills could be identified by their primary textures and mineralogy, and as a result of this, could be classified into discrete lithologies (i.e., quartz diorite). The tonalite and pyroxenite dyke groups only contain one sample each. Comparatively, there was much more variation between volcanic rock types at Pemberton Hills (i.e., porphyritic andesites and basalts, volcaniclastic rocks, breccias, flows, tuffs, etc.). Additionally, some volcanic rocks are pervasively altered, making it difficult to accurately identify primary textures. Thus, for the purpose of this chapter, which focuses largely on plutonic rocks,

volcanic rocks were sub-divided into three fairly distinct groups (mafic volcanic rocks, intermediate volcanic rocks, and volcanic breccias) in order to best represent the samples.

All seven rock types are characterized by negative Ti and Nb anomalies, and exhibit weakly negative to positive Zr and Hf anomalies. On primitive mantle normalized plots, all rock types except the pyroxenite dyke display Ta-Nb, Ti, and Th depletions (Fig. 5.2). Most rock types are characterized by Sr enrichment. Samples that exhibit a Sr depletion reflect the presence of plagioclase-destructive pervasive potassium feldspar alteration, or a lack of plagioclase in the sample itself.

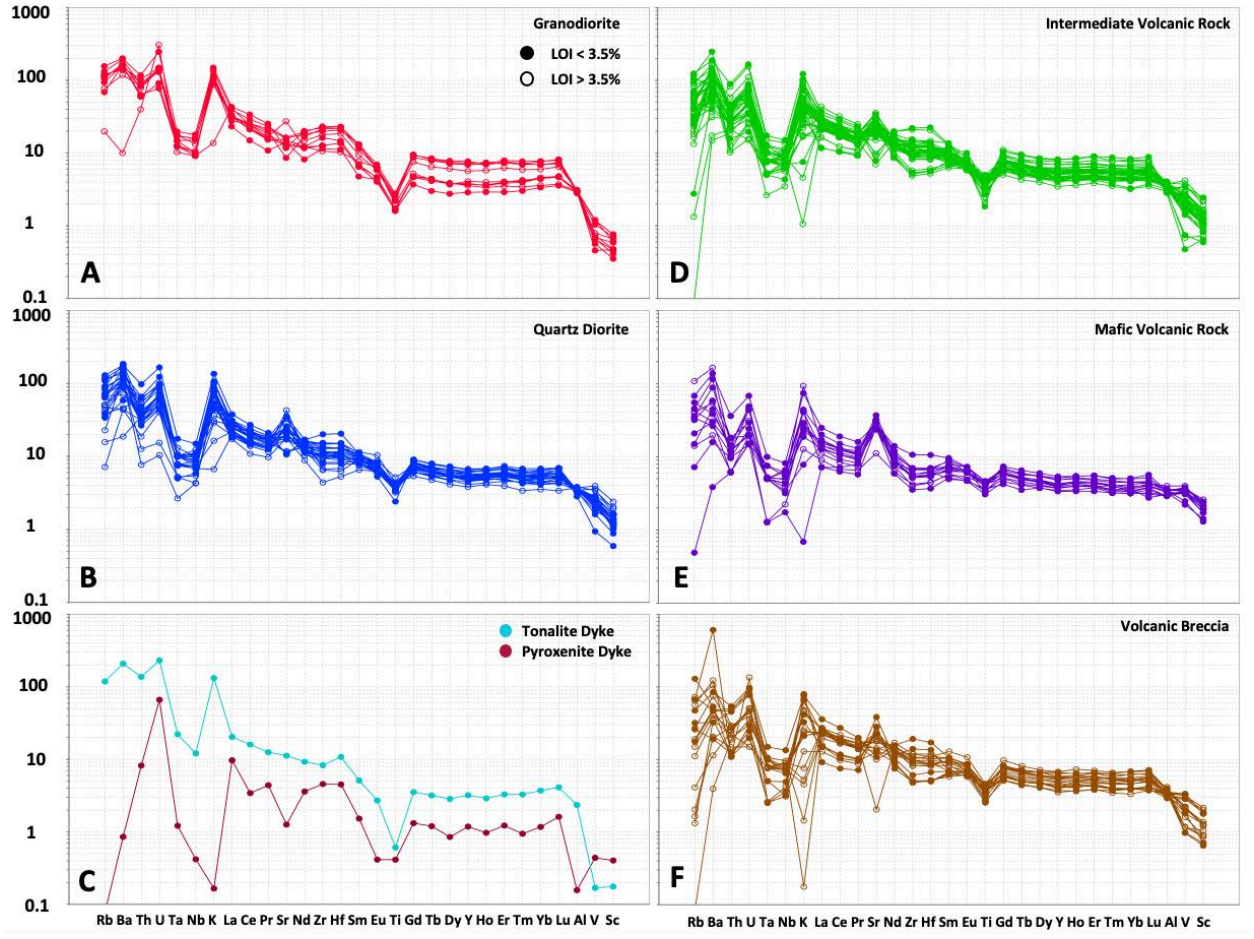


Figure 5.2. Primitive mantle-normalized multielement plots of units from the Pemberton Hills property. Normalizing values from Sun and McDonough (1989). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

On chondrite normalized plots, all rock types are characterized by LREE enrichment with fractionation of HREE's, with the more felsic rock types showing stronger LREE enrichment relative to HREE's (Fig. 5.3). Weak Eu depletions occur in only a few samples within each rock type, however, samples within the granodiorite unit that display a relative depletion in Eu also exhibit higher MREE to LREE values than samples without the Eu enrichment, which also appears to be the same case for samples within the intermediate volcanic rock and to a lesser extent the diorite group.

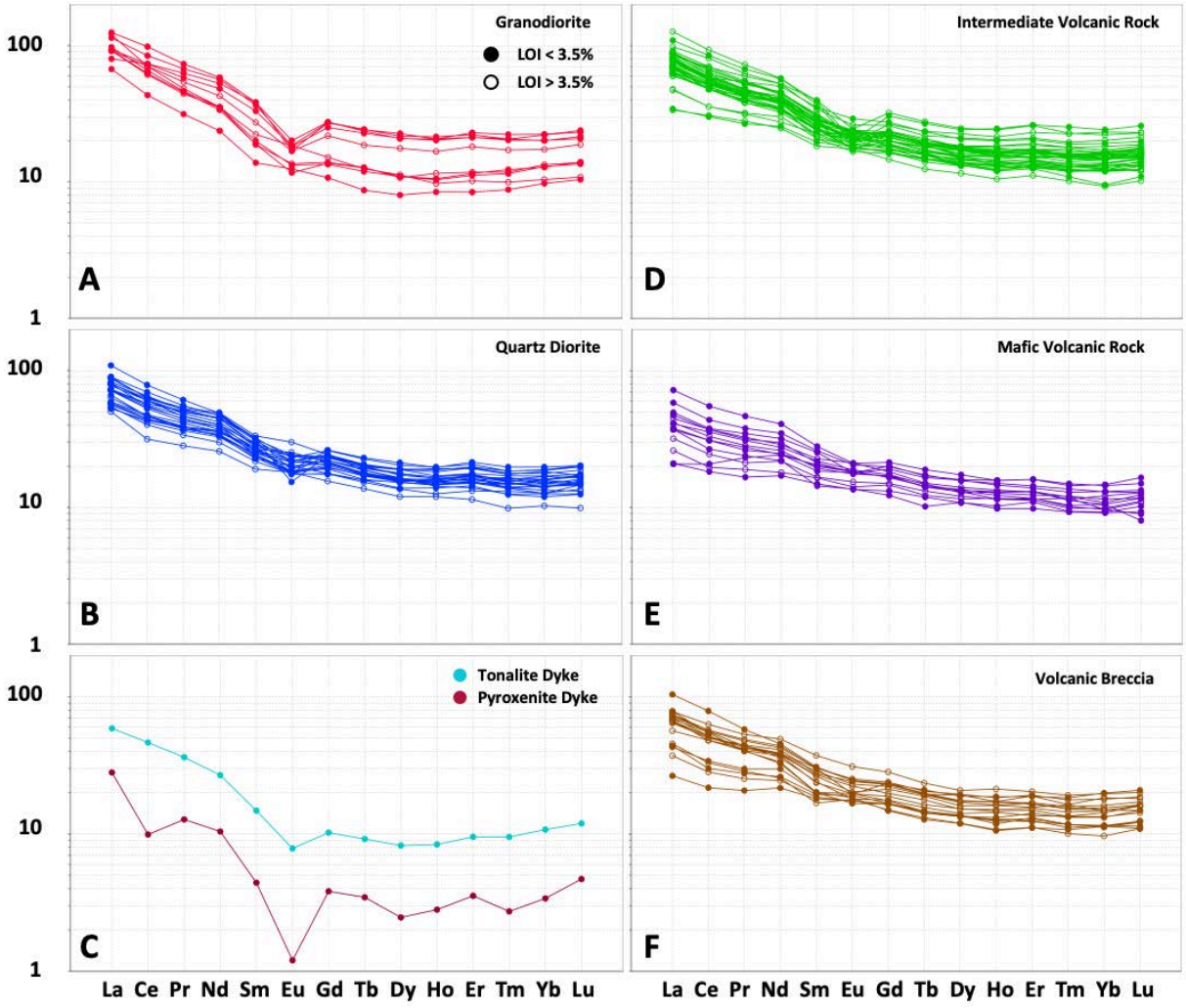


Figure 5.3. Chondrite-normalized REE plots of units from the Pemberton Hills property. Normalizing values from Sun and McDonough (1989). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

5.1.2 Geochronology

Four new high-precision U-Pb zircon age determinations of various Island Plutonic Suite samples have been obtained using chemical abrasion thermal ionization mass spectrometry (CA-TIMS) in order to better understand the crystallization ages of different intrusive units across the Pemberton Hills property (Fig. 5.4). Additionally, one U-Pb garnet age and one U-Pb epidote were also determined to provide constraints on the timing of alteration with respect to these intrusive units. All samples were collected from outcrop; three from the northern Wanakana pluton (PM18AJ273, PM18AJ274, PM18AJ289), two from the southern Wanakana pluton (PM18AJ203, PM18AJ248), and one from the porphyritic andesite (PM18AJ242).

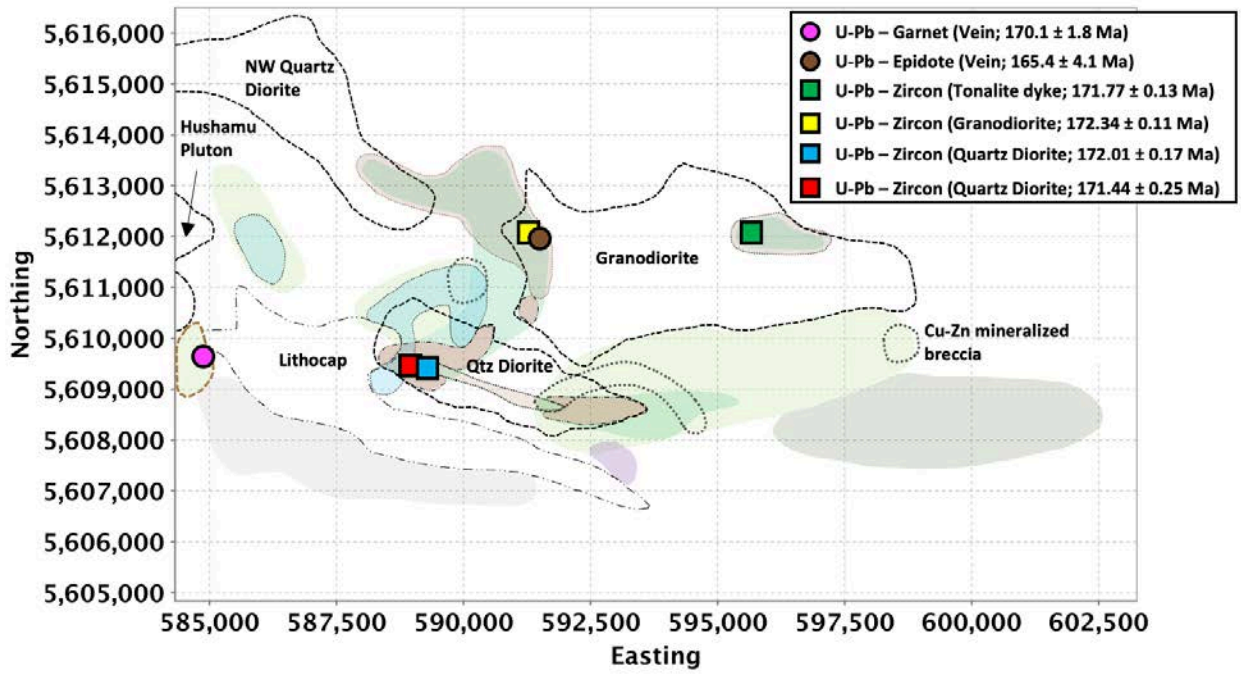


Figure 5.4. Map showing distribution of samples used for geochronology in this study. Outlines of plutonic units modified after Nixon et al. (2011a, b).

5.1.2.1 Zircon U-Pb geochronology (CA-TIMS)

Zircon U-Pb ages for the four plutonic samples contain three different errors shown in Figures 5.6, 5.8 and 5.10, and data presented in Appendix B. The first value (shown without brackets), are errors based on analytical precisions that can only be used to compare results within the data set or with other U-Pb TIMS age dates using the same isotopic tracer (ET535). The second value (shown in round brackets), are errors based on analytical precisions and ET535 spike errors that should be used to compare with other U-Pb age determinations not using ET535 spike, including non-TIMS U-Pb age dates. The third value (shown in square brackets), are errors based on analytical precisions, ET535 spike and U decay constant errors that should be used to compare with age determinations from other decay systems (i.e., Ar-Ar and Re-Os). For the remainder of this results section, the zircon ages will be reported with the first error unless being compared to other U-Pb age determinations, in which case the second error will be used. When the zircon ages are being used in comparison with other decay schemes in the discussion section, they will be used with the third error.

Xenocrysts and antecrysts are interpreted to represent zircons that did not crystallize directly from the host magma that they are contained in, but may be from slightly older magma phases that that ended up in younger phases. In porphyry environments such as Pemberton Hills where several phases of magma crystallized over a short period of time, antecrysts differ from xenocrysts such that while they did not crystallize from the host magma they are contained in, they may be genetically related to the same magma system (Friedman, pers comm). Age determinations are based on the assumption that all Pb loss was mitigated for all analyses, so that the youngest $^{206}Pb/^{238}U$ date or weighted $^{206}Pb/^{238}U$ average for a concordant group of

zircons comprising the youngest results for a sample provide the best estimate for the crystallization age of the rock.

Granodiorite (northern Wanakana pluton): Sample PM18AJ273 was collected along the northwestern margin of the northern Wanakana pluton in weakly porphyritic, medium-grained granodiorite to granite near the inferred contact with volcanic host rock. Crosscutting relationships suggest that granodiorite from the northern Wanakana pluton was emplaced before the tonalite dyke sample (PM18AJ289), however, relative timing of emplacement with respect to the southern Wanakana pluton based on crosscutting relationships is not well constrained. Zircons from sample PM18AJ273 are mostly euhedral, stubby to prismatic grains that are well zoned with distinct cores, mantles, and rims. Grains are typically around 200 μm in size and sometimes contain micro-inclusions of other minerals as well as hairline fractures. A representative suite of zircon grains from this sample is shown in Figure 5.5. The oldest rock type dated at Pemberton Hills based on the weighted average of $^{206}Pb/^{238}U$ dates for five concordant fractions yielded an age of 172.34 ± 0.11 Ma (Fig. 5.6).

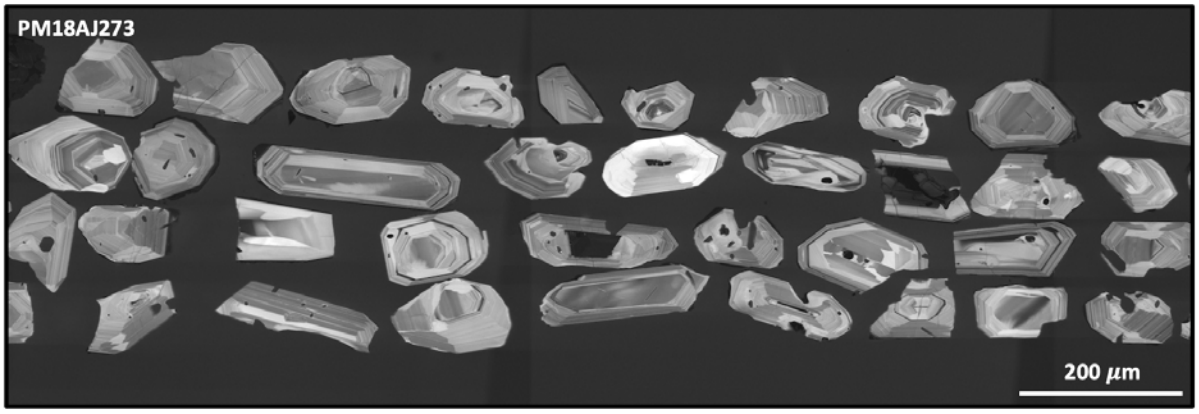


Figure 5.5. Representative cathodoluminescence image of zircon grains from sample PM18AJ273.

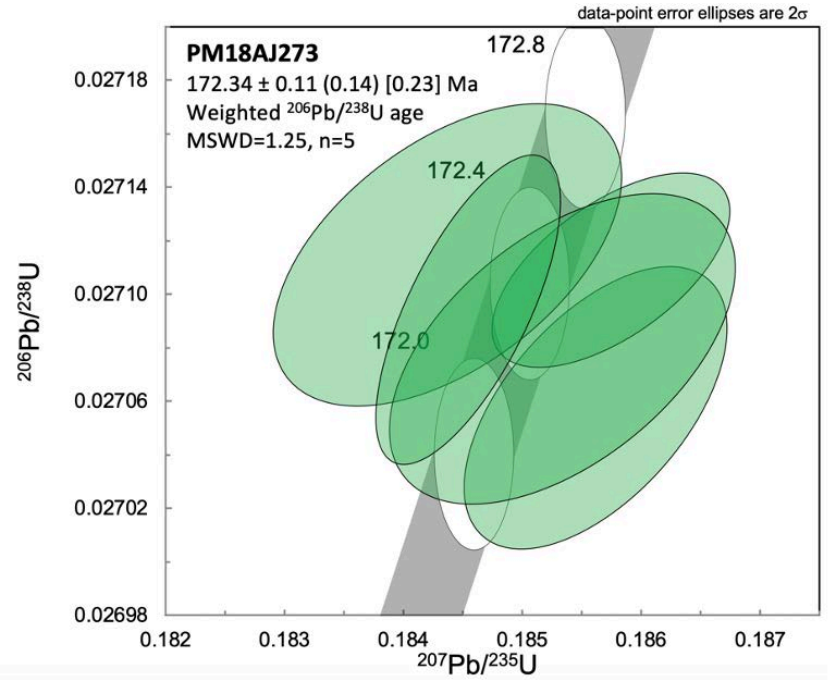


Figure 5.6. Concordia plot used for U-Pb age determination of sample PM18AJ273. Green ellipses represent zircon fractions used for determining U-Pb ages.

Tonalite dyke (northern Wanakana pluton): Sample PM18AJ289 was collected from an ~12-15 cm wide fine- to medium-grained tonalite dyke located along the northeastern margin of the northern Wanakana pluton. The dyke is hosted within sedimentary rock that is in contact with the northern Wanakana pluton (granodiorite). Two pyroxenite dykes were observed at the same outcrop; one intrudes along the boundary of the granodiorite and sedimentary host rock whereas the other is in partial contact with one side of the tonalite dyke. The tonalite dyke intruded prior to the pyroxenite dyke based on contacts observed at outcrop. Both sets of dykes are interpreted to have intruded after the emplacement of the granodiorite. Zircons from the sample of tonalite dyke are mostly euhedral, stubby to prismatic grains that are well zoned with distinct cores, mantles, and rims. Grains are generally between 100 – 200 μm in size and sometimes contain micro-inclusions of other minerals as well as hairline fractures. A representative suite of zircon grains from this sample is shown in Figure 5.7. Two discordant

zircon grains that yielded older ages are interpreted to represent antecrysts and/or xenocrysts and were excluded for age determination of this sample. The weighted average of $^{206}Pb/^{238}U$ dates for the youngest two concordant fractions yielded an age of 171.77 ± 0.13 Ma (Fig. 5.8).

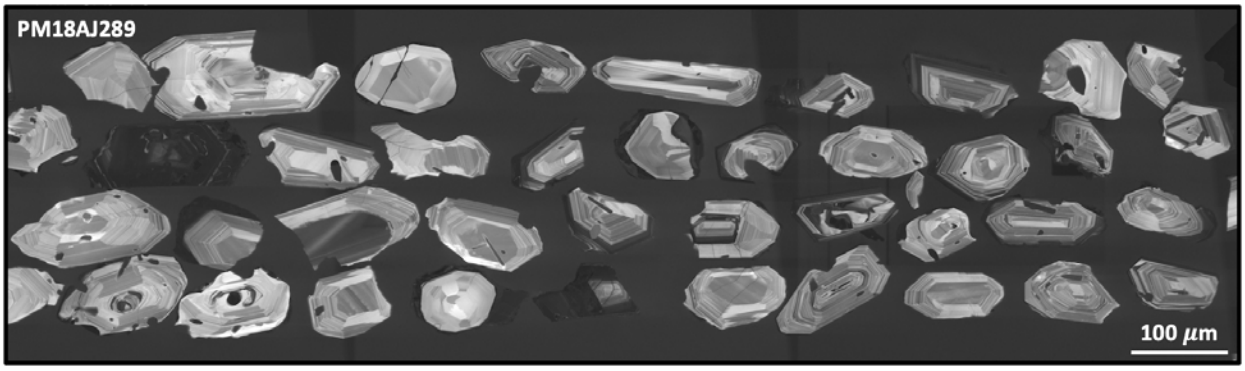


Figure 5.7. Representative cathodoluminescence image of zircon grains from sample PM18AJ289.

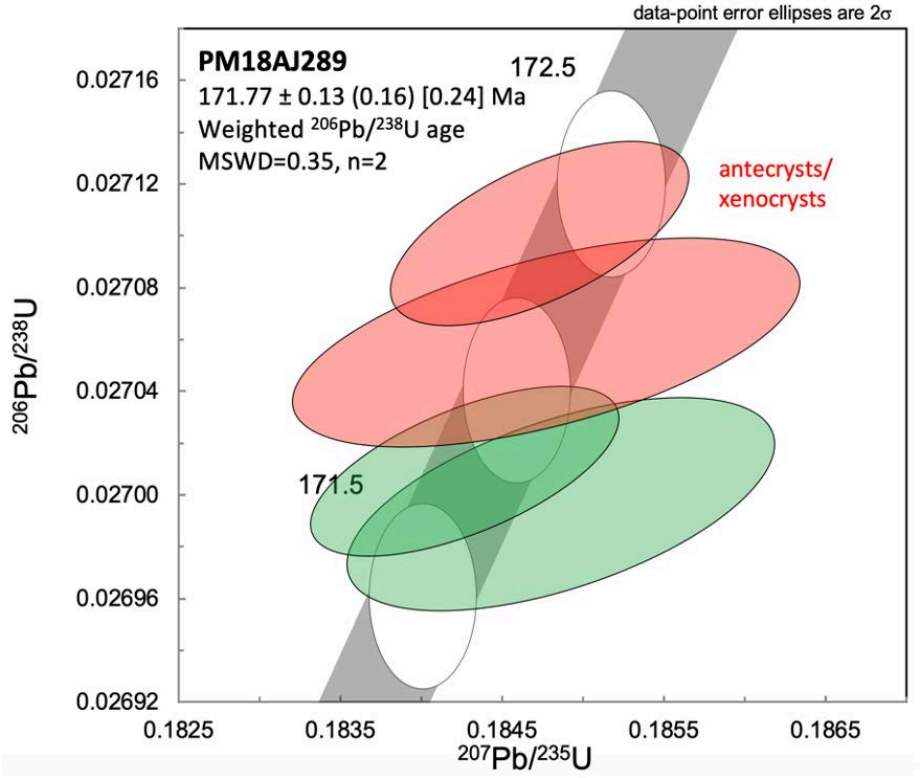


Figure 5.8. Concordia plot used for U-Pb age determination of sample PM18AJ289. Green ellipses represent zircon fractions used for determining U-Pb ages. Red ellipses represent zircon fractions interpreted as antecrysts and/or xenocrysts.

Quartz diorite (southern Wanakana pluton): Two samples of fine- to medium-grained quartz diorite (PM18AJ203 and PM18AJ248) were collected from the southwestern margin of the southern Wanakana pluton close to the Pemberton Hills lithocap. Despite their close spatial association to one another, sample PM18AJ248 exhibits a slightly coarser grain size than sample PM18AJ203. No obvious crosscutting relationships were observed between the multiple pulses of quartz diorite in the southern Wanakana pluton. Zircons from the quartz diorite sample PM18AJ248 are mostly fragmental, anhedral grains with irregular, often serrated boundaries. Euhedral, stubby to prismatic zircon grains with zoning are rare. The fragments may encompass the zircon core, mantle, and rim, or a combination of the above. The fragments that include parts of the zircon mantle are often zoned. The grains are generally ~100 μm in size and contain rare micro-inclusions. Zircons from the quartz diorite sample PM18AJ203 are generally fragments of anhedral to euhedral grains. The fragments can represent the core of the zircon, which generally exhibit a euhedral tabular habit, or contain parts of the core, mantle, and rim of a euhedral grain, or contain more anhedral parts of the mantle and/or rim. Zoning is almost always observed in fragments that contain parts of the mantle. The fragments in this sample commonly exceed 200 μm in size and contain rare hairline fractures. Representative suites of zircon grains from samples PM18AJ248 and PM18AJ203 are shown in Figure 5.9.

Four discordant zircon grains from sample PM18AJ248 and five discordant zircon grains from sample PM18AJ203 that yielded older ages have been interpreted to be antecrysts and/or xenocrysts and were excluded for age determinations. Reported ages for each sample are based on the youngest zircon grain analyzed, which generated ages of 172.01 ± 0.17 Ma for sample PM18AJ248 and 171.44 ± 0.25 Ma for sample PM18AJ203 (Fig. 5.10). The ages do not overlap

within error, suggesting the samples represent two discrete pulses of quartz diorite magma that were emplaced during the evolution of the quartz diorite pluton.

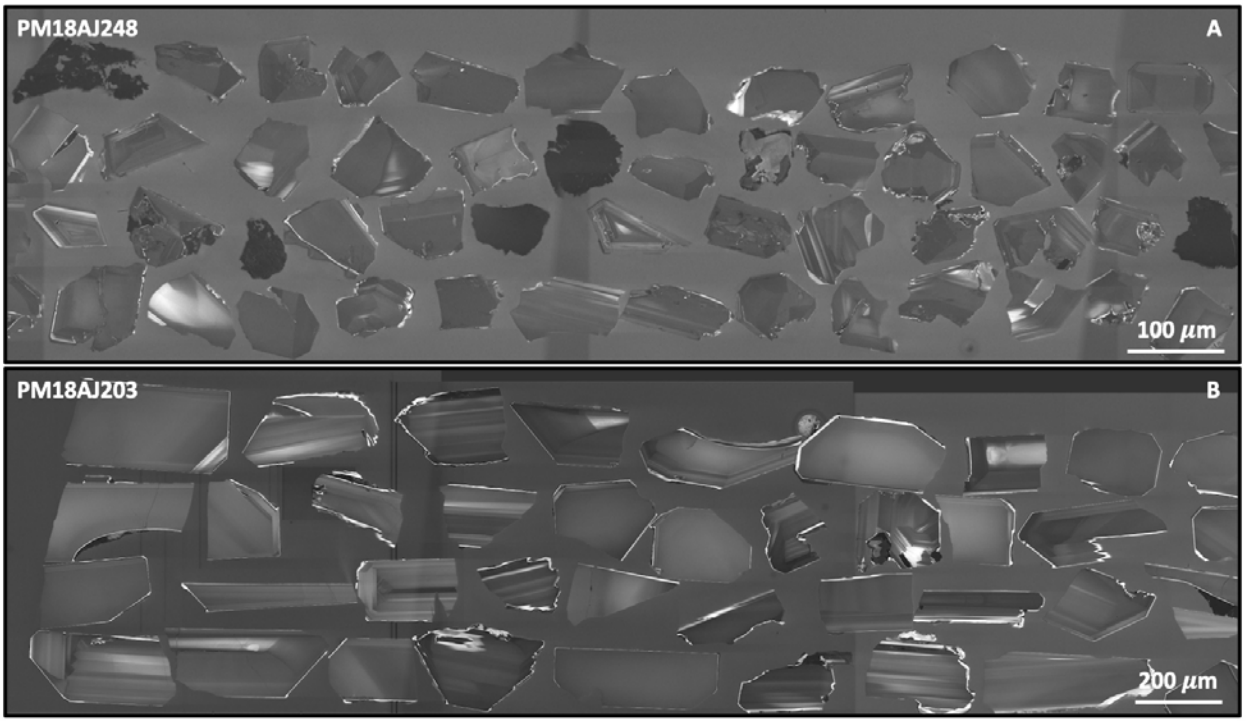


Figure 5.9. Representative cathodoluminescence images of zircon grains from samples PM18AJ248 (A) and PM18AJ203 (B).

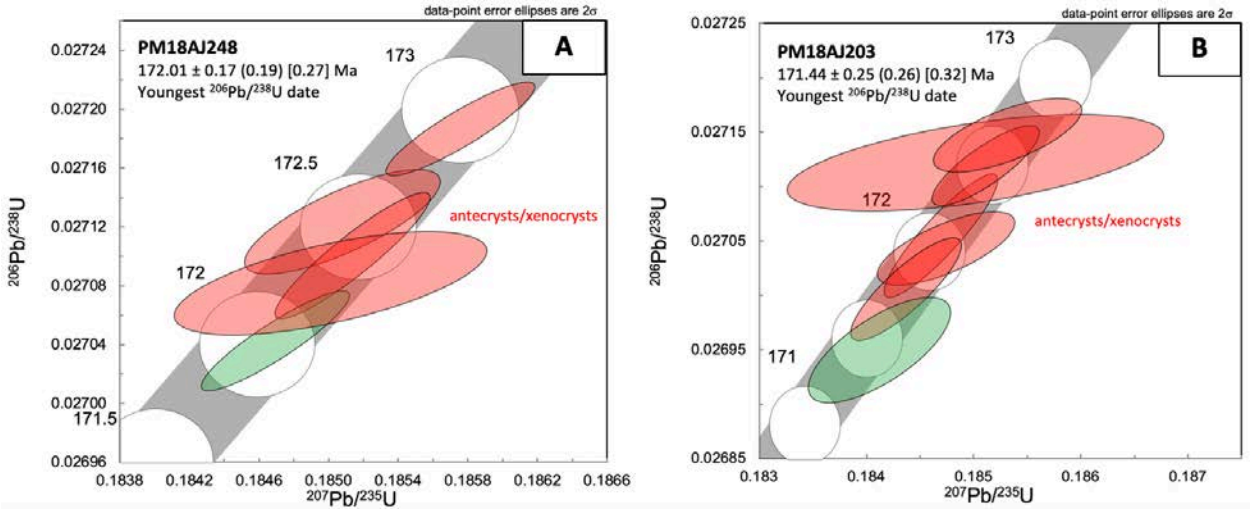


Figure 5.10. Concordia plots used for U-Pb ages determination of samples PM18AJ248 (A) and PM18AJ203 (B). Green ellipses represent zircon fractions used for determining U-Pb ages. Red ellipses represent zircon fractions interpreted as antecrysts and/or xenocrysts.

5.1.2.2 Epidote and garnet U-Pb geochronology (LA-ICP-MS)

Epidote Vein (Granodiorite): Sample PM18AJ274 was collected from an epidote-chlorite-calcite vein in granodiorite along the northwest margin of the northern Wanakana pluton. Attempts at dating epidote from additional samples were made, but the epidote from sample PM18AJ274 was the only epidote found to contain enough radiogenic Pb to generate any meaningful results This epidote vein was dated to try and constrain the timing of propylitic (epidote) alteration with respect to crystallization ages of the various intrusive units, as well as the ages of other alteration minerals observed across the property reported below. The epidote vein is ~2-3 cm thick and consists of mostly fine, well crystallized grains that were used for the U-Pb analysis, however there were also domains within the vein that contained extremely fine-grained to aphanitic and sub-microscopic epidote that were avoided (Fig. 5.11). The average U-Pb age collected from the epidote vein was 165.4 ± 4.1 Ma (Fig. 5.13; Appendix D). The age was calculated by plotting $^{207}Pb/^{206}Pb$ vs. $^{236}U/^{206}Pb$ values of 41 LA-ICP-MS spots from the epidote vein.

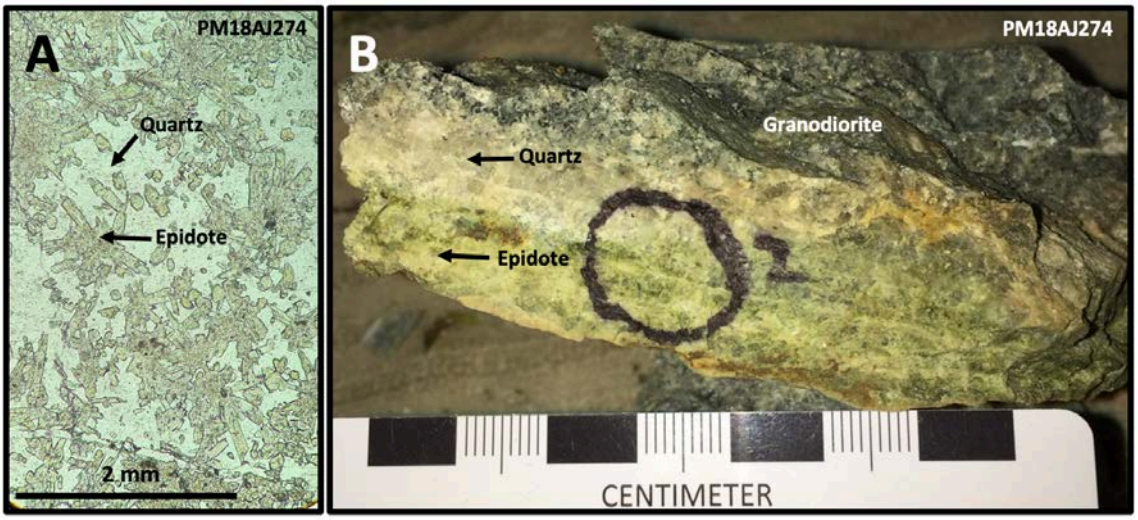


Figure 5.11. (A) Transmitted light photomicrograph (PPL) of epidote vein used for U-Pb geochronology; (B) Hand sample photograph of epidote vein in granodiorite used for U-Pb geochronology.

Andradite Garnet Vein (Porphyritic Andesite): Sample PM18AJ242 was collected from a garnet-epidote-calcite vein in porphyritic andesite on the southwestern side of the Pemberton Hills lithocap. Sample PM18AJ242 was collected to constrain the timing of this skarn-like alteration assemblage with respect to crystallization ages of the various intrusive units, as well as the ages of other alteration minerals observed across the property. The vein is primarily composed of calcite, epidote, quartz, and garnet with associated chlorite and pyrite (Fig. 5.12). The garnet is andraditic in composition, but does show some zoning with increasing Mn and Mg content towards the outer margin of the vein. No obvious changes in radiogenic Pb concentration were recorded between the inner and outer zones based on initial analyses using LA-ICP-MS. Efforts were made to only ablate the inner zone of the garnet, but given the larger spot sizes used (110 μm) to achieve a better result and the thin width of the garnet zones this was not possible for every spot. The average U-Pb age collected from the garnet vein was 170 ± 1.8 Ma (Fig. 5.13; Appendix E). The age was calculated by plotting the $^{207}Pb/^{206}Pb$ vs. $^{236}U/^{206}Pb$ values of 35 LA-ICP-MS spots on the garnet in the vein.

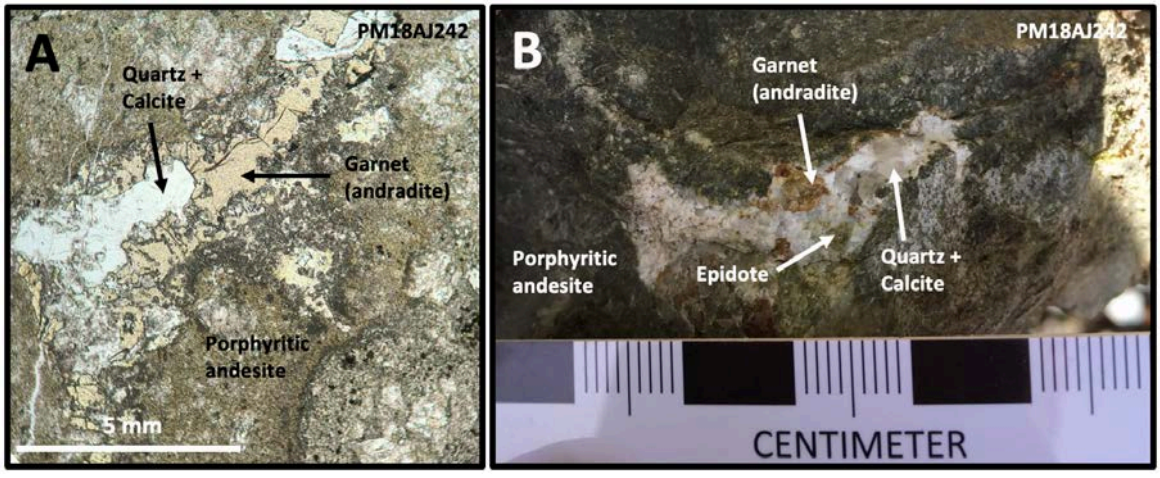


Figure 5.12. (A) Transmitted light photomicrograph (PPL) of garnet vein used for U-Pb geochronology; (B) Hand sample photograph of garnet vein in porphyritic andesite used for U-Pb geochronology.

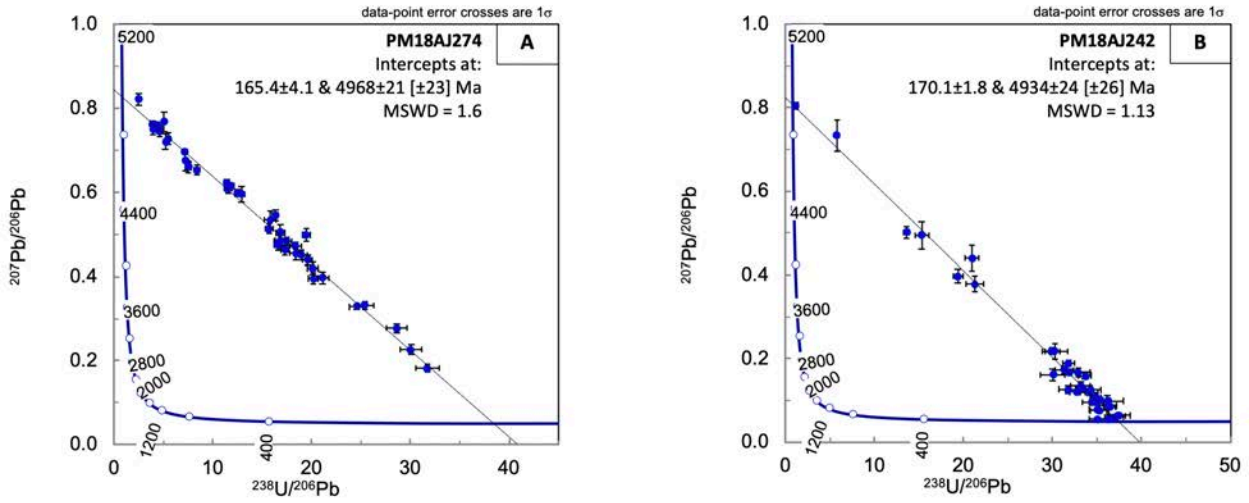


Figure 5.13. Concordia plots of U-Pb ages of epidote and garnet generated from samples (A) PM18AJ274 and (B) PM18AJ242, respectively.

5.1.3 Zircon geochemistry and Lu-Hf isotope analysis

Zircon major and trace element geochemistry as well as Lu-Hf isotope analysis was completed on zircon fractions from the four intrusive samples used for TIMS U-Pb geochronology (PM18AJ203, PM18AJ248, PM18AJ273, PM18AJ289). These analyses were completed in order to investigate the magmatic conditions during the crystallization of the intrusive units at Pemberton Hills and to provide insight into their primary sources. Additionally, Vancouver Island is an island arc emplaced into a Devonian-Triassic arc-oceanic plateau-carbonate succession, and as such represents a sequence that has formed on thick (>24 km) non-continental crust, providing an interesting geological setting to study the magmatic evolution of porphyry deposit-related intrusive suites (D'Souza et al., 2016).

5.1.3.1 Zircon trace element geochemistry

Zircon major and trace element data were collected for 24 grains of each of the four samples used for TIMS U-Pb geochronology for a total of 96 analyses. This was done to assist in the screening process in selecting grains suitable for Lu-Hf isotope analysis, but also to provide a

more robust data set for the interpretation of the magmatic evolution of various intrusive rocks at Pemberton Hills. The TIMS U-Pb geochronology study has placed tight age constraints on each of the four samples used in this study, which is beneficial when looking at the trace element data and correlative LA-MC-ICP-MS ages for each zircon. Three zircon crystals have been excluded from all trace element and rare earth plots based on strongly anomalous LA-MC-ICP-MS ages (PM18AJ289-17: 204.18 Ma; PM18AJ289-18: 121.72 Ma; and PM18AJ289-19: 138.84 MA) relative to the samples TIMS U-Pb age of 171.77 ± 0.16 Ma. Additionally, grains with concordances of under 95% are shown as open circles, and grains with concordances over 95% have been shown as solid circles with their respective sample colours. Zircon geochemical data for all elements analyzed including LA-MC-ICP-MS ages is presented in Appendix C.

The REE patterns of magmatic zircons from four intrusive samples normalized to C1 chondrite values are presented in Figure 5.14. All samples are characterized by a depletion in light rare earth elements (LREE) relative to heavy rare earth elements (HREE). Both quartz diorite samples (Fig. 5.14C, D) are tightly constrained and show pronounced Ce anomalies and moderately negative Eu anomalies. Patterns from the granodiorite and tonalite dyke samples (Fig. 5.14A, B) display fairly weak negative Eu anomalies and exhibit a wide range in LREE values, which results in nearly flat LREE patterns in some samples with weak positive Ce anomalies.

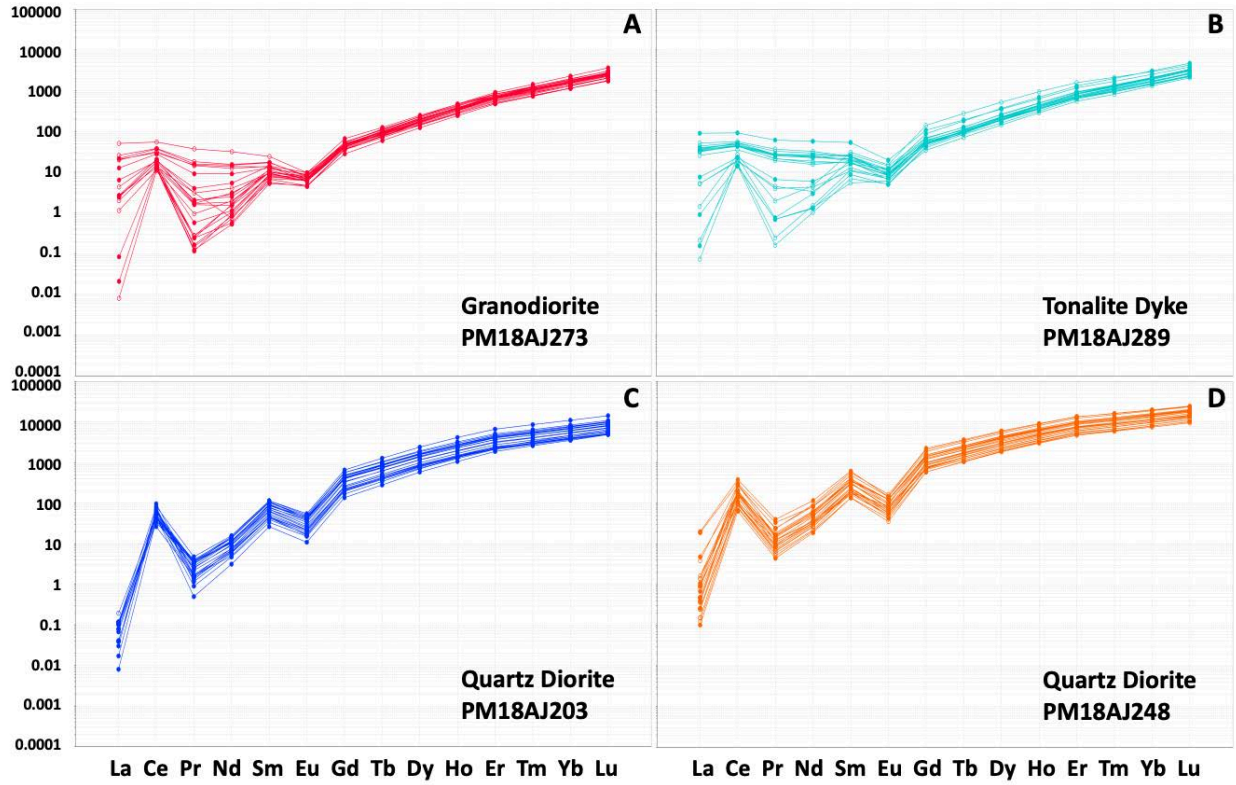


Figure 5.14. C1 chondrite-normalized REE plots of zircon grains from (A) granodiorite, (B) quartz diorite, (C) tonalite dyke, and (D) quartz diorite. Normalizing values from Sun and McDonough (1989). Closed circles correspond to zircon concordance > 95%, open circles correspond to zircon concordance < 95%.

5.1.3.2 Zircon Hf isotopes

The results of the zircon Lu-Hf isotope analyses of U-Pb dated grains and corresponding calculated parameters are presented in Tables 5.1 and 5.2. Table 5.1 contains Hf isotope data that has been calculated using the TIMS U-Pb ages known for each of the samples, and Table 2 contains Hf isotope data that has been re-calculated using the LA-MC-ICP-MS ages determined for the corresponding grain. Ten zircon grains were selected for each sample for Lu-Hf isotope analyses, however in the case of sample PM18AJ273, 16 grains were needed because six of the grains contained anomalously high $^{176}Yb/^{177}Hf$ values. This was also the case for all of the zircon grains analyzed for sample PM18AJ248, so no accurate Hf isotope data is available for this

sample. Given the high Yb values of all grains analyzed for PM18AJ248, only eight zircons ended up being tested instead of the standard ten.

The ten analyses obtained from zircons from the tonalite dyke sample (PM18AJ289) using TIMS U-Pb ages yielded $^{176}Yb/^{177}Hf$ and $^{176}Lu/^{177}Hf$ values of 0.02814 to 0.04941 and 0.00090 to 0.00155, respectively, with ∈Hf (t) values ranging from 10.5 to 11.6. For the granodiorite sample (PM18AJ273), using the TIMS U-Pb ages of the ten valid zircons yielded $^{176}Yb/^{177}Hf$ and $^{176}Lu/^{177}Hf$ values of 0.02155 to 0.04195 and 0.00066 to 0.00129, respectively, with ∈Hf (t) values ranging from 10.6 to 12.8. For the quartz diorite sample (PM18AJ203), using the TIMS U-Pb ages yielded $^{176}Yb/^{177}Hf$ and $^{176}Lu/^{177}Hf$ values of 0.07734 to 0.20123 and 0.00215 to 0.00548, respectively, with ∈Hf (t) values ranging from 8.9 to 10.6. Re-calculated ∈Hf (t) values of 10.6 to 11.7, 10.5 to 12.7, and 8.9 to 10.6 are reported for zircons from the tonalite dyke, granodiorite, and quartz diorite, respectively using the LA-ICP-MS ages.

Table 5.1. Zircon Lu-Hf data for intrusive rocks from the Pemberton Hills property using TIMS U-Pb ages.

Rock	Sample/spot	Age (Ma)	$^{176}Yb/^{177}Hf$	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$	1σ	εHf(0)	εHf(t)	T_{DM1} (Ma)	T_{DM2}(Ma)	$f_{Lu/Hf}$
tonalite dyke	PM18AJ289-06	171.77	0.02825	0.00090	0.28298	0.00001	7.4	11.1	383	509	-0.97
	PM18AJ289-07	171.77	0.03651	0.00114	0.28299	0.00001	7.6	11.3	377	497	-0.97
	PM18AJ289-08	171.77	0.03693	0.00126	0.28299	0.00001	7.8	11.4	372	488	-0.96
	PM18AJ289-10	171.77	0.04230	0.00134	0.28300	0.00001	8.0	11.6	362	472	-0.96
	PM18AJ289-11	171.77	0.02814	0.00090	0.28298	0.00001	7.3	11.0	385	513	-0.97
	PM18AJ289-12	171.77	0.03988	0.00132	0.28299	0.00001	7.7	11.4	374	490	-0.96
	PM18AJ289-13	171.77	0.04078	0.00125	0.28300	0.00001	7.9	11.5	366	478	-0.96
	PM18AJ289-16	171.77	0.04427	0.00153	0.28297	0.00001	6.9	10.5	409	544	-0.95
	PM18AJ289-22	171.77	0.04941	0.00155	0.28297	0.00001	7.1	10.7	400	530	-0.95
	PM18AJ289-24	171.77	0.04102	0.00140	0.28300	0.00001	7.9	11.5	367	479	-0.96
granodiorite porphyry	PM18AJ273-01	172.34	0.03280	0.00102	0.28297	0.00001	7.0	10.6	402	538	-0.97
	PM18AJ273-02	172.34	0.03383	0.00107	0.28301	0.00001	8.2	11.9	351	456	-0.97
	PM18AJ273-04	172.34	0.02155	0.00066	0.28300	0.00001	7.9	11.6	360	474	-0.98
	PM18AJ273-05	172.34	0.02797	0.00089	0.28301	0.00001	8.4	12.1	344	446	-0.97
	PM18AJ273-07	172.34	0.03224	0.00101	0.28298	0.00001	7.5	11.2	380	502	-0.97
	PM18AJ273-09 *	172.34	0.03850	0.00124	0.28297	0.00001	7.1	10.8	397	527	-0.96
	PM18AJ273-11 *	172.34	0.03221	0.00101	0.28299	0.00001	7.6	11.3	376	496	-0.97
	PM18AJ273-12 *	172.34	0.02858	0.00083	0.28297	0.00001	7.0	10.7	398	533	-0.97
	PM18AJ273-13 *	172.34	0.02437	0.00079	0.28301	0.00001	8.4	12.1	343	445	-0.98
	PM18AJ273-14	172.34	0.03278	0.00105	0.28297	0.00001	7.0	10.6	402	537	-0.97
	PM18AJ273-17 *	172.34	0.02814	0.00091	0.28304	0.00001	9.4	13.1	302	380	-0.97
	PM18AJ273-18	172.34	0.02436	0.00081	0.28303	0.00001	9.1	12.8	312	396	-0.98
	PM18AJ273-19	172.34	0.02898	0.00094	0.28300	0.00001	8.1	11.8	355	463	-0.97
	PM18AJ273-20	172.34	0.04195	0.00129	0.28298	0.00001	7.5	11.1	383	505	-0.96
	PM18AJ273-23 *	172.34	0.03097	0.00093	0.28300	0.00001	8.0	11.6	361	473	-0.97
	PM18AJ273-24	172.34	0.02291	0.00074	0.28298	0.00001	7.5	11.2	377	500	-0.98
quartz diorite	PM18AJ203-01	171.44	0.07734	0.00215	0.28297	0.00001	7.1	10.6	410	540	-0.94
	PM18AJ203-04	171.44	0.11984	0.00330	0.28297	0.00001	7.2	10.5	419	542	-0.90
	PM18AJ203-07	171.44	0.13981	0.00377	0.28296	0.00001	6.6	10.0	448	580	-0.89
	PM18AJ203-09	171.44	0.14809	0.00408	0.28295	0.00001	6.4	9.7	464	599	-0.88
	PM18AJ203-11	171.44	0.17535	0.00475	0.28293	0.00001	5.7	8.9	502	645	-0.86
	PM18AJ203-12	171.44	0.17785	0.00488	0.28294	0.00001	6.0	9.2	493	630	-0.85
	PM18AJ203-13	171.44	0.20123	0.00548	0.28294	0.00001	6.0	9.1	502	634	-0.83
	PM18AJ203-14	171.44	0.13181	0.00362	0.28293	0.00001	5.8	9.1	484	634	-0.89
	PM18AJ203-17	171.44	0.13879	0.00373	0.28293	0.00001	5.5	8.9	496	650	-0.89
	PM18AJ203-23	171.44	0.11815	0.00324	0.28295	0.00001	6.1	9.5	462	606	-0.90
quartz diorite	PM18AJ248-01 *	172.01	0.24540	0.00719	0.28289	0.00002	4.3	7.3	608	751	-0.78
	PM18AJ248-06 *	172.01	0.29779	0.00825	0.28295	0.00002	6.2	9.1	534	637	-0.75
	PM18AJ248-07 *	172.01	0.29937	0.00813	0.28297	0.00002	6.8	9.7	502	597	-0.76
	PM18AJ248-08 *	172.01	0.29968	0.00886	0.28285	0.00002	2.7	5.4	726	869	-0.73
	PM18AJ248-09 *	172.01	0.37956	0.01063	0.28280	0.00002	1.1	3.7	853	978	-0.68
	PM18AJ248-11 *	172.01	0.38371	0.00991	0.28280	0.00002	0.9	3.5	847	991	-0.70
	PM18AJ248-13 *	172.01	0.44481	0.01325	0.28270	0.00003	-2.7	-0.5	1170	1242	-0.60
	PM18AJ248-16 *	172.01	0.31021	0.00860	0.28282	0.00002	1.6	4.4	773	934	-0.74

* Denotes zircon grains excluded from Lu-Hf interpretation due to high Yb values.

Table 5.2. Zircon Lu-Hf data for intrusive rocks from the Pemberton Hills property using LA-ICP-MS U-Pb ages.

Rock	Sample/spot	Age (Ma)	$^{176}Yb/^{177}Hf$	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$	1σ	εHf(0)	εHf(t)	T_{DM1} (Ma)	T_{DM2}(Ma)	$f_{Lu/Hf}$
tonalite dyke	PM18AJ289-06	165.69	0.02825	0.00090	0.28298	0.00001	7.4	10.9	383	512	-0.97
	PM18AJ289-07	168.93	0.03651	0.00114	0.28299	0.00001	7.6	11.2	377	499	-0.97
	PM18AJ289-08	170.77	0.03693	0.00126	0.28299	0.00001	7.8	11.4	372	489	-0.96
	PM18AJ289-10	173.33	0.04230	0.00134	0.28300	0.00001	8.0	11.7	362	471	-0.96
	PM18AJ289-11	175.64	0.02814	0.00090	0.28298	0.00001	7.3	11.1	385	510	-0.97
	PM18AJ289-12	178.18	0.03988	0.00132	0.28299	0.00001	7.7	11.5	374	487	-0.96
	PM18AJ289-13	165.60	0.04078	0.00125	0.28300	0.00001	7.9	11.4	366	482	-0.96
	PM18AJ289-16	176.02	0.04427	0.00153	0.28297	0.00001	6.9	10.6	409	541	-0.95
	PM18AJ289-22	173.05	0.04941	0.00155	0.28297	0.00001	7.1	10.8	400	529	-0.95
	PM18AJ289-24	175.31	0.04102	0.00140	0.28300	0.00001	7.9	11.6	367	477	-0.96
granodiorite porphyry	PM18AJ273-01	165.67	0.03280	0.00102	0.28297	0.00001	7.0	10.5	402	542	-0.97
	PM18AJ273-02	167.34	0.03383	0.00107	0.28301	0.00001	8.2	11.8	351	459	-0.97
	PM18AJ273-04	164.38	0.02155	0.00066	0.28300	0.00001	7.9	11.4	360	479	-0.98
	PM18AJ273-05	167.66	0.02797	0.00089	0.28301	0.00001	8.4	12.0	344	449	-0.97
	PM18AJ273-07	173.61	0.03224	0.00101	0.28298	0.00001	7.5	11.2	380	502	-0.97
	PM18AJ273-09 *	163.03	0.03850	0.00124	0.28297	0.00001	7.1	10.6	397	533	-0.96
	PM18AJ273-11 *	167.88	0.03221	0.00101	0.28299	0.00001	7.6	11.2	376	498	-0.97
	PM18AJ273-12 *	160.12	0.02858	0.00083	0.28297	0.00001	7.0	10.4	398	540	-0.97
	PM18AJ273-13 *	167.58	0.02437	0.00079	0.28301	0.00001	8.4	12.0	343	448	-0.98
	PM18AJ273-14	164.64	0.03278	0.00105	0.28297	0.00001	7.0	10.5	402	542	-0.97
	PM18AJ273-17 *	163.78	0.02814	0.00091	0.28304	0.00001	9.4	12.9	302	385	-0.97
	PM18AJ273-18	164.11	0.02436	0.00081	0.28303	0.00001	9.1	12.7	312	400	-0.98
	PM18AJ273-19	171.80	0.02898	0.00094	0.28300	0.00001	8.1	11.8	355	463	-0.97
	PM18AJ273-20	169.76	0.04195	0.00129	0.28298	0.00001	7.5	11.1	383	507	-0.96
	PM18AJ273-23 *	178.34	0.03097	0.00093	0.28300	0.00001	8.0	11.8	361	469	-0.97
	PM18AJ273-24	165.97	0.02291	0.00074	0.28298	0.00001	7.5	11.1	377	503	-0.98
quartz diorite	PM18AJ203-01	172.04	0.07734	0.00215	0.28297	0.00001	7.1	10.6	410	539	-0.94
	PM18AJ203-04	171.22	0.11984	0.00330	0.28297	0.00001	7.2	10.5	419	542	-0.90
	PM18AJ203-07	170.01	0.13981	0.00377	0.28296	0.00001	6.6	9.9	448	580	-0.89
	PM18AJ203-09	171.67	0.14809	0.00408	0.28295	0.00001	6.4	9.7	464	598	-0.88
	PM18AJ203-11	170.16	0.17535	0.00475	0.28293	0.00001	5.7	8.9	502	645	-0.86
	PM18AJ203-12	170.56	0.17785	0.00488	0.28294	0.00001	6.0	9.2	493	630	-0.85
	PM18AJ203-13	173.77	0.20123	0.00548	0.28294	0.00001	6.0	9.2	502	633	-0.83
	PM18AJ203-14	170.61	0.13181	0.00362	0.28293	0.00001	5.8	9.1	484	634	-0.89
	PM18AJ203-17	171.89	0.13879	0.00373	0.28293	0.00001	5.5	8.9	496	650	-0.89
	PM18AJ203-23	173.67	0.11815	0.00324	0.28295	0.00001	6.1	9.6	462	605	-0.90
quartz diorite	PM18AJ248-01 *	176.11	0.24540	0.00719	0.28289	0.00002	4.3	7.4	608	750	-0.78
	PM18AJ248-06 *	170.02	0.29779	0.00825	0.28295	0.00002	6.2	9.0	534	638	-0.75
	PM18AJ248-07 *	172.36	0.29937	0.00813	0.28297	0.00002	6.8	9.7	502	597	-0.76
	PM18AJ248-08 *	168.99	0.29968	0.00886	0.28285	0.00002	2.7	5.4	726	870	-0.73
	PM18AJ248-09 *	166.65	0.37956	0.01063	0.28280	0.00002	1.1	3.6	853	979	-0.68
	PM18AJ248-11 *	163.47	0.38371	0.00991	0.28280	0.00002	0.9	3.4	847	993	-0.70
	PM18AJ248-13 *	167.52	0.44481	0.01325	0.28270	0.00003	-2.7	-0.5	1170	1242	-0.60
	PM18AJ248-16 *	164.56	0.31021	0.00860	0.28282	0.00002	1.6	4.3	773	936	-0.74

* Denotes zircon grains excluded from Lu-Hf interpretation due to high Yb values

5.2 Discussion

5.2.1 Whole-rock geochemistry

The Pemberton Hills property is characterized by strong hydrothermal alteration (i.e., potassic, phyllic, propylitic, argillic) in essentially all rock types. Consequently, it is necessary to assess the degree of element mobility in the element variation plots. In plots of SiO_2 vs. K_2O and Na_2O (Fig. 5.15A, B), discrimination of mafic to felsic rock types based on increasing K_2O and Na_2O with SiO_2 values is possible, but there is considerable scatter on both plots. Samples with loss on ignition (LOI) values of >3.5% display lower values of the relatively mobile K_2O and Na_2O than the less altered samples with LOI values of <3.5%. These elements are commonly used on rock classification diagrams (i.e., total alkali-silica (TAS) diagrams), but given the mobility suggested here, they cannot be applied to Pemberton Hills rocks.

In contrast, plots of SiO_2 vs. relatively immobile TiO_2 and Al_2O_3 show less scatter and display a relatively tight trend of decreasing Al_2O_3 and TiO_2 with increasing SiO_2, except for the mafic volcanic rocks, which show the opposite correlation (Fig. 5.16A, B). Samples with LOI values >3.5% exhibit greater scatter than the less altered samples. Crawford et al. (2007) proposed using a plot of P_2O_5/Al_2O_3 vs. K_2O/Al_2O_3 as an alternative classification diagram for volcanic arc rocks as it uses fewer mobile elements (Fig. 5.17). On this plot, most samples from Pemberton Hills lie within the upper limit of the medium-K calc-alkaline trend with some overlap into the high-K calc-alkaline series.

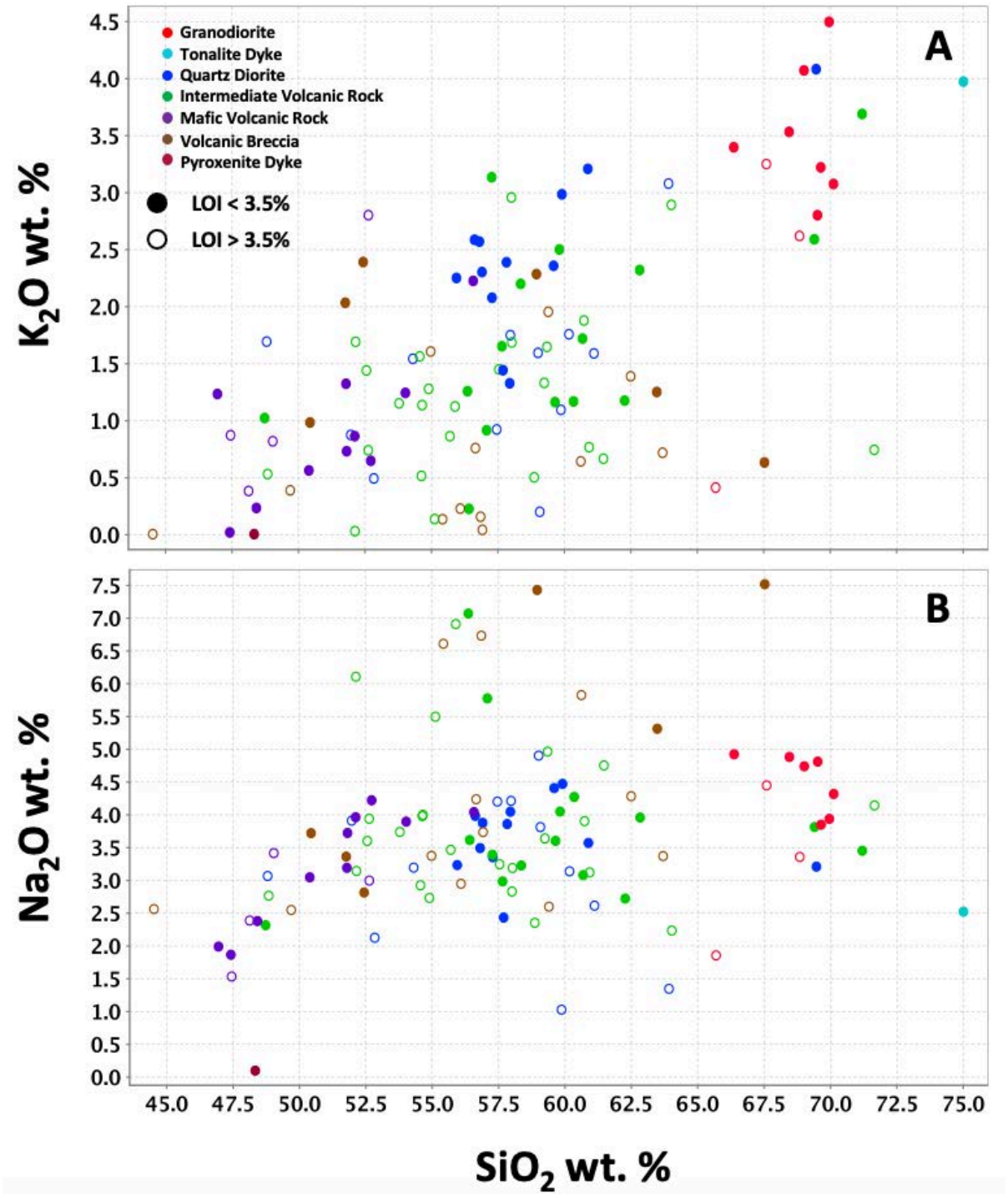


Figure 5.15. K_2O and Na_2O variation diagrams for samples from the Pemberton Hills property. Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

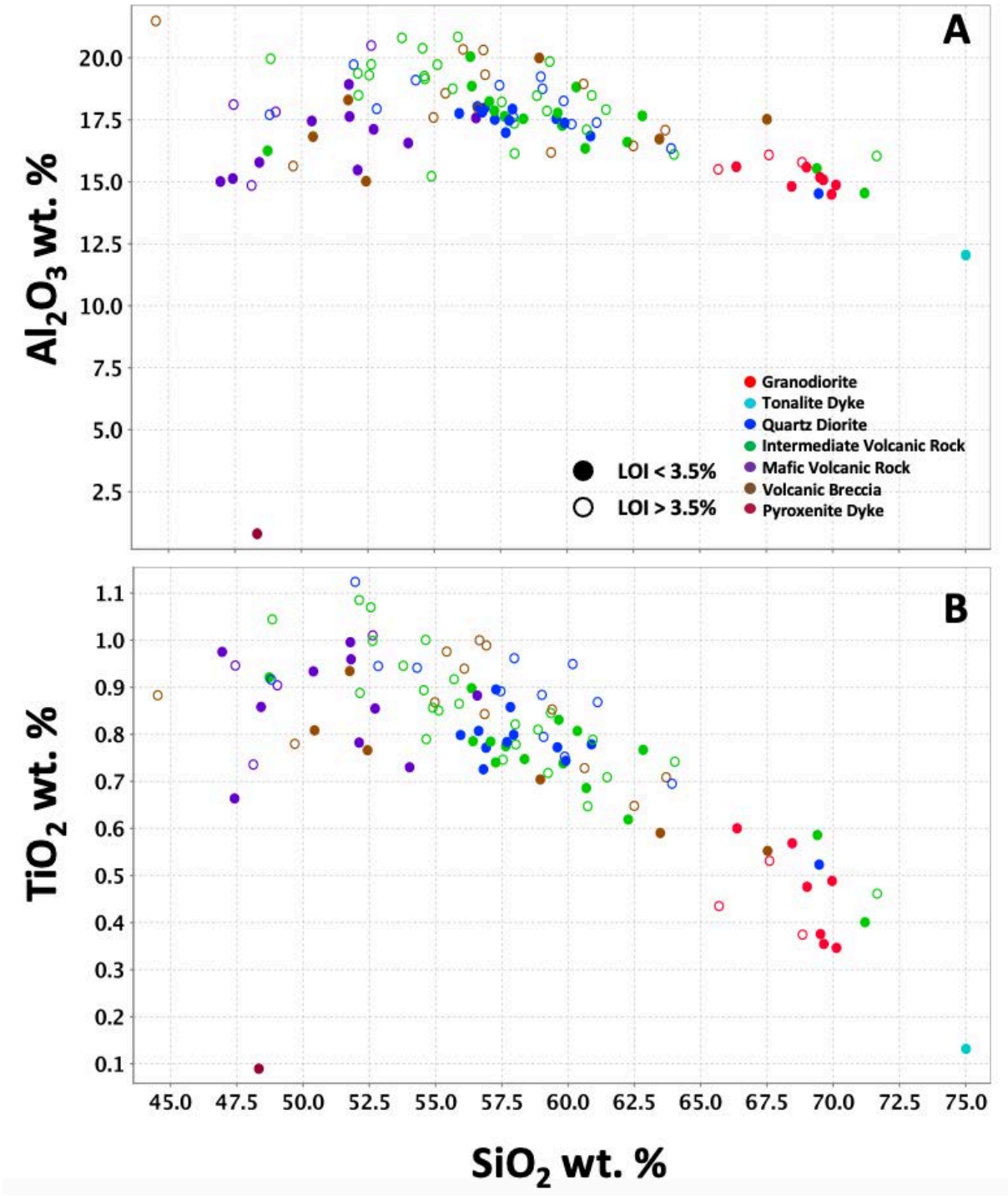


Figure 5.16. Al_2O_3 and TiO_2 variation diagrams for samples from the Pemberton Hills property. Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

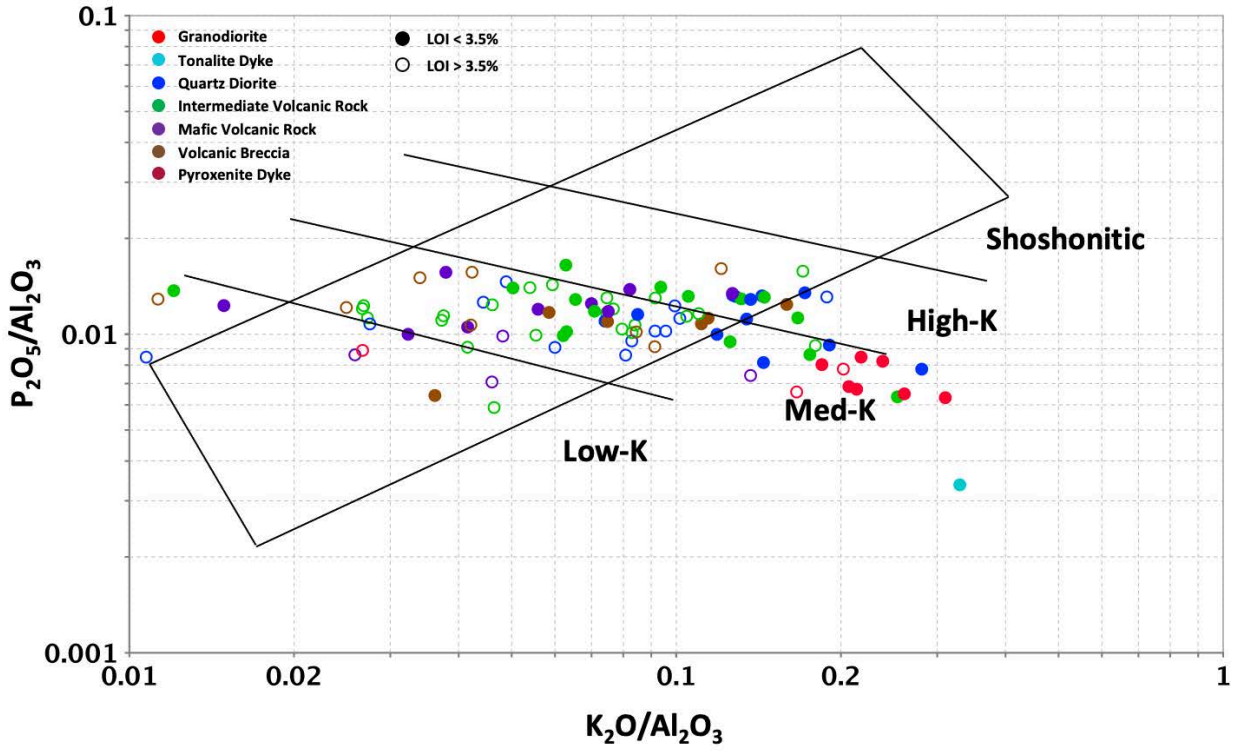
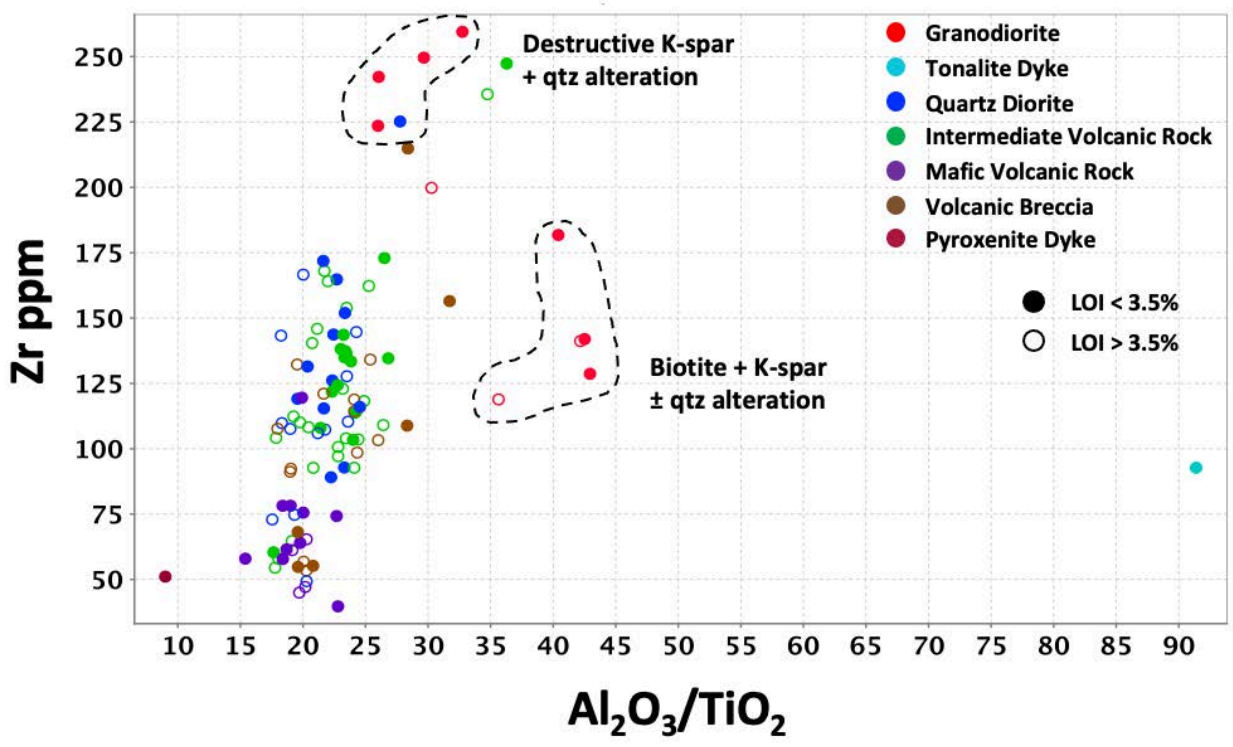


Figure 5.17. Plot of P_2O_5/Al_2O_3 vs. K_2O/Al_2O_3 for samples from the Pemberton Hills property. Box represents compositions of modern lavas from the Vanuatu and Sundra arcs. Fields from Crawford et al. (2007). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

There is a distinction between mafic, intermediate, and felsic rock types illustrated in the plot of Zr versus Al_2O_3/TiO_2 (Fig. 5.18). Two sub-populations of granodiorite can be identified; one with high Zr values above ~225 ppm and moderately high Al_2O_3/TiO_2 values between ~25 – 35, and the other with moderate Zr values of between ~125 – 150 ppm, and high Al_2O_3/TiO_2 values of between ~35 – 45 (outlined in Fig. 5.18). The sub-population with relatively lower Zr values is characterized by abundant shreddy biotite as the dominant potassic alteration mineral with lesser secondary potassium feldspar. The other sub-population defined by high Zr is characterized by destructive potassium feldspar and quartz alteration, predominantly in the form of micrographic texture, confirmed by HF staining that highlights pervasive potassium feldspar

alteration in these samples (examples shown in Fig. 4.14). These samples were all mainly taken along the western and southwestern margin of the northern Wanakana pluton.

It is acknowledged that the granodiorite sub-population with elevated Zr could represent rocks of primary syenitic composition. However, this is difficult to reconcile with given that no such rock types have been reported in the literature for the Island Plutonic Suite. Furthermore, that the one sample taken from the southern Wanakana quartz diorite pluton also displays pervasive potassium feldspar alteration also contains elevated Zr values suggests that this is a feature related to intense potassic alteration and not differentiation of alkalic magma, supported by the calc-alkalic magmatic differentiation trend that demonstrates a progression from granodiorite to tonalite compositions (Fig. 5. 19).



Plot 5.18. Plot of Zr vs. Al_2O_3 for samples from the Pemberton Hills property. Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

Immobile elements such as Zr, Al, and Ti provide the best means of evaluating the magmatic evolution of most lithologies from the study site. Loucks (2014) suggested that Cu-ore-forming intrusions are end members of a calc-alkalic igneous differentiation trend, representing compositions that are considerably more aluminous than infertile or unproductive intrusions. This is exemplified by using a plot of Al_2O_3/TiO_2 versus SiO_2 (Fig. 5.19). Loucks (2014) suggests that at higher dissolved H_2O contents and/or elevated total pressure, typical crystallization sequences involving plagioclase, titanomagnetite, and hornblende can become disrupted, resulting in early hornblende fractionation and suppression of plagioclase crystallization. This drives an initially tholeiitic, parental basaltic magma to differentiate by crystal-liquid separation, corresponding to increasing Al_2O_3/TiO_2 as the differentiation trend continues. Samples from Pemberton Hills show a positive correlation between Al_2O_3/TiO_2 and SiO_2 that corresponds to a compositional evolution from mafic to felsic rock types, with mafic volcanic rocks displaying the lowest Al_2O_3/TiO_2 and SiO_2 values and felsic plutonic rocks showing the highest Al_2O_3/TiO_2 and SiO_2 values (Fig. 5.19). There is an increase in Al_2O_3/TiO_2 ratios in the tonalite dyke and granodiorite samples relative to the intermediate and mafic rocks, implying that these rocks were derived from melts that underwent early amphibole fractionation (Loucks, 2014).

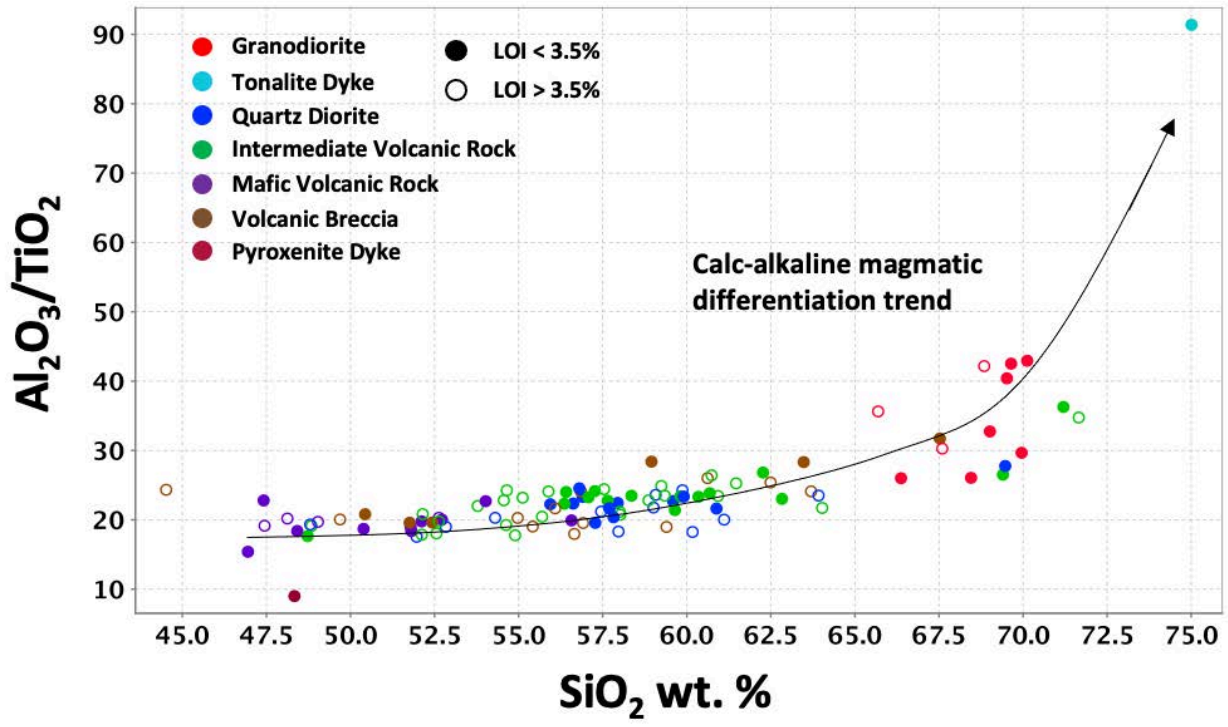


Figure 5.19. Plot of Al_2O_3 vs. TiO_2 for samples from the Pemberton Hills property. Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

5.2.2 Magma fertility

Richards et al. (2012) described many of the key precursor tectonomagmatic processes as well as compositional and mineralogical characteristics of porphyry deposit-related rocks that are reflected in the geochemistry of fertile or mineralizing arc magmas. Fertile intrusions are: (1) mainly evolved, medium- to high-K, calc-alkaline andesites-dacites or diorites-granodiorites; (2) often contain hornblende and/or biotite phenocrysts that act as a proxy for high magmatic water contents (>4 wt. % H_2O); (3) early fractionation of hornblende from arc magmas will preferentially deplete the magma in MREE-HREE and Y, producing listric-shaped REE patterns and low Y and Yb concentrations that decrease with increasing SiO_2 (Romick et al., 1992; Davidson et al., 2007; Rooney et al., 2011); (4) suppression of plagioclase due to high magmatic water content generates elevated Sr/Y values that only begin to decrease in felsic magmas (Moore and

Carmichael, 1998; Müntener et al., 2001); and (5) the culmination of these conditions results in porphyry-related rocks characterized by relatively high Sr/Y and La/Yb ratios. Although high Sr/Y ratios are often interpreted to be the result of plagioclase suppression due to high magmatic water contents of the magma, this same result may be also be achieved by/combined with high crystallizing pressures of ~1 GPa that can also suppress plagioclase fractionation and promote amphibole crystallization at depth (Moore and Carmichael, 1998; Müntener et al., 2001; Richards and Kerrich, 2007; Richards et al., 2012; Loucks, 2014).

Loucks (2000) proposed that Sr/Y values will increase as hornblende fractionation proceeds and plagioclase crystallization is suppressed in hydrous mafic-to-felsic magmatic differentiation series, whereas Sr/Y ratios may remain flat or decline with increasing SiO_2 in less hydrous mafic-to-felsic differentiation series. A later compilation by Loucks (2014) of 135 magmas parental to magmatic-hydrothermal copper ore deposits at convergent plate margins occurring throughout the Phanerozoic identified that samples with Sr/Y > 35 at 57 – 70 wt. % SiO_2 could be considered Cu-fertile with Au-poor or low grade, sub-economic prospects plotting almost entirely at Sr/Y < 40. Most samples from Pemberton Hills show decreasing Sr/Y as they evolve from mafic (Sr/Y of ~30 – 40) to intermediate (Sr/Y of ~5 – 35) to felsic (Sr/Y of ~5.5 – 23) compositions, with the biotite altered granodiorite and tonalite dyke samples plotting at slightly higher Sr/Y ratios (~15 – 23) than the pervasively potassium-feldspar altered granodiorite samples (5.5 – 10; Fig. 5.20). Based on these criteria illustrated by the fields shown in Figure 5.20, all rock types from Pemberton Hills would be considered non-Cu-fertile rocks. However, the degree of alteration in these samples illustrated in Figure 5.20 suggests that this method may be unreliable.

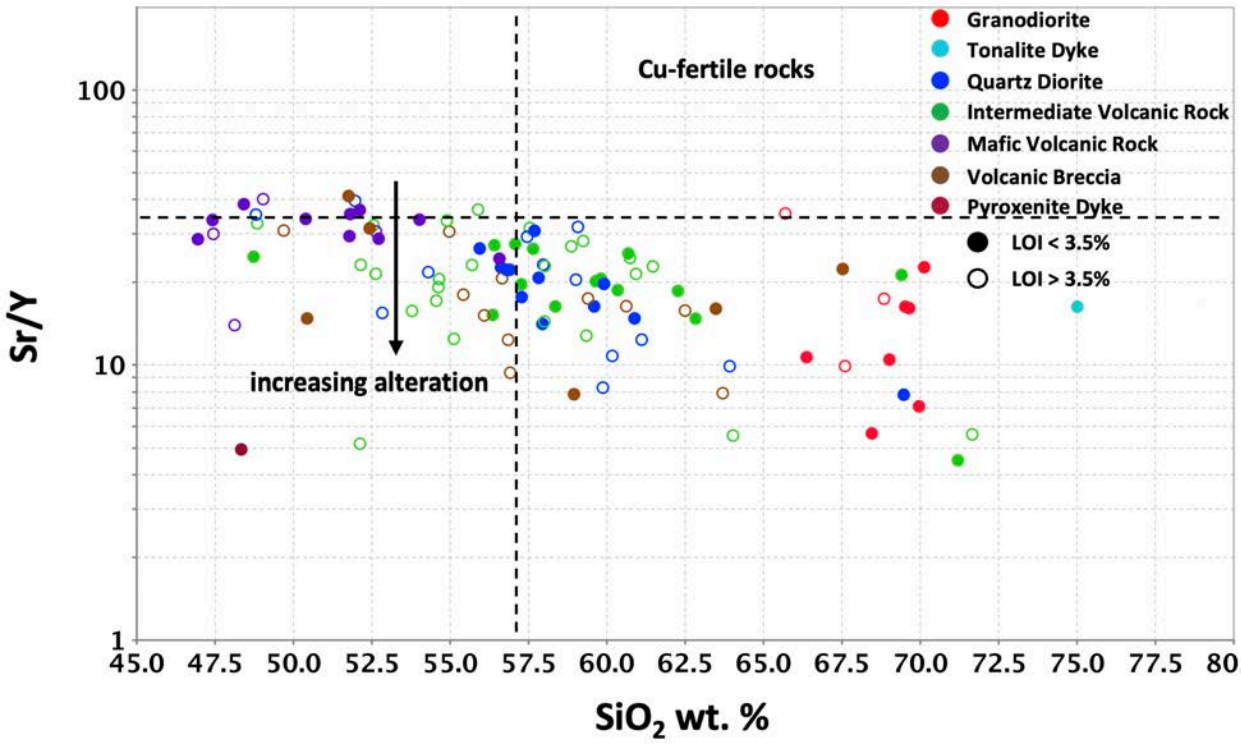


Figure 5.20. Plot of Sr/Y vs. SiO_2 for samples from the Pemberton Hills property. Dotted lines represent boundaries of prospectivity fields from Loucks (2014). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

Loucks (2014) has shown V/Sc to be an alternative and effective means of discriminating porphyry-ore-forming intrusions from apparently barren, typical volcanic and hypabyssal andesites, dacites, and rhyolites in circum-Pacific Neogene-Quaternary arcs. While both Sc and V are relatively incompatible elements, the speciation and partition coefficient for V largely depend on fO_2 (Lindstrom, 1976; Canil, 1999; Canil and Fedortchouk, 2000). At an oxygen fugacity of NNO-3, the oxidation state of V changes from mainly V^{3+} to V^{4+}, and also exhibits a decrease in $D\nu^{silicate/melt}$ (Lindstrom, 1976; Canil, 1999; Canil and Fedortchouk, 2000). The partition coefficient for V^{4+} is also an order of magnitude higher in titanomagnetite than it is in silicates and so higher V/Sc ratios can thus potentially be attributed to an elevated oxidation state and dissolved H_2O content and/or pressure of the magma (Lindstrom, 1976; La Tourette et al., 1991).

This results in the incompatible behaviour of V^{4+} and incorporation of Sc, Fe^{2+} and Fe^{3+} into hornblende (± minor clinopyroxene) at the expense of titanomagnetite (Loucks, 2014).

Loucks (2014) determined that samples with V/Sc > 10 at 58 – 70 wt. % SiO_2 are prospective for large Cu (± Au) deposits. However, Loucks (2014) also notes that many of the parental magmas to the major Au-Cu deposits have lower V/Sc ratios that plot within the range of scatter of apparently barren intrusive suites in the plot of V/Sc versus SiO_2. Based on these criteria illustrated by the fields shown in Figure 5.20, rocks of mafic and intermediate composition at Pemberton Hills would almost all be considered un-prospective and felsic plutonic rocks would be weakly prospective. The relatively low V/Sc ratios of the granodiorite samples could be the result of Fe-Ti oxide fractionation at depth. This is consistent with the strong listric REE patterns of the granodiorite samples that have also been noted in many porphyry-related arc rocks in southwestern North America to imply amphibole and Fe-Ti oxide fractionation at depth in magmas with high water contents (Fig. 5.2; Lang and Titley, 1998; Richards et al., 2001; Leveille and Stegen, 2012). This provides a reasonable explanation for the higher V/Sc ratios observed in the intermediate plutonic and volcanic rocks compared to felsic plutonic rocks at Pemberton Hills, and suggests that V/Sc may not be an appropriate metric to evaluate these magmas.

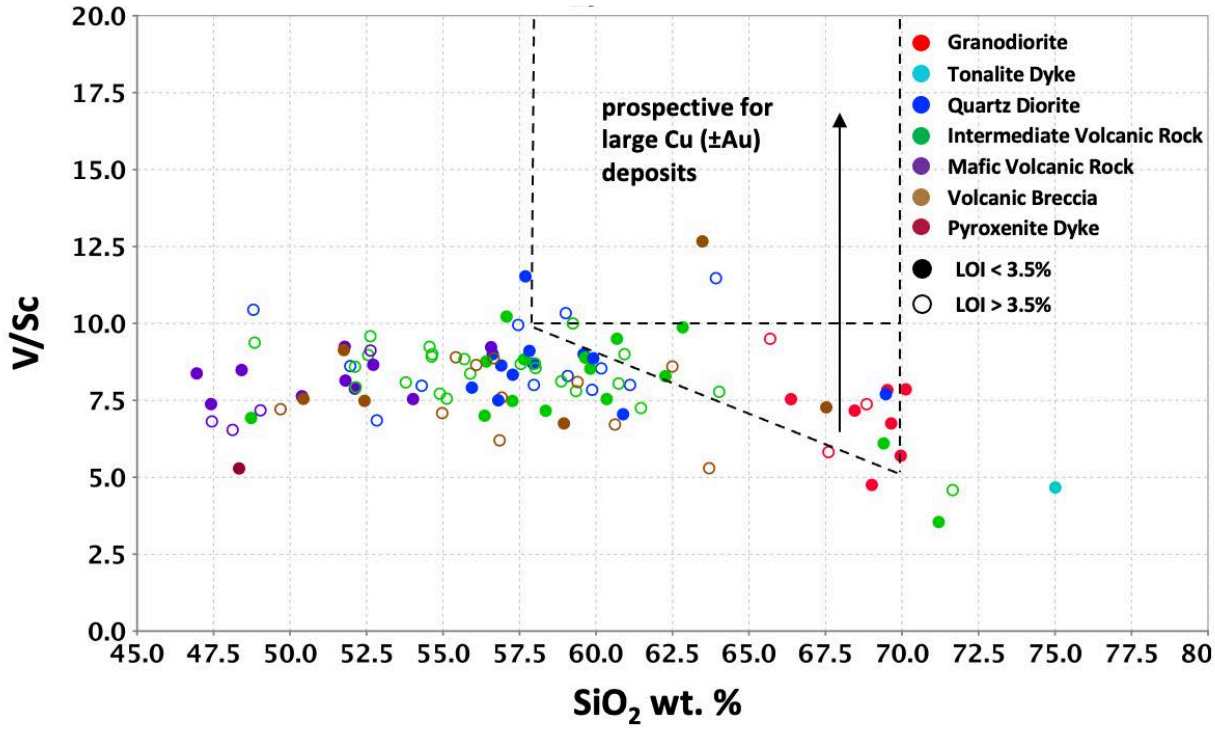


Figure 5.21. Plot of V/Sc vs. SiO_2 for samples from the Pemberton Hills property. Dotted lines represent mineralized reference suite from Loucks (2014). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

5.2.3 Geochronology

In order to fully assess the timing of potentially causative magmatism, mineralization, and alteration, a geochronology study has been completed across the Pemberton Hills property in both the epithermal and porphyry environments, which is schematically illustrated in Figure 5.22 and tabulated in Table 5.3. The new high-precision CA-TIMS U-Pb dating of zircons from four plutonic samples provides maximum emplacement ages for the quartz diorite, granodiorite, and tonalite dyke. Re-Os dating of molybdenite (Hamilton, in prep) records the timing of hydrothermal mineralization, in-situ LA-ICP-MS U-Pb dating of epidote and garnet records the timing of propylitic- and skarn-related hydrothermal alteration, respectively, and ^{40}Ar-^{39}Ar dating

of alunite (Hamilton, in prep) records the timing of advanced argillic alteration. This chapter focuses on the high-precision U-Pb dating of zircons from the four plutonic samples.

Table 5.3. Summary of new geochronology from this study and the study by Hamilton (in prep).

	Sample	Rock Type	Mineral Used	Method	Age Determination (Ma)
*	PM18AJ273	Granodiorite	Zircon	U-Pb (CA-TIMS)	172.34 ± 0.11 (0.14) [0.23]
**	PM18PH026	Lithocap	Molybdenite	Re-Os	172.3 ± 0.8
*	PM18AJ248	Quartz Diorite	Zircon	U-Pb (CA-TIMS)	172.01 ± 0.17 (0.19) [0.27]
*	PM18AJ289	Tonalite Dyke	Zircon	U-Pb (CA-TIMS)	171.77 ± 0.13 (0.16) [0.24]
*	PM18AJ203	Quartz Diorite	Zircon	U-Pb (CA-TIMS)	171.44 ± 0.25 (0.26) [0.32]
	PM18AJ242	Andesite	Garnet	U-Pb (LA-ICP-MS)	170.1 ± 1.8
**	PM18PH032	Lithocap	Alunite	Ar-Ar	166.2 ± 0.3
**	PM18PH065	Lithocap	Alunite	Ar-Ar	166.7 ± 0.3
**	PM18PH053	Lithocap	Alunite	Ar-Ar	167.1 ± 0.7
	PM18AJ274	Granodiorite	Epidote	U-Pb (LA-ICP-MS)	165 ± 4.1

* The first set of errors should be used for comparison with the other U-Pb age determinations using CA-TIMS; the second set of errors in the parentheses should be used for comparison with the other U-Pb age determinations not using CA-TIMS (i.e., LA-ICP-MS); the third set of errors in the square brackets should be used for comparison with age determinations from the other radiometric decay systems (i.e., Ar-Ar, Re-Os).
**Data from Hamilton (in prep).

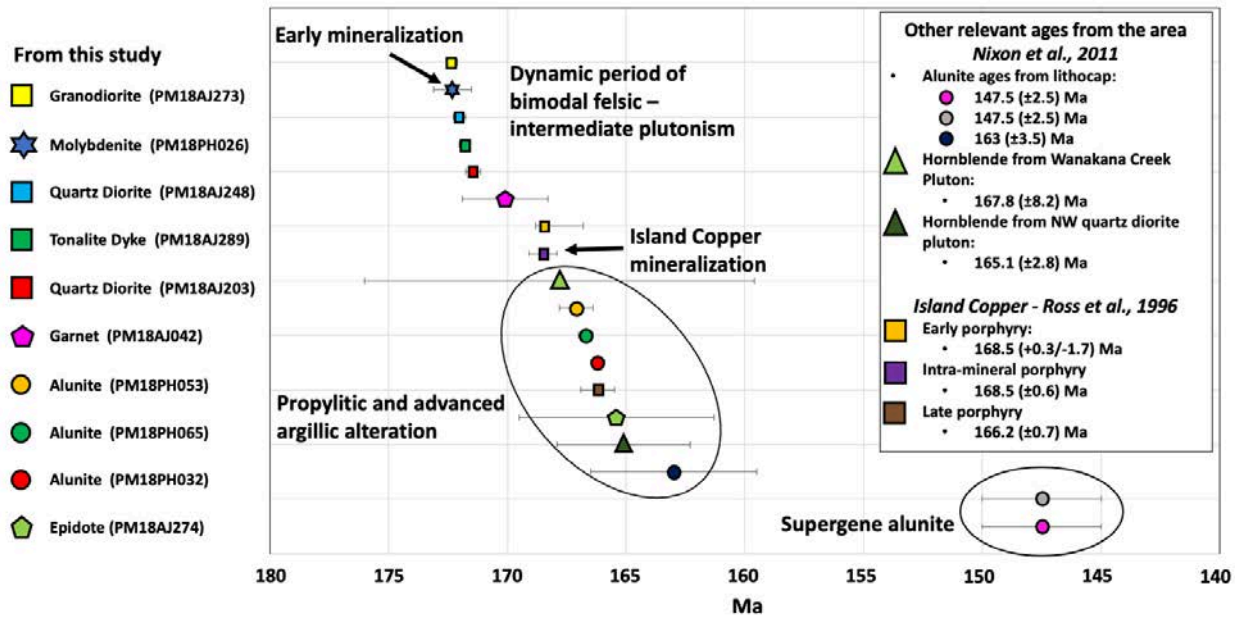


Figure 5.22. Geochronology summary of various rocks, mineralization and alteration from the Pemberton Hills region. Data are from this study and Nixon et al. (2011a, b).

Newly reported zircon U-Pb ages of two quartz diorite samples from the southern Wanakana pluton, as well as granodiorite and tonalite dyke samples from the northern Wanakana pluton constrain the timing of emplacement and crystallization of felsic and intermediate plutonism within a maximum range of ~1.26 m.y. from 172.34 ± 0.11 to 171.44 ± 0.25 Ma. Granodiorite sample PM18AJ273 from the northern Wanakana pluton is the oldest intrusive unit dated at 172.34 ± 0.11 Ma. Following this is an age of 172.01 ± 0.17 Ma for the quartz diorite sample PM18AJ248 from the southern Wanakana pluton, which overlaps with tonalite dyke sample PM18AJ289 (171.77 ± 0.13 Ma) from the northern Wanakana pluton. The quartz diorite sample PM18AJ203 has the youngest reported age at 171.44 ± 0.25 Ma. These results suggest that felsic plutonism in the northern Wanakana pluton began with crystallization of granodiorite material and evolved to more felsic compositions over time, consistent with the presence of the late-stage tonalite dyke and cross cutting relationships in the field. The ages of the granodiorite and tonalite dyke imply that felsic plutonism was occurring for a minimum of ~0.33 m.y. to a maximum of ~0.8 m.y. However, it is evident that following crystallization of granodiorite, discrete intermediate plutonism in the southern Wanakana pluton was also an ongoing process for a minimum of ~0.15 m.y. to a maximum of ~1.0 m.y. that likely overlapped with the emplacement of the tonalite dyke. Although the quartz diorite samples are within ~300m of each other, they are texturally distinct with a coarser grain size in sample PM18AJ248 relative to sample PM18AJ203. This, combined with ages that do not overlap within error suggests that these samples were emplaced as discrete pulses of magma.

Prior to this study, limited geochronology work had been carried out at the Pemberton Hills study site. Age dates for a number of different minerals (i.e., zircon, hornblende, alunite)

taken from various plutonic and volcanic rocks from across the Pemberton Hills region can be found on BCGS maps published by Nixon et al. (2011a-e), however, many of these ages carry significant errors and have very limited geological context. Nixon et al. (2011a) reported Ar-Ar age dates of 147.5 ± 2.5, 147.5 ± 2.5, and 163 ± 3.5 Ma from three samples of alunite from the Pemberton Hills rhyolite (also referred to as the Pemberton Hills lithocap). Uranium-Pb age dates of 169.3 ± 0.4 and 167.1 ± 0.2 Ma were reported for zircon grains from the Pemberton Hills rhyolite and the Wanakana Creek pluton, respectively (Nixon et al., 2011a, b). Additionally, Ar-Ar ages of 167.8 ± 8.2 and 165.1 ± 2.8 Ma were reported for hornblende from the Wanakana Creek pluton and the unspecified northwest diorite pluton, respectively (Nixon et al., 2011a, b).

Other important age determinations from the Pemberton Hills region are zircon ages from three samples of the rhyodacitic quartz-feldspar porphyry dyke complex that hosts the Island Copper mine (Ross et al., 1996). An early porphyry phase interpreted to pre-date mineralization yielded an age of 168.5 +0.3 / -1.7 Ma (Ross et al., 1996). An intramineral porphyry phase interpreted to reflect the main mineralization event at Island Copper yielded an age of 168.5 ± 0.6 Ma (Ross et al., 1996). A late porphyry phase understood to post-date mineralization was dated at 166.2 ± 0.7 Ma (Ross et al., 1996). The ages for these porphyry phases do not overlap within error of the ages generated for the intrusive units dated at Pemberton Hills in this study. Furthermore, the porphyry phase associated with the main mineralization event at Island Copper does not overlap within error of the Re-Os age of molybdenite from the lithocap at Pemberton Hills (Fig. 5.22). This suggests that the molybdenite is not related to the emplacement of the rhyodacitic porphyry dyke complex at Island Copper and is likely related to one of the older intrusive units from Pemberton Hills dated in this study (Fig. 5.22). The epidote dated at 165.4 ±

4.1 Ma from Pemberton Hills may be related to a later stage porphyry event given its age does not overlap within error of the ages generated for the intrusive units dated in this study, but shares a similar age to hornblende from the northwest quartz diorite pluton dated at 165.1 ± 2.8 Ma (Nixon et al., 2011a; Fig. 5.22). The garnet age of 170.1 ± 1.8 Ma from Pemberton Hills overlaps within error of the ages for the three younger intrusive units dated in this study.

5.2.4 Zircon trace element geochemistry

Zircon trace element geochemistry can be used as a window into primary magmatic conditions and as a tool to discriminate between fertile and infertile intrusive suites associated with porphyry Cu ± Au ± Mo deposits. A number of studies have demonstrated that zircon trace element geochemistry can be an effective means of differentiating between fertile and infertile porphyry suites (Ballard et al., 2002; Dilles et al., 2015, Lu et al., 2016, Lee et al., 2017).

It is widely recognized that porphyry Cu ± Au deposits have a temporal and spatial relationship to oxidized parental magmas with high water contents (Richards et al., 2012 and references therein). One of the most widely used zircon trace element ratios is Eu/Eu*, which can act as a measure of the magma conditions at the time of zircon crystallization (Ballard et al., 2002). Unlike all other trivalent REE's except Ce, Eu exists as both Eu^{2+} and Eu^{3+}, with Eu^{2+} predominantly being incorporated into plagioclase in a normal melt, producing negative Eu anomalies in the residual melt and subsequently in the zircon geochemistry. In strongly oxidized magmas, more Eu^{3+} is available and will be incorporated into zircon with less Eu^{2+} going into plagioclase, diminishing the Eu anomaly in the zircon geochemistry. The change in the oxidation state of Eu from Eu^{2+} to Eu^{3+} has been proposed by Dilles et al. (2015) to be the result of reduction of sulphate to sulfur dioxide during separation of the sulfur-rich magmatic-hydrothermal fluid in

a crystallizing magma. Eu anomalies may also be diminished by high magmatic water contents and/or crystallization pressures of ~1 GPa, which may suppress early fractionation of plagioclase (Moore and Carmichael, 1998; Richards et al., 2012; Loucks, 2014). Ballard et al. (2002) reported that Eu/Eu* ratios >0.4 were characteristic of mineralizing intrusions in the Chuquicamata-El Abra porphyry copper belt of northern Chile. The Eu/Eu* ratio was also used to discriminate ore forming intrusions at El Salvador, Chile, Yanacocha, Peru, and Yerington, Nevada (Dilles et al., 2015; Lee et al., 2017). Additionally, Lu et al. (2016) used Eu/Eu* ratios of >0.3 to fingerprint mineralizing intrusions at Bata Hijau, Tampakan, Sar Cheshmeh, Dexting, Jiama, Sungun, Qulong, Nannihu, and Yuchiling.

Ce/Ce* ratios have also been used to infer the oxidation state of a magma at the time of zircon crystallization and can be used to discriminate between fertile and infertile magmatic suites (Ballard et al., 2002). Similar to Eu, Ce also exists in two valence states (3+ and 4; Ballard et al., 2002). As magmatic conditions become more oxidized, Ce^{4+} will be preferentially incorporated into zircon relative to Ce^{3+}, increasing the overall Ce content and producing a positive Ce anomaly in the zircon geochemistry (Ballard et al., 2002). Measuring the Ce anomaly can be difficult due to low concentrations of La and Pr that may be near or below detection limits (Lee et al., 2017). Lee et al. (2017) showed that high Ce/Ce* ratios at El Salvador are a feature of barren Paleocene and Paleozoic igneous rocks and weakly mineralized rhyolite and quartz porphyry units. They concluded that Eu/Eu* was a useful measure of late oxidation of the mineralized El Salvador magmas, but Ce/Ce* was not. Lu et al. (2016) used Ce/Nd as a proxy for Ce/Ce* given the difficulties in measuring the Ce anomaly stated above. They found that Ce/Ce* and Ce/Nd had a power law relationship and suggested Ce/Nd could be used as an alternative to

estimating the amplitude of the Ce anomaly. Given the abundance of at or near detection limit values of La and Pr reported in the zircon geochemistry from Pemberton Hills, Ce/Nd is used as a proxy for the Ce anomaly (Appendix C).

The plot of Eu/Eu* versus Ce/Nd in Figure 5.23 displays overlapping Eu/Eu* ratios for zircons from the granodiorite porphyry and tonalite dyke, with almost all values for both units falling between 0.2 – 0.3. Both quartz diorite samples are characterized by lower Eu/Eu* ratios, but are also subtly different from one another. The coarser grained quartz diorite sample PM18AJ248 exhibits the lowest Eu/Eu* ratios that almost all lie between 0.09 – 0.14, whereas the finer grained quartz diorite sample PM18AJ203 is characterized by higher Eu/Eu* ratios that nearly all fall between 0.13 – 0.17 (Fig. 2.23). The granodiorite and tonalite dyke exhibit a wider range of predominantly overlapping Ce/Nd values between ~2 – 31, with the granodiorite exhibiting the highest ratios and the tonalite dyke the lowest. Unlike the Eu/Eu* ratio, both quartz diorite samples overlap within the range of the granodiorite and tonalite dyke based on Ce/Nd values (Fig. 2.23). Lu et al. (2016) recognized a strong overlap of Ce/Nd ratios between unmineralized and mineralized sample suites and ultimately concluded that Ce/Nd may not be the most appropriate indicator or proxy of oxidation state for the intrusions in question. Differences in the more robust Eu/Eu* values observed between the quartz diorites and the granodiorite/tonalite dyke samples suggests the felsic magmas were more oxidized than the intermediate magmas. This is not evident with the Ce/Nd ratio, and thus it is likely that the Ce/Nd ratio on its own may not be a reliable measure of oxidation state.

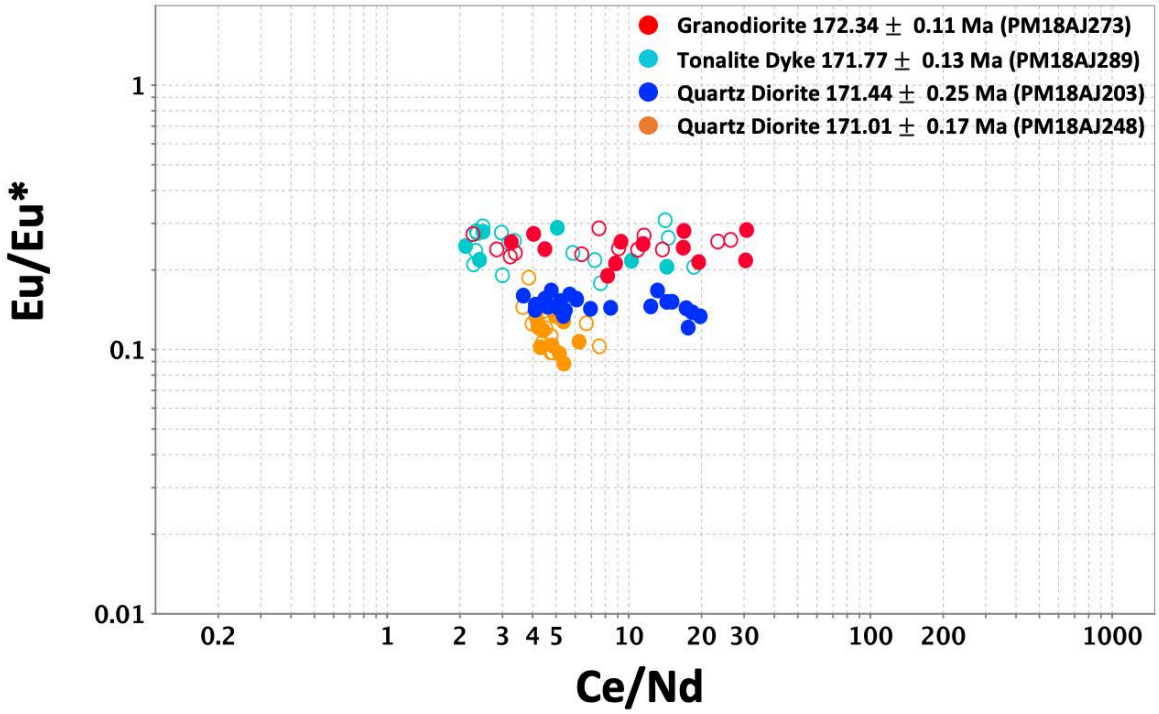


Figure 5.23. Zircon Eu/Eu* vs. Ce/Nd log plot of intrusive samples from Pemberton Hills. Eu/Eu* is the europium anomaly, calculated as (2*[Eu])/([Sm+Gd]) using chondrite normalized values. Closed circles correspond to zircon concordance > 95%, open circles correspond to zircon concordance < 95%.

Hydrous, oxidized fertile suites should have higher (Eu/Eu*)/Y and (Ce/Nd)/Y ratios if Y is incorporated into early crystallizing hornblende and Eu remains in the melt or is incorporated into zircon due to plagioclase suppression (Lu et al., 2016). The granodiorite and tonalite dyke are characterized by the highest 10000*(Eu/Eu*)/Y and (Ce/Nd)/Y values that together form a flat, horizontal trend (Fig. 5.24). They have similar 10000*(Eu/Eu*)/Y values to each other (mostly between 2 – 6), but the granodiorite has slightly higher ratios. The quartz diorite samples demonstrate a strong positive linear correlation of increasing 10000*(Eu/Eu*)/Y and (Ce/Nd)/Y, progressing from lower values defined by sample PM18AJ248 (10000*(Eu/Eu*)/Y values between ~0.07 – 0.3) to higher values characterized by sample PM18AJ203 (10000*(Eu/Eu*)/Y values between ~0.2 – 0.8; Fig. 5.24). The peak in 10000*(Eu/Eu*)/Y values represented by the first cluster of zircons from PM18AJ203 marks a change in conditions within the crystallizing magma,

as the second cluster of zircons flattens out and deviates from the positive correlation observed between sample PM18AJ248 and the first cluster of zircons from PM18AJ203 (Fig. 5.24). This is important because it suggests that amphibole fractionation was an ongoing process at upper crustal levels in the intermediate magmas, whereas amphibole fractionated earlier on in the felsic magmas. Early fractionation of hornblende is an important characteristic of porphyry deposit-related rocks (Richards et al., 2012).

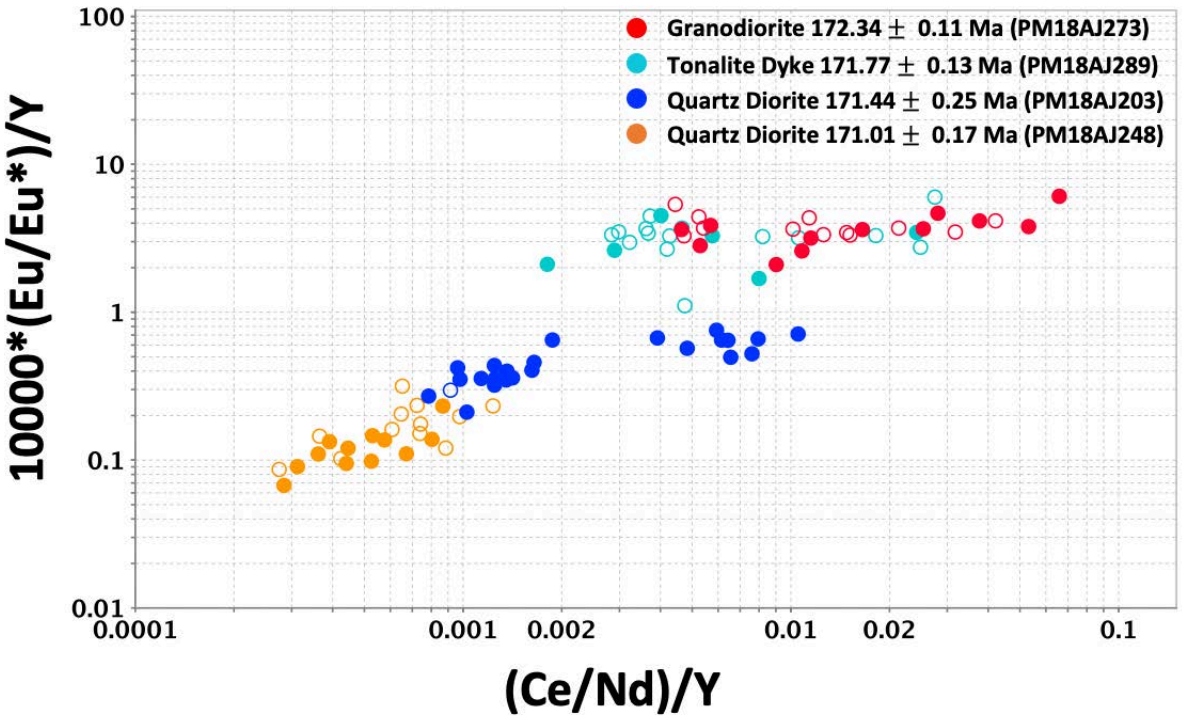


Figure 5.24. Zircon 10,000*(Eu/Eu*)/Y vs. (Ce/Nd)/Y log plot of intrusive samples from Pemberton Hills. Closed circles correspond to zircon concordance > 95%, open circles correspond to zircon concordance < 95%.

Dysprosium/Ytterbium versus Eu/Eu* can also be a useful indication of amphibole fractionation in a hydrous and oxidized melt, as amphibole crystallization will preferentially incorporate middle rare earth (MREE) over heavy rare earth elements (HREE), and high magmatic water contents will suppress plagioclase crystallization, resulting in the zircon geochemistry from the residual melt being characterized by low Dy/Yb and high Eu/Eu* (Lu et al., 2016 and references therein). The plot of Eu/Eu* versus Dy/Yb in Figure 5.25 shows decreasing Dy/Yb ratios with increasing Eu/Eu* ratios for the quartz diorite units. Sample PM18AJ248 has the highest Dy/Yb values between ~0.36 – 0.46 and PM18AJ203 shows lower values between ~0.22 – 0.35, with no overlap between the two units (Fig. 5.25). The granodiorite and tonalite dyke sample are essentially indistinguishable from one another with low Dy/Yb ratios between ~0.14 – 0.21 and overlapping Eu/Eu* ratios (Fig. 5.25). Lu et al. (2016) reported fertile intrusions to have Dy/Yb values of <0.3, whereas infertile intrusions have Dy/Yb values of >0.3. Dysprosium/Ytterbium values of <0.3 characterize zircons from the granodiorite and tonalite dyke samples, but also some zircons from the quartz diorite sample PM18AJ203. Based on this criteria, felsic plutonic rocks at Pemberton Hills are more fertile and thus more prospective with respect to porphyry mineralization than the intermediate plutonic units.

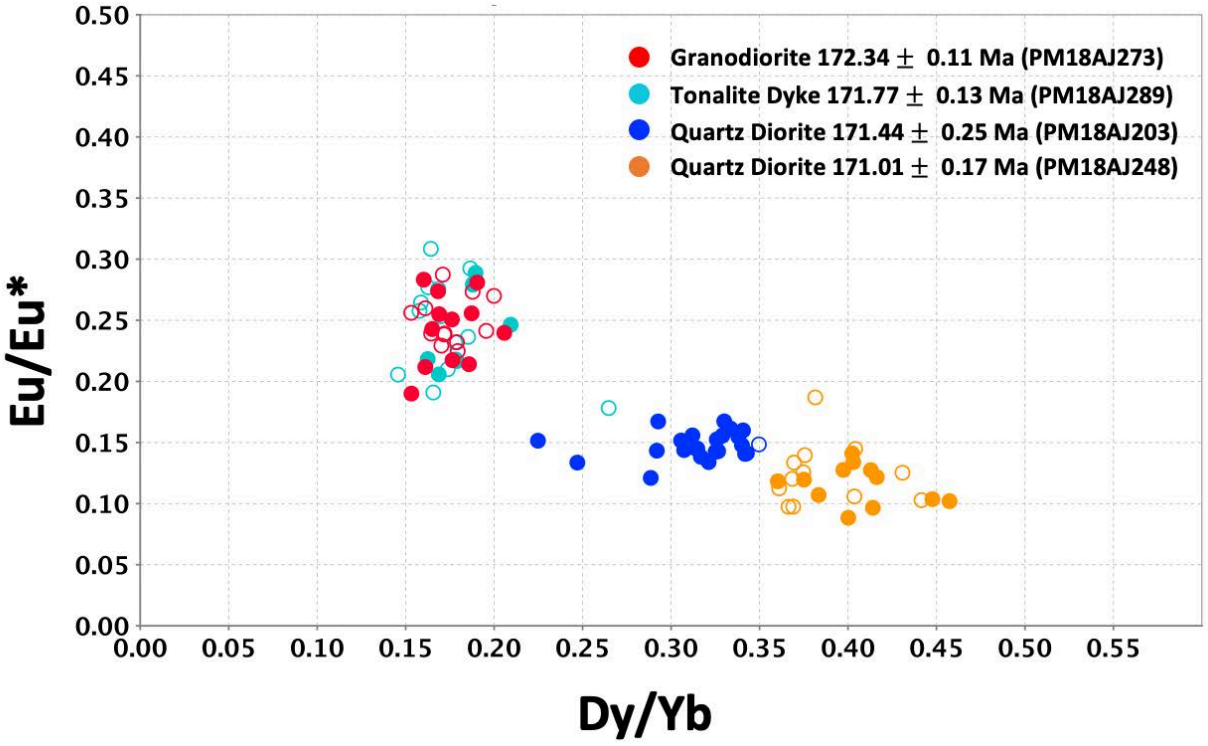


Figure 5.25. Zircon Eu/Eu* vs. Dy/Yb plot of various intrusive samples from Pemberton Hills. Closed circles correspond to zircon concordance > 95%, open circles correspond to zircon concordance < 95%.

Although the high precision zircon U-Pb geochronology suggests that felsic and intermediate plutonism at Pemberton Hills was broadly contemporaneous, the zircon trace element geochemistry reveals that conditions in the felsic and intermediate magmas were very different during the emplacement history of these rocks. Eu/Eu* ratios show no change over time between the granodiorite and tonalite dyke, but increase from the older to the younger quartz diorite sample (Fig. 5.26A). This suggests that the felsic plutonic magmas had reached stable oxidation levels at the time of the emplacement of the granodiorite and tonalite dyke, whereas the intermediate magmas were becoming more oxidized during the emplacement of the quartz diorite pluton.

Similar to Eu/Eu* ratios, Dy/Yb ratios completely overlap between the granodiorite and tonalite dyke samples, but decrease from the older to the younger quartz diorite sample (Fig. 5.26B). This suggests that amphibole fractionation had already occurred at the time of the emplacement of the granodiorite and tonalite dyke, or was not a dominant control on the Dy/Yb ratios and oxidation state of the felsic plutonic magmas. In contrast, changing Dy/Yb ratios over the crystallization history of the quartz diorite samples suggest amphibole was still fractionating out of the intermediate magmas during the emplacement of the quartz diorite pluton. Given that Eu/Eu* and Dy/Yb ratios do not change during the crystallization history of the granodiorite and tonalite dyke samples, the decrease in 10000*(Eu/Eu*)/Y values over time from the granodiorite to the tonalite dyke suggests that another mineral phase is likely the dominant control on Y partitioning in the felsic magmas (Fig. 5.27).

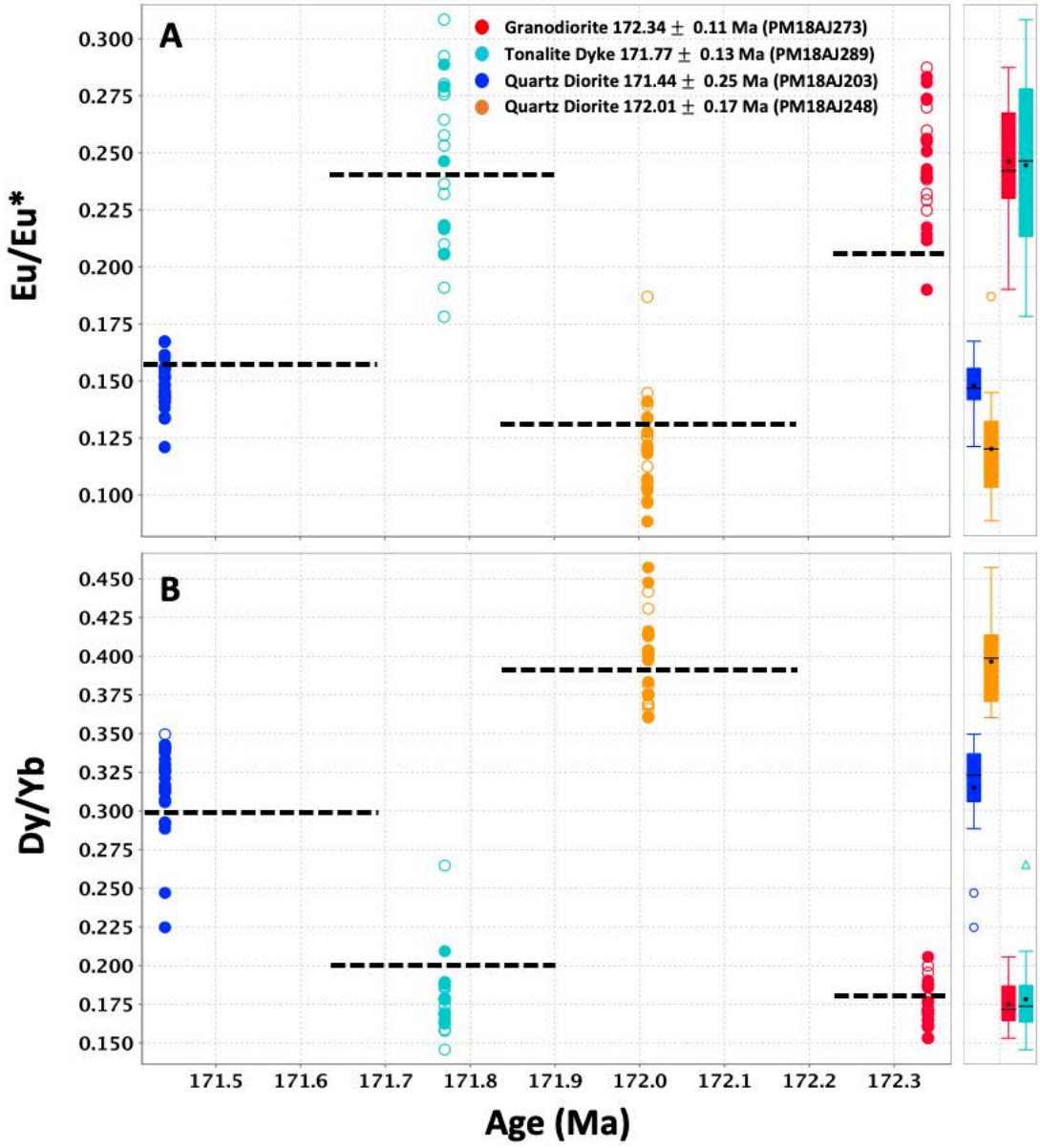


Figure 5.26. (A) Zircon Eu/Eu* vs. CA-TIMS ages; (B) Zircon Dy/Yb vs. CA-TIMS ages. The boxes to the right of the plot show the Eu/Eu* (A) and Dy/Yb (B) mean (black circle), median (black line), Q1 (bottom of box), Q3 (top of box), min regular (bottom whisker), max regular (top whisker), and outliers (circles) for each sample. Closed circles correspond to zircon concordance > 95%, open circles correspond to zircon concordance < 95%. Dashed horizontal lines represent error associated with each sample.

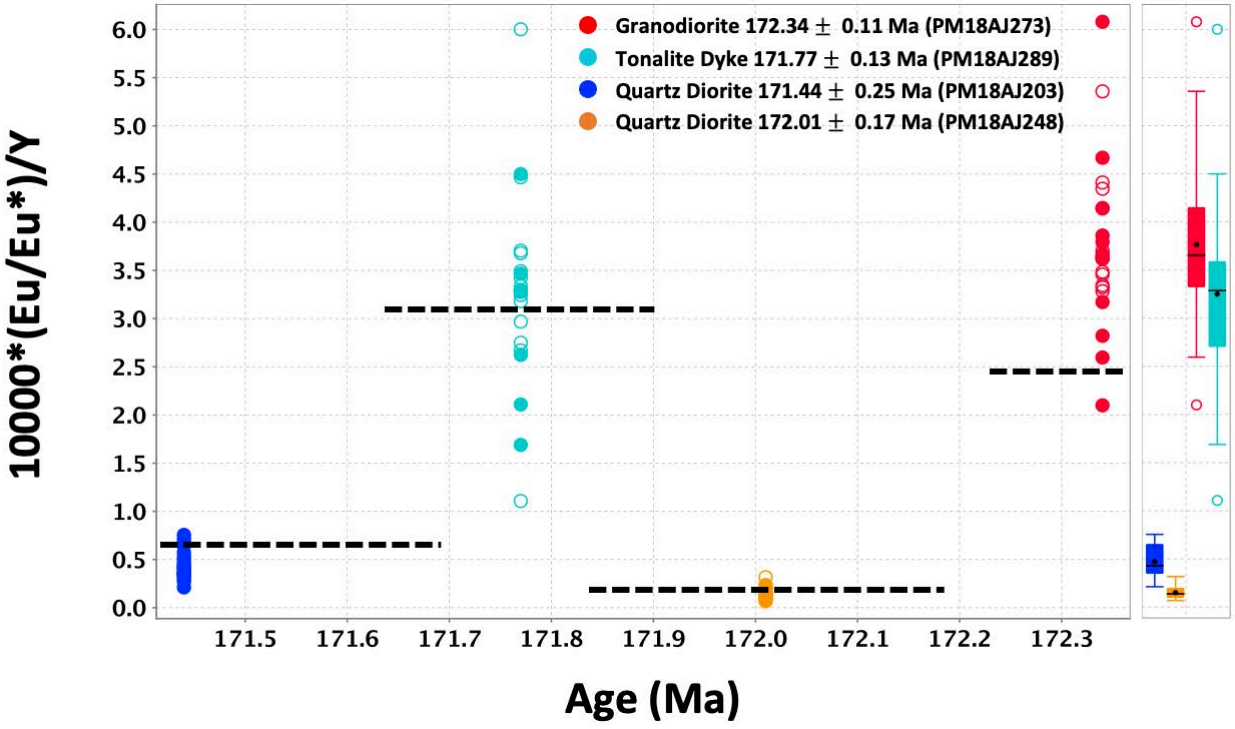


Figure 5.27. Zircon 10000*(Eu/Eu*)/Y vs. CA-TIMS ages. The boxes to the right of the plots show the 10000*(Eu/Eu*)/Y (A) mean (black circle), median (black line), Q1 (bottom of box), Q3 (top of box), min regular (bottom whisker), max regular (top whisker), and outliers (circles) for each sample. Closed circles correspond to zircon concordance > 95%, open circles correspond to zircon concordance < 95%. Dashed horizontal lines represent error associated with each sample.

A few key observations can be drawn from the zircon geochemistry: (1) the granodiorite and tonalite dyke samples are indistinguishable on the basis of their Eu/Eu* values, which are collectively the highest measured, suggesting that these melts were more hydrous/had higher crystallization pressures/were more oxidized than the quartz diorite samples. However, in comparison to many known porphyry Cu-Au deposits worldwide, these values would fall near the discrimination line between barren and mineralized suites (see Ballard et al., 2002; Lu et al., 2016); (2) amphibole fractionation predominantly occurred prior to crystallization of zircons from the granodiorite and tonalite dyke samples, based on the flat horizontal trend observed in Figure 5.24 and complete overlap of values with no positive or negative correlation in the plot of Eu/Eu*

vs. Dy/Yb (Fig. 5.25); (3) amphibole fractionation with weakly increasing oxidation of the magma were ongoing processes during most of the crystallization history of both the quartz diorite units based on increasing 10000*(Eu/Eu*)/Y and (Ce/Nd)/Y ratios and decreasing Dy/Yb ratios; (4) conditions in the magma changed at some point during the crystallization history of the quartz diorite, marked by flatlining of 10000*(Eu/Eu*)/Y ratios observed in zircons from sample PM18AJ203, suggesting cessation of amphibole fractionation or possible assimilation of surrounding crustal material. Together, these points suggest that magmatic conditions during the emplacement of felsic plutonic units remained relatively stable, whereas zircons from the quartz diorite suggest more variable conditions throughout the crystallization history of both samples. The zircon geochemistry signatures of the felsic plutonic rocks at Pemberton Hills suggest that they are more fertile with respect to porphyry mineralization compared to the intermediate plutonic rocks. Felsic and intermediate plutonism displayed contrasting magmatic conditions and histories despite very similar and even overlapping ages of emplacement based on the high precision geochronology study completed on these samples.

5.2.5 Sources and petrogenesis of rock types at Pemberton Hills

An important debate in the literature within recent years has been centered on the apparent spatial and genetic link between adakites and porphyry Cu-Au deposits, particularly with respect to high Sr/Y ratios associated with many large porphyry deposit intrusions. Some authors have argued that the generation of adakites by slab melting of subducted aseismic ridges, seamounts, and oceanic plateaus may be one of the key elements in producing fertile porphyry deposits (i.e., Thiéblemont et al., 1997; Sajona and Maury, 1998; Oyarzun et al., 2001; Mungall, 2002; Cooke et al., 2005). Others have suggested that typical evolutionary and crystallization

processes associated with amphibole (± garnet) fractionation in hydrous calc-alkaline melts can also generate magmas with high Sr/Y ratios and enough Cu for porphyry deposit formation, and that melting of oceanic lithosphere is not necessarily the fundamental mechanism for porphyry deposit formation (Cline and Bodnar, 1991; Cline, 1995; Richards and Kerrich, 2007; Richards et al., 2012). Using a combination of high-precision geochronology, whole-rock and zircon trace element geochemistry, as well as Lu-Hf isotopes on select zircons from intrusive units we can assess the petrogenesis of Bonanza arc rocks at Pemberton Hills.

Lithologies at Pemberton Hills demonstrate a relatively broad range in Sr/Y and Y values, (Fig. 5.28). Mafic volcanic rocks exhibit the highest overall Sr/Y ratios and low Y, plotting as a roughly horizontal trend between the adakite-like and normal andesite-dacite-rhyolite fields (Fig. 5.28). Intermediate volcanic and plutonic samples display lower overall Sr/Y ratios that increase with decreasing Y, and plot within the normal andesite-dacite-rhyolite field (Fig. 5.28). The cluster of biotite altered felsic plutonic samples trend towards lower Y values compared to samples of intermediate composition, but have lower Sr/Y ratios closer to the boundary between the adakite-like rocks and normal andesite-dacite-rhyolite fields (outlined in Fig. 5.28). The remaining potassium-feldspar altered granodiorites display the lowest Sr/Y ratios and highest Y values.

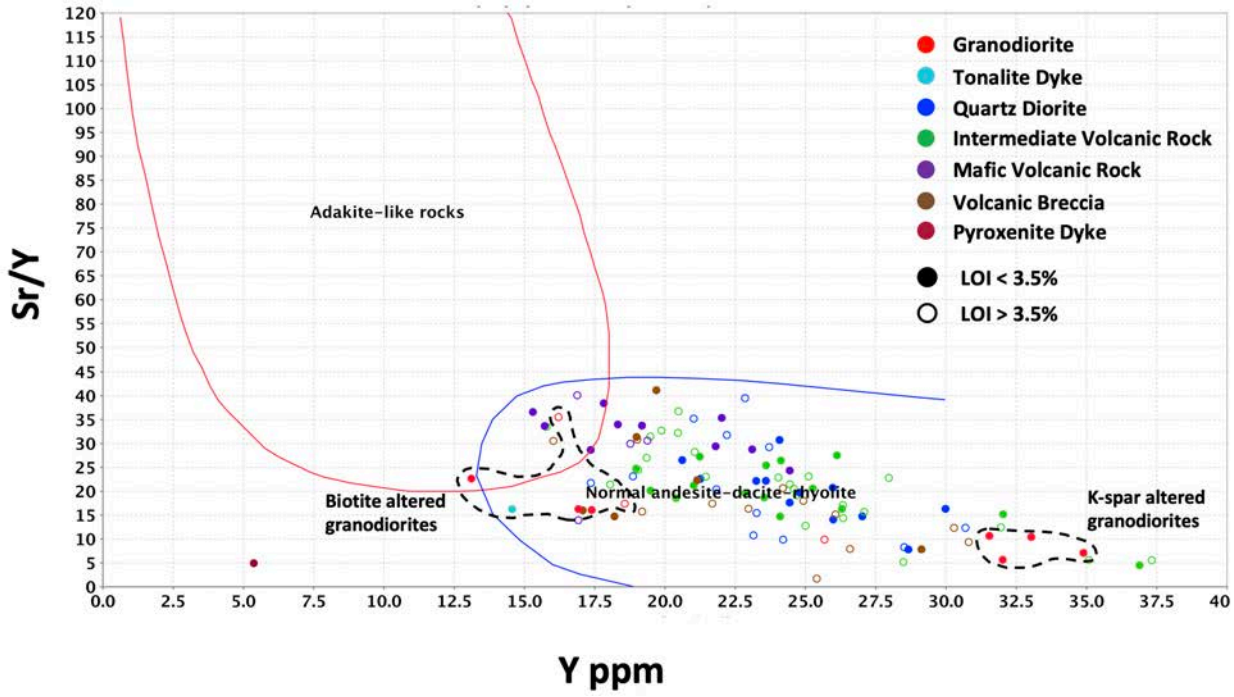


Figure 5.28. Plot of Sr/Y vs. Y for samples from the Pemberton Hills property. Solid lines represent fields from Richards and Kerrich (2007), dashed lines represent biotite and potassium feldspar (K-spar) altered granodiorite samples. Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

On the plot of La/Yb versus Yb mafic volcanic rocks are characterized by the lowest overall La/Yb and Yb values that form a roughly horizontal trend within the normal andesite-dacite-rhyolite field (Fig. 5.29). Intermediate volcanic and plutonic rocks display moderate La/Yb ratios that increase with decreasing Yb values and plot within the normal andesite-dacite-rhyolite field. The biotite altered granodiorite rocks are characterized by low Yb values and trend towards adakite-like rocks with increasing La/Yb ratios, but still lie within the normal andesite-dacite-rhyolite field (Fig. 5.29). The potassium-feldspar altered granodiorite samples display low to moderate La/Yb ratios but the highest Yb values (Fig. 5.29).

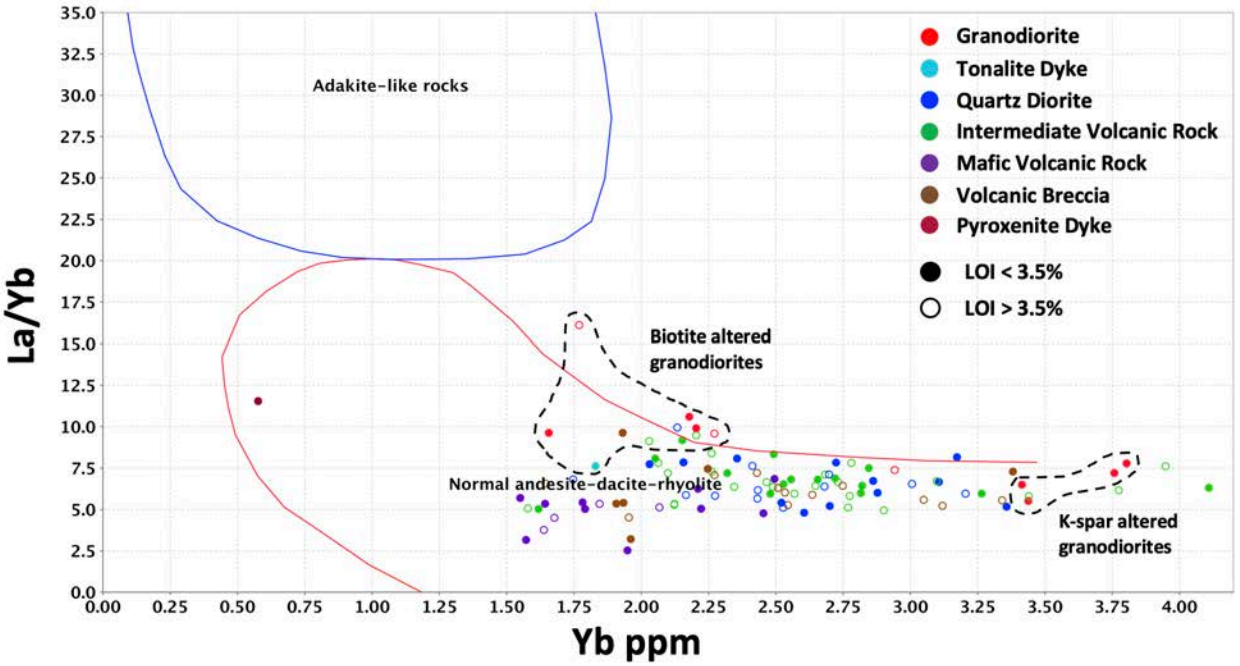


Figure 5.29. Plot of La/Yb vs. Yb for samples from the Pemberton Hills property. Solid lines represent fields from Richards and Kerrich (2007), dashed lines represent biotite and potassium feldspar (K-spar) altered granodiorite samples. Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

D'Angelo et al. (2017) showed that for the Guichon Creek batholith that hosts the Highland Valley porphyry Cu ± Mo district, rock types from the batholith plot within the adakite-like field on a Sr/Y versus Y diagram, but within the normal andesite-dacite-rhyolite field on the La/Yb versus Yb diagram and show a progressive evolution to more adakite-like compositions. They suggested that this was consistent with normal AFC (assimilation fractional crystallization; see DePaolo, 1981) processes in a parent magma with high magmatic water content (see Moore and Carmichael, 1998; Müntener et al., 2001; Richards and Kerrich, 2007; Loucks, 2014). This is consistent with what is observed for the intermediate and felsic plutonic rocks at Pemberton Hills. However, D'Angelo et al. (2017) also note that deep crustal melting in the MASH zone (Melting, Assimilation, Storage, and Homogenization; Hildreth and Moorbath, 1988) involving garnet, amphibole, clinopyroxene, titanite, and/or zircon with negligible plagioclase fractionation

in a deep crustal magma reservoir could also generate similar results (Richards, 2003; Richards and Kerrich, 2007; Richards et al., 2012). D'Angelo et al. (2017) concluded that based on increasing La/Sm_{cn} (0.6 – 12.9) and relatively low, constant Gd/Yb_{cn} (0.6 – 2.6) ratios, garnet fractionation or partial melting of deep crustal garnetiferous rocks could be ruled out and amphibole fractionation was the controlling factor behind the high Sr/Y, La/Yb, and overall geochemical evolution of the Guichon Creek batholith. In the plot of La/Sm_{cn} versus Gd/Yb_{cn}, most samples from Pemberton Hills show an overall decrease in La/Sm_{cn} (~5.0 – 1.5) with relatively low, but increasing Gd/Yb_{cn} (~0.9 – 1.8) with evolving felsic to mafic compositions (Fig. 5.30). If garnet fractionation was the dominant control on these ratios, we would expect to see higher Gd/Yb_{cn} ratios in the felsic and intermediate rock types because garnet strongly partitions HREE over MREE. However, lithologies at Pemberton Hills do not show constant Gd/Yb_{cn} ratios, which suggest there are multiple controls on the compositions of these rocks.

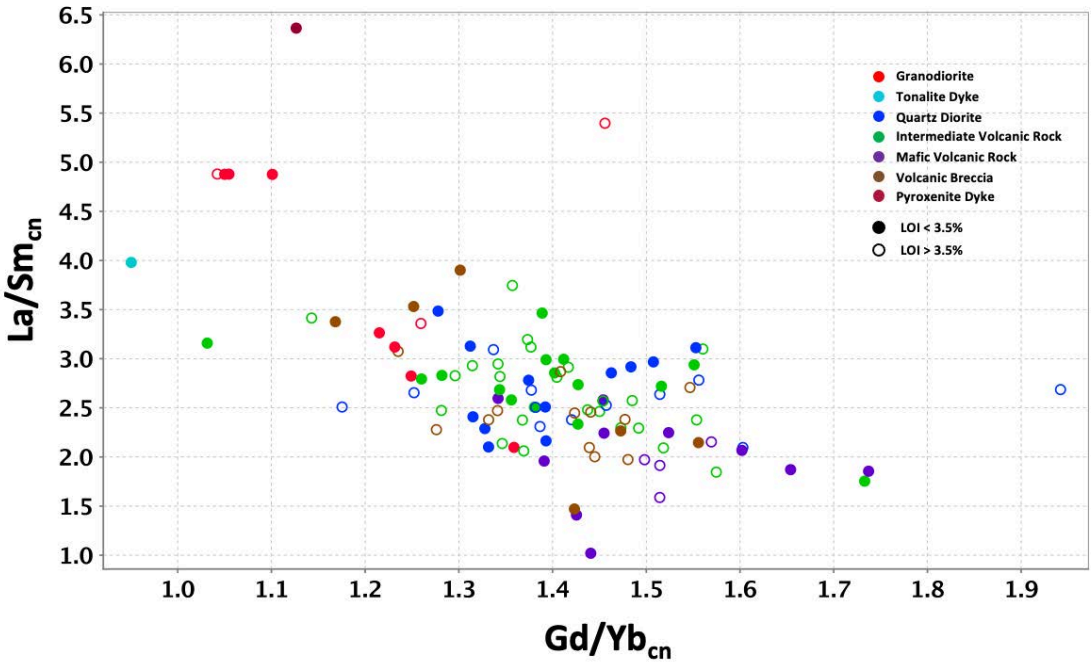


Figure 5.30. Plot of La/Sm_{cn} vs. Gd/Yb_{cn} for samples from Pemberton Hills. Normalizing values from Sun and McDonough (1989). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

The Jurassic Bonanza arc on Vancouver Island is unusual as it was built upon a Devonian-Triassic arc-oceanic plateau-carbonate succession, and thus represents an island arc that has formed on thick non-continental crust (D'Souza et al., 2016). D'Souza et al. (2016) note that during the ~40 m.y. lifespan of the Bonanza arc, it may have thickened enough to increase the pressure of magmatic differentiation to above 0.8 GPa (~24 km), at which point garnet becomes a stable liquidous phase in a hydrous basaltic system (Müntener and Ulmer, 2006). Jagoutz (2010) in a study of 12 arcs with crustal thickness exceeding 24 km concluded that felsic plutonic rocks with low Yb and high SiO_2 could be used to infer garnet fractionation during magma evolution in the lower crust. To evaluate this, D'Souza et al. (2016) established thickness estimates of between ~22 and 33 km for the Bonanza arc and its preexisting crust, suggesting that the base of the crust was most likely deeper than 24 km and would provide suitable conditions for garnet stability.

Despite the thickness estimates provided by D'Souza et al. (2016) for the Bonanza arc that would provide suitable conditions for garnet stability, no garnet-bearing cumulate rocks have been identified thus far. However, amphibole is abundant throughout the Bonanza arc, particularly as a cumulate phase, and is interpreted to play a dominant role in controlling arc rock compositions (Larocque and Canil, 2010). D'Souza et al. (2016) argued that as a liquid evolves to higher SiO_2, Yb will partition more strongly into amphibole, which means that amphibole fractionation alone could generate low- to intermediate-silica liquids with high Yb and felsic liquids with low Yb. D'Souza et al. (2016) identified two sample populations based on Yb and SiO_2 concentrations in their data set of Bonanza arc rocks (Fig. 5.31). The first population displays increasing Yb with increasing SiO_2, while the other is characterized by low Yb values at high SiO_2.

D'Souza et al. (2016) classified these populations as "normal Yb" and "low Yb" groups. Mafic volcanic rocks, intermediate volcanic rocks, and quartz diorites from Pemberton Hills plot within the normal Yb group, whereas the tonalite dyke and biotite altered granodiorite samples fall within the low Yb group (Fig. 5.31).

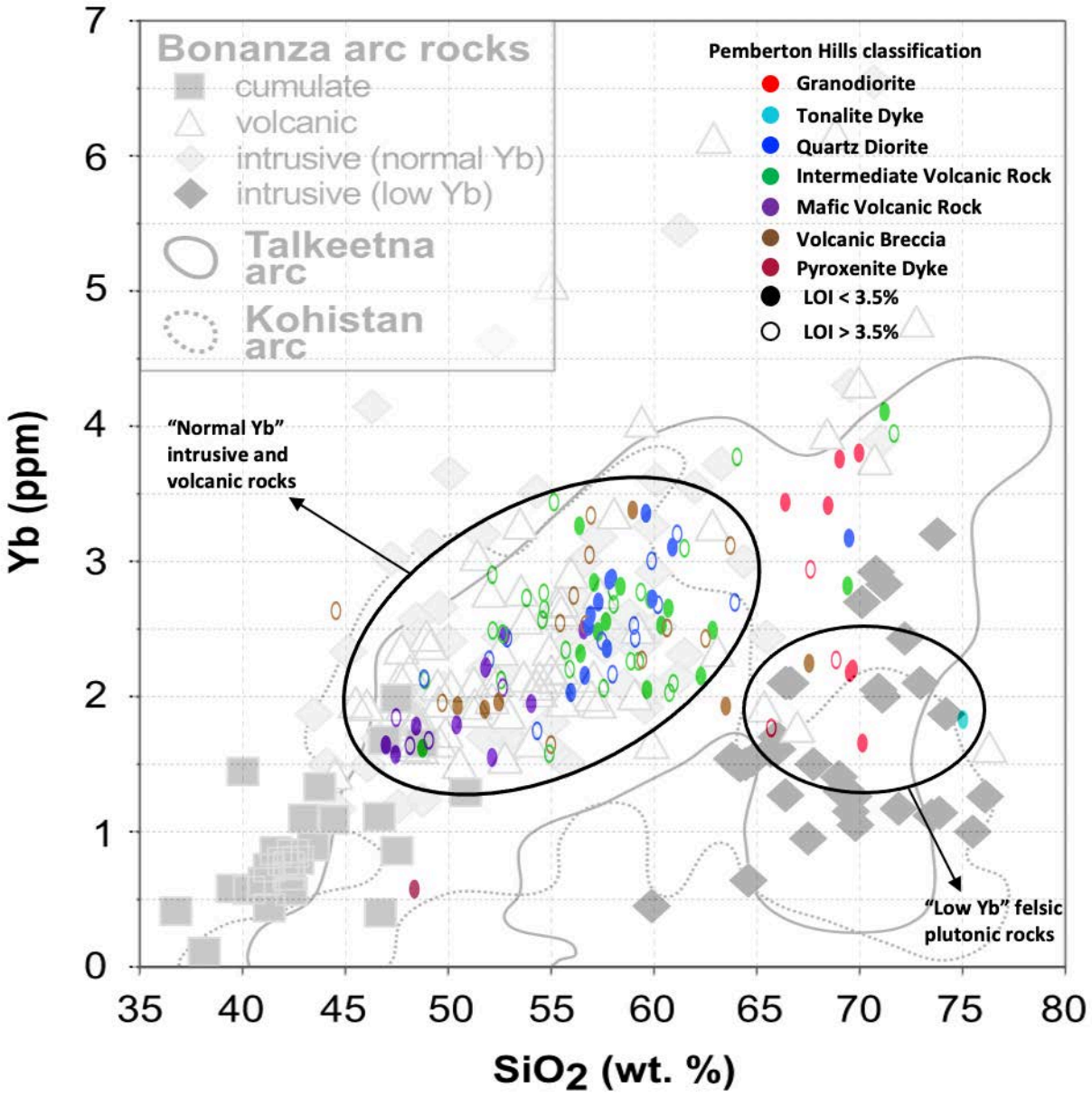


Figure 5.31. Plot of Yb vs. SiO_2 for Bonanza, Talkeetna and Kohistan arc rocks. Data are from this study, D'Souza et al. (2016), Kelemen et al. (2014), and Jagoutz and Schmidt (2012). "Normal Yb" and "low Yb" volcanic and plutonic rock from Pemberton Hills are circled. Modified after D'Souza et al. (2016). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

D'Souza et al. (2016) investigated Dy and Yb variations to evaluate whether garnet of amphibole fractionation was the dominant control on the "low Yb" bonanza arc rocks, as these elements will partition differently if garnet or amphibole is fractionating. They concluded that amphibole rather than garnet was the primary control on Dy and Yb variations in the Bonanza arc rocks. This result is consistent with the conclusions of Larocque and Canil (2010), who argued that the role of olivine-hornblende assemblages of early cumulate phases in the Bonanza arc suggests hydrous conditions during differentiation of Bonanza arc. They argued that a lack of Eu anomalies in plagioclase cumulates of the Bonanza arc relative to distinct Eu anomalies noted in the Talkeetna arc reinforces this claim. The role of amphibole in controlling Dy and Yb ratios is further supported by the zircon trace element data in this study that suggests changing magmatic conditions and Dy/Yb ratios during the emplacement of the quartz diorite samples were the result of amphibole fractionation (Fig. 5.25).

Rayleigh fractionation modelling led D'Souza et al. (2016) to conclude that fractionation of a hornblende-olivine orthopyroxenite from a primitive liquid followed by fractionation of a clinopyroxene-rich gabbro and an apatite-titanite-garnet-hornblende gabbro from the respective intermediate liquid can account for the La, Dy, and Yb variations in most Bonanza arc intrusive rocks and some volcanic rocks. In contrast, they argued that fractionation of a garnet-bearing gabbro from a primitive liquid followed by fractionation of a clinopyroxene-rich hornblende gabbro can account for these element variations in most volcanic rocks and some intrusive rocks. This suggests that if garnet did play a role in the evolution of the low Yb felsic plutonic rocks, it was a minor component. The Raleigh fractionation modelling is consistent with secondary

controls such as apatite, titanite, and garnet to form the compositional variations observed in rocks from Pemberton Hills.

Dysprosium and Yb concentrations of samples from Pemberton Hills are plotted with the samples used by D'Souza et al. (2016) on Figure 5.32A. The intermediate volcanic and plutonic rocks at Pemberton Hills are indistinguishable from each other on the basis of their Dy and Yb values whereas the mafic volcanic rocks can be distinguished from intermediate compositions. Although D'Souza et al. (2016) suggested that volcanic and plutonic rocks underwent different fractionation pathways starting from a parental liquid (i.e., garnet-gabbro and hornblende-olivine orthopyroxenite fractionation, respectively, the linear relationship based on Dy and Yb concentrations, defined by intermediate intrusive and intermediate volcanic rock samples from Pemberton Hills suggests they both evolved by hornblende-olivine orthopyroxenite fractionation (Fig. 5.32). However, the Dy and Yb concentrations for mafic volcanic rocks suggest that these samples may have evolved as a result of garnet-gabbro fractionation from a primitive liquid of basaltic composition.

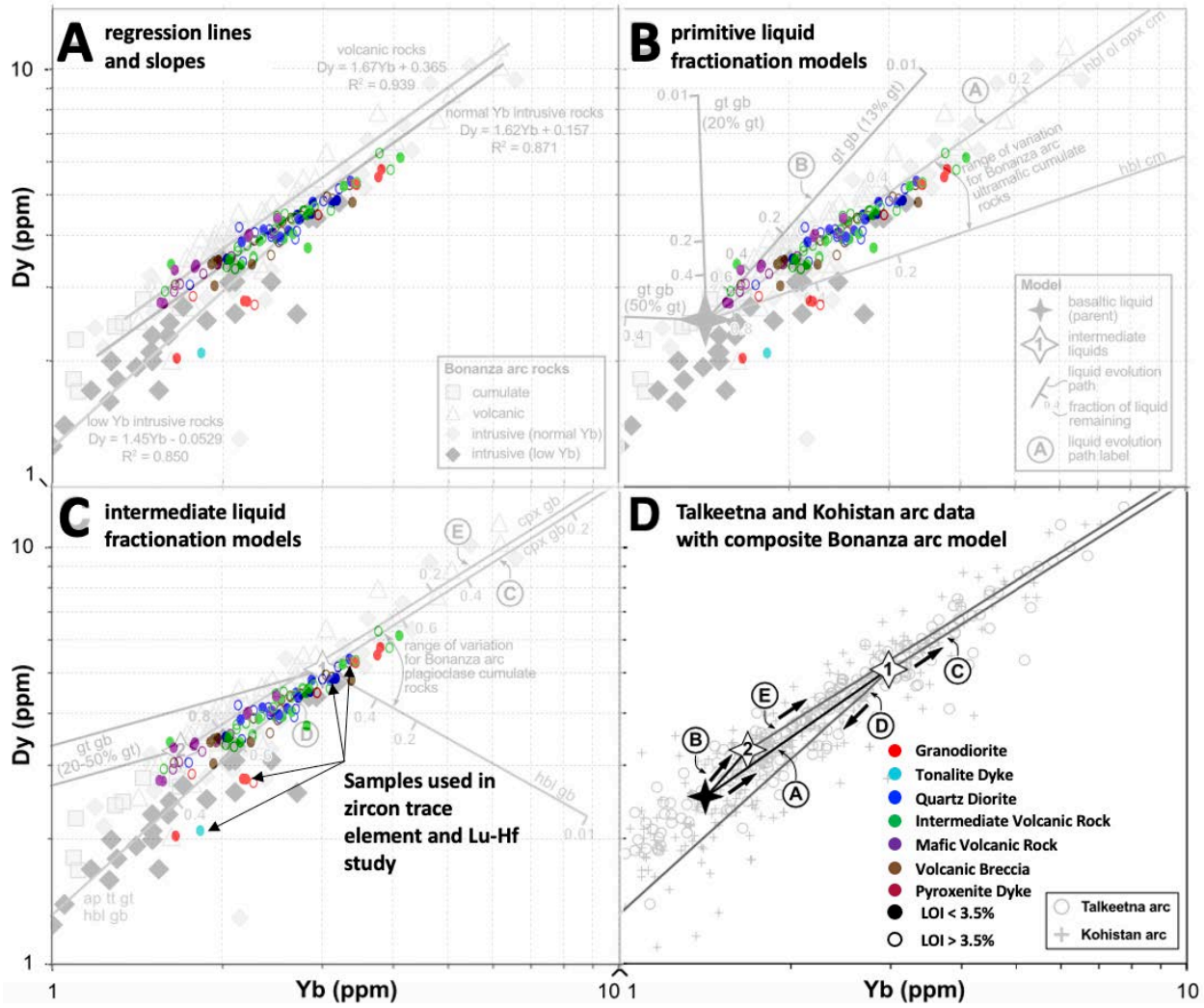


Figure 5.32. Dy and Yb variation in the Bonanza arc rocks. Data are from this study and D'Souza et al. (2016). (A) Regression lines and their equations fitted through the volcanic, "normal Yb," and "low Yb" intrusive rock groups. (B) Liquid evolution models for fractionation of different mineral assemblages from a basaltic parent melt. (C) Liquid evolution models for fractionation of different mineral assemblages from an intermediate liquid. (D) Data for the Talkeetna and Kohistan arcs (Kelemen et al., 2014; Jagoutz and Schmidt, 2012) and a composite of liquid evolution paths A–E from panels B and C, with arrows to indicate direction of liquid evolution. Abbreviations: ap—apatite, cm—cumulate, cpx—clino- pyroxene, gb—gabbro, gt—garnet, hbl—hornblende, ol—olivine, opx—orthopyroxene, tt—titanite. Modified after D'Souza et al. (2016). Closed circles correspond to LOI < 3.5%, open circles correspond to LOI > 3.5%.

Based on the liquid evolution models, the quartz diorite samples fractionated very early from an intermediate-stage liquid, whereas the "low Yb" granodiorite and tonalite dyke samples represent highly fractionated, evolved melts from the same intermediate-stage liquid (Fig. 5.32C). This is consistent with zircon trace element chemistry data for these samples (Fig. 5.33).

This plot was initially used by Lee et al. (2017), who demonstrated that highest temperature zircons from mafic magmas had relatively high Th and U contents, and suggests contamination by incompatible element-enriched crustal melts. Lee et al. (2017) proposed that elevated Yb/Gd and high overall REE ratios in melts were produced by fractionation of hornblende, titanite, and minor apatite. The granodiorite and tonalite dyke samples represent the most evolved and fractionated melts in the sample suite that have higher Yb/Gd due to relatively strong hornblende, apatite, titanite and possible garnet fractionation, whereas the two quartz diorite samples have lower Yb/Gd and higher Th/U ratios that suggest they were less evolved, hotter melts that did not fractionate amphibole effectively and may have been contaminated by incompatible element-enriched material (Fig. 5.33).

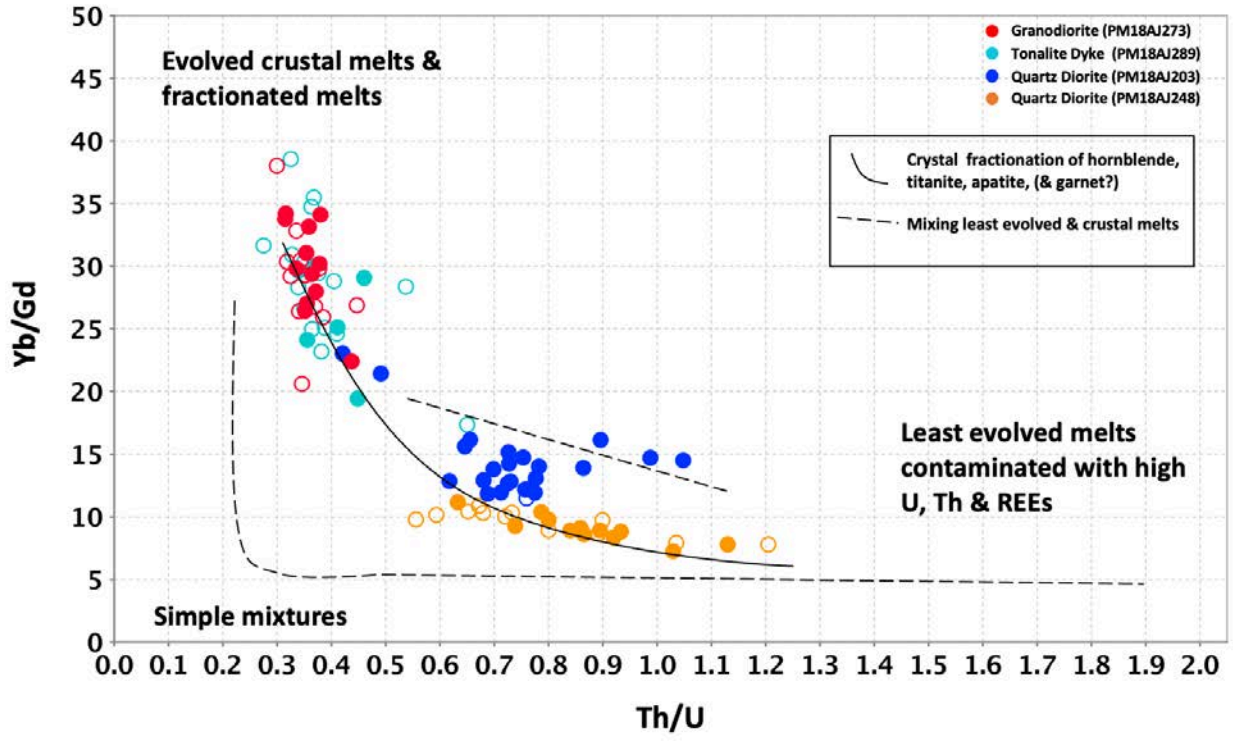


Figure 5.33. Zircon Yb/Gd vs. Th/U plot of various intrusive samples from Pemberton Hills. Modified from Lee et al. (2017). Closed circles correspond to zircon concordance > 95%, open circles correspond to zircon concordance < 95%.

5.2.6 Exploring the role of crustal contamination

In their study, D'Souza et al. (2016) also investigated the effect that assimilation of crustal material may have imparted on primary geochemical signatures of Bonanza arc magmas during their ascent by constructing AFC (assimilation fractional crystallization) calculations using Nd and Sr isotopes for 24 samples of various lithologies. The authors ultimately concluded that Bonanza arc magmas underwent minimal assimilation (<10%) of Devonian Sicker arc material. They did not consider the Triassic Karmutsen formation basalt as a possible contaminant because any assimilation of this unit would be undetectable by the Rb-Sr and Sm-Nd isotopic systems given the similarity in isotopic ratios between the arc magmas and the basalt. Although no whole-rock radiogenic isotope work was undertaken on the Pemberton Hills rocks, the zircon Lu-Hf isotopes can be used to assess contamination.

Hafnium is relatively incompatible and partitions more strongly into a melt than Lu during partial melting, resulting in lower $^{176}Lu/^{177}Hf$ and $^{176}Hf/^{177}Hf$ ratios observed in crustal material than in the mantle (Zhang et al., 2017). Under this assumption, material sourced from partial melting of juvenile crustal material will display a higher ∈Hf (t) signature whereas a negative ∈Hf (t) signature would be expected in material sourced from old crust (Zhang et al., 2017 and references therein). Zircon Lu-Hf data from three samples of intrusive rocks from Pemberton Hills show juvenile isotopic signatures, consistent with the AFC calculations by D'Souza et al. (2016) that suggest <10% crustal assimilation of Bonanza arc rocks. The tonalite dyke and granodiorite are essentially indistinguishable on the basis of their ∈Hf (t) signatures (avg. ∈Hf (t) of +11.2 and +11.4, respectively), whereas the quartz diorite is characterized by lower ∈Hf (t) values (avg. ∈Hf (t) of 9.5; Fig. 5.34), despite having a slightly more primitive composition. One potential

explanation for this could be that the quartz diorite experienced a long enough residency time in the magma chamber to assimilate relatively minor amounts of evolved crustal material, which would generate a less positive ∈Hf (t) signature than the granodiorite and tonalite dyke samples. This interpretation is consistent with the zircon trace element geochemistry, which suggests the quartz diorite samples experienced some form of REE contamination and mixing of least evolved and crustal melts (Fig. 5.33).

Despite the Bonanza arc being been built upon a thick non-continental crust, the zircon ∈Hf (t) values for intrusive rocks from Pemberton Hills are strongly positive and suggest a juvenile source. Other major subduction-related porphyry Cu environments have similar Hf isotopic signatures, such as El Teniente, Chile (+6 to +10; Muñoz et al., 2012), and Oyu Tolgoi, Mongolia (+11.6 to 14.5; Dolgopolova et al., 2013). The positive ∈Hf (t) values of intrusive rocks that suggest a primary mantle source and low degrees of contamination are reported in many porphyry deposits worldwide, and imply that irrespective of tectonic setting, juvenile sources are a critical component in the evolution of fertile magmas associated with porphyry Cu ± Au ± Mo mineralization (Dolgopolova et al., 2013 and references therein).

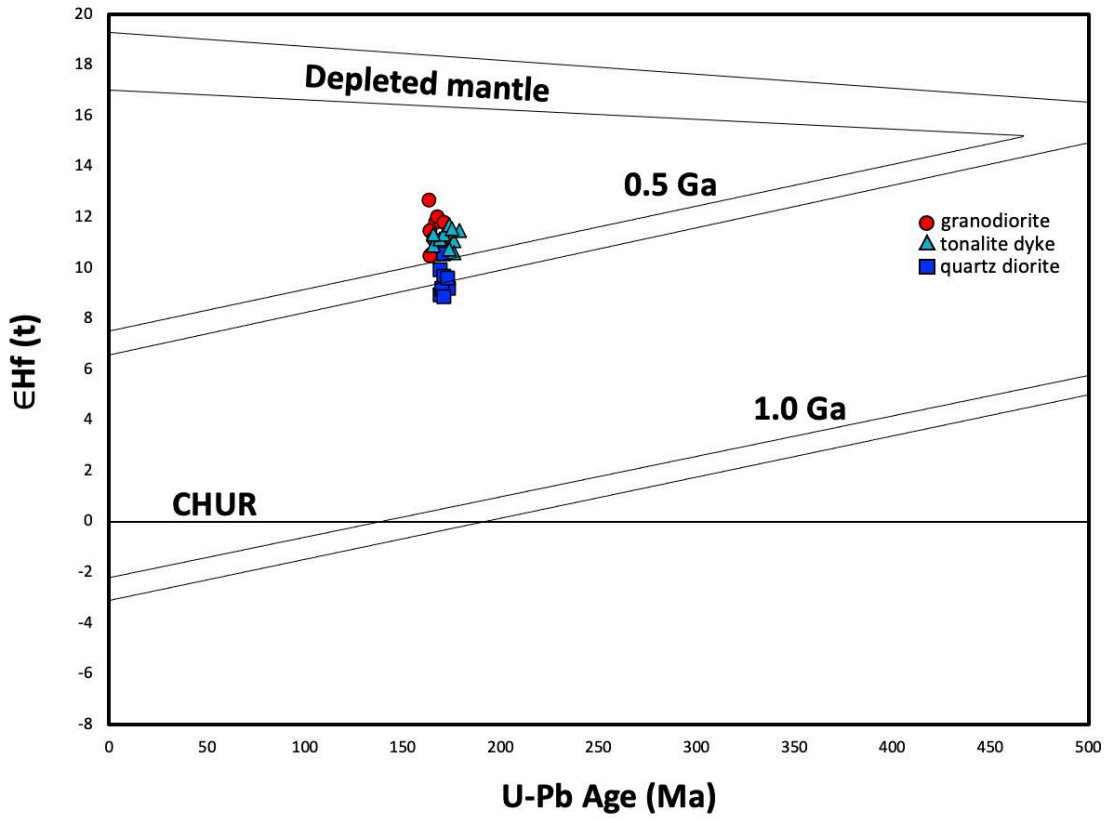


Figure 5.34. ∈Hf (t) vs. U-Pb age plot for zircons from various intrusive rocks at Pemberton Hills. CHUR is the chondritic uniform reservoir. Modified after Zhang and Li (2017).

5.2.7 Petrogenetic model

Based on the above the following petrogenetic model has been developed:

1. Subduction-related processes involving dehydration of the downgoing oceanic slab and subsequent release of fluids metasomatized the subarc mantle.

2. Partial melting of the forearc mantle generated primitive mafic magmas that rose to the crust-mantle boundary. The melts potentially ponded into two magma chambers, one that formed the mafic volcanic rocks, and one that formed the intermediate and felsic rocks. The Bonanza arc and its underlying crustal material likely exceed 24 km in thickness, meaning that melting at the base of the crust took place within the garnet stability field (D'Souza et al., 2016).

3. Fractionation of a hornblende-rich garnet-gabbro assemblage followed by low degrees of fractionation of a clinopyroxene gabbro resulted in a clinopyroxene- and plagioclase-rich basalt with low Al_2O_3/TiO_2 and SiO_2, relatively high Sr/Y, and low La/Yb.

4. Fractionation of a hornblende-olivine orthopyroxenite followed by early fractionation of an apatite-titanite-(garnet?)-hornblende gabbro assemblage resulted in magmas of intermediate composition with relatively low to moderate Al_2O_3/TiO_2, SiO_2, and Sr/Y.

5. Fractionation of a hornblende-olivine orthopyroxenite assemblage from the primitive mafic magma followed by late fractionation of an apatite-titanite-(garnet?)-hornblende gabbro assemblage generated the evolved felsic plutonic magma characterized by high Al_2O_3/TiO_2 and SiO_2, relatively moderate Sr/Y, and relatively high La/Yb.

6. Low, but increasing Eu/Eu* with high but decreasing Dy/Yb ratios in zircons from the quartz diorite samples suggest these magmas were weakly oxidized with ongoing amphibole fractionation that proceeded at shallow crustal levels until the onset of plagioclase crystallization and/or interaction with evolved crustal material highlighted by flattening of 10000*(Eu/Eu*)/Y ratios and mixing trends observed in the plot of Yb/Gd vs. Th/U in zircons from sample PM18AJ203. Relatively high, constant Eu/Eu* and low, constant Dy/Yb ratios of zircons from the granodiorite and tonalite dyke samples imply that these magmas were relatively oxidized, and fractionated amphibole at depth.

In summary, the onset of plutonism at Pemberton Hills is marked by the emplacement of granodiorite material at 172.34 ± 0.11 Ma in the northern Wanakana pluton, which lasted for a minimum of ~0.33 My and a maximum of ~0.8 My based on the emplacement age of the tonalite dyke at 171.77 ± 0.13 Ma. Intermediate plutonism was essentially synchronous with felsic

plutonism, marked by the emplacement of quartz diorite sample PM18AJ248 at 172.01 ± 0.17 Ma, and lasted for at least ~0.15 My and up to ~1.0 My based on the timing of crystallization for quartz diorite sample PM18AJ203 at 171.44 ± 0.25 Ma. Despite overlapping emplacement ages for felsic and intermediate plutonism, conditions in the magmas that produced these discrete rock types were very different, exemplified by various trace element ratios in the zircon geochemistry that suggest felsic plutonic magmas were more oxidized and had effectively fractionated amphibole at the time of crystallization. The magmas that derived the Bonanza arc rocks at Pemberton Hills were generated from a juvenile, lower mantle source and experienced minimal contamination or assimilation of crustal material, demonstrated by strongly positive ∈Hf (t) signatures and Nd and Sr isotope work that suggests <10% assimilation of Devonian Sicker group material occurred in Bonanza arc rocks (D'Souza et al., 2016). The slightly less positive ∈Hf (t) signature of the quartz diorite sample suggests a longer residency time and minor contamination of evolved crustal material during emplacement.

Chapter 6: Green Rock Mineral Chemistry and Hydrothermal Alteration of the Pemberton Hills Porphyry Environment

6.1 Introduction to porphyry deposits

Porphyry deposits are large tonnage, low-grade, base and precious metal resources. They may be classified based on the dominant metal type present (i.e., Au, Cu, Mo, Sn, W, and Ag), but are typically polymetallic, with porphyry copper $\pm$ gold $\pm$ molybdenum deposits being the most common (Kirkham and Sinclair, 1996; Seedorf et al., 2005; Holliday and Cooke, 2007). Skarn, carbonate-replacement, sediment-hosted, and high- and intermediate-sulfidation epithermal base and precious metal mineralization are also related to the porphyry systems (Sillitoe, 2010).

The porphyry deposit class is understood to be spatially, genetically, and temporally associated to subvolcanic porphyritic intrusive complexes that include the hypogene mineralization and surrounding hydrothermal alteration (Holliday and Cooke, 2007). Porphyry deposits are predominantly formed in magmatic arc and backarc environments that undergo a range of regional-scale stress regimes from moderately extensional through oblique slip to contractional (Tosdal and Richards, 2001; Sillitoe, 2010). An important spatial relationship is observed between large, high-grade porphyry deposits and contractional settings that experience crustal thickening, surface uplift, and rapid exhumation (Sillitoe, 2010 and references therein). Most porphyry deposits are associated with calc-alkalic intrusive complexes, but alkalic porphyry deposits are observed. Where present, alkalic porphyry systems are exclusively associated with Cu-Au mineralization (Holliday and Cooke, 2007). The degree of fractionation of the intrusive complexes is also understood to play a role in the distribution of the metals present,

with more fractionated calc-alkalic intrusions related to Cu-Mo mineralization, and less fractionated intrusions related to Cu-Au mineralization (Holliday and Cooke, 2007).

There is a broadly consistent alteration mineral zoning observed in porphyry deposits that form from the bottom of the porphyry system to the top and outwards, reflecting initial high emplacement temperatures of the intrusive complex, and subsequent cooling of the system (Sillitoe, 2010). Holliday and Cooke (2007) detailed the main porphyry alteration assemblages that are typically associated with the high-grade core of calc-alkalic porphyry systems (Fig. 6.1). They follow as such:

1) Potassic: characterized by potassium feldspar (orthoclase) and/or biotite and magnetite

2) Phyllic: an overprinting assemblage found near the core consisting of mainly sericite, quartz and pyrite

3) Advanced argillic: characterized by quartz, alunite, kaolinite, and/or pyrophyllite and may be associated with high sulfidation state mineralization

4) Calc-silicate (skarn): consists of combinations of garnet, pyroxene, epidote, calcite, chlorite, sulphides, quartz, and anhydrite that occur when carbonate wallrocks are present

Holliday and Cooke (2007) highlight that typically barren propylitic alteration halos (characterized by epidote, chlorite, carbonate, pyrite, and actinolite) can extend several kilometers outwards from the core of the porphyry system. Propylitic alteration can be classified into actinolite-, epidote-, and chlorite sub-facies that reflect temperature gradients moving away or towards the potassic core of the porphyry system (Norman et al., 1991; Garwin, 2002; Rae et al., 2003; Holliday and Cooke, 2007; Cooke et al., 2014; Fig. 6.1). Propylitic alteration comprises

part of the overall porphyry system including the ore deposit itself, as well as the underlying intrusions and the unmineralized wallrocks (Holliday and Cooke, 2007).

Holliday and Cooke (2007) also note that some porphyry deposits may contain magnetite- and feldspar-destructive quartz and clay alteration known as lithocaps (see Sillitoe, 1995; Fig. 6.1). Lithocaps may be described as stratabound domains of advanced argillic alteration and residual silicic alteration that are structurally rooted in phyllic and/or argillic alteration and form above porphyry deposits (Sillitoe, 1995). The roots of lithocaps are typically associated with steeply dipping faults that may also be host to high sulfidation state mineralization (Sillitoe, 1995; Hedenquist et al., 2000; Einaudi et al., 2003).

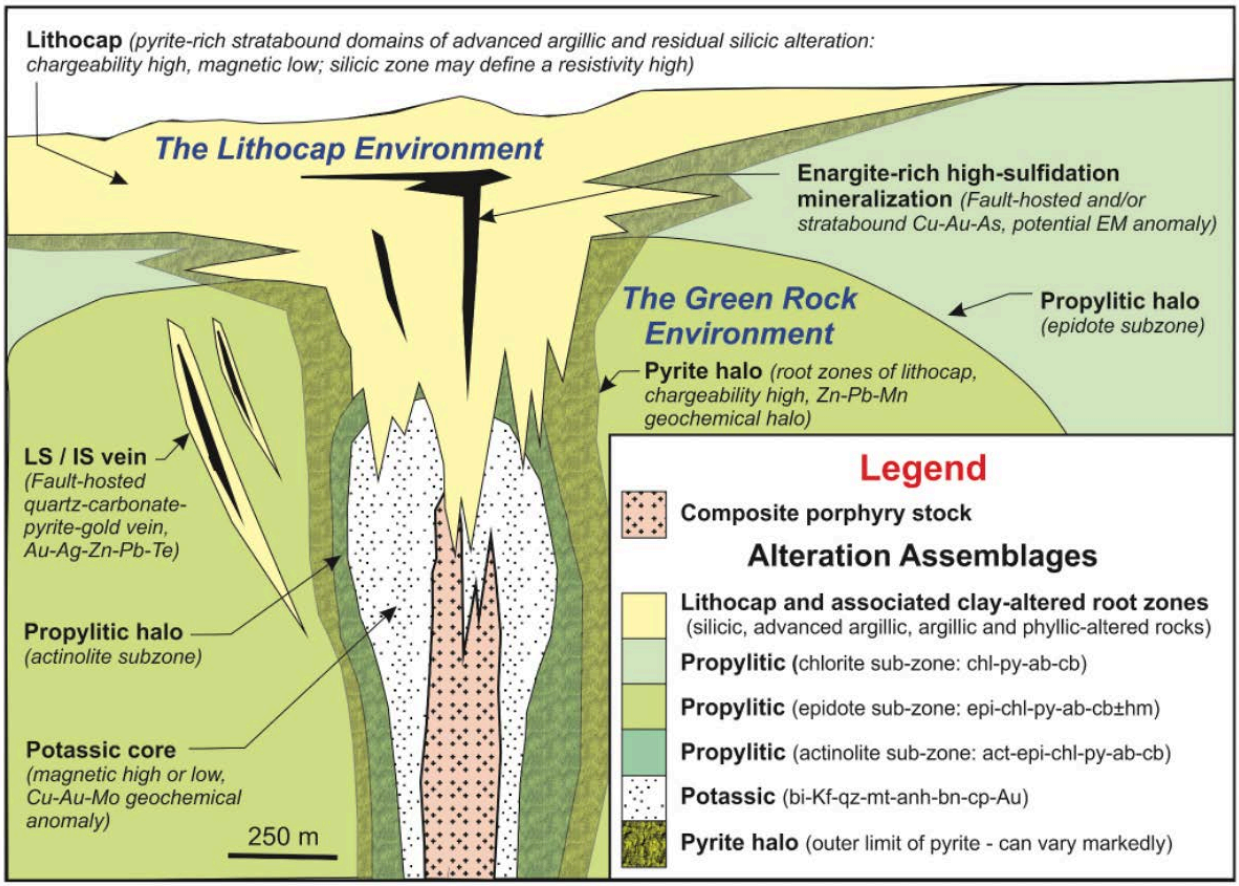


Figure 6.1. Schematic illustration of alteration zoning and overprinting relationships in the porphyry-epithermal environment. From Cooke et al. (2014) after Holliday and Cooke (2007).

Porphyry deposit mineralization characteristically manifests as a “stockwork” system of copper-sulphide veins with orientations that reflect the local intrusion-related stress regimes, or far-field stress regimes that occurred during the development of the deposit (Holliday and Cooke, 2007). Mineralization may occur in both the intrusive complexes and wallrocks, but the amount of mineralization that occurs in each is variable between deposits (Holliday and Cooke, 2007). The direct relationship between sulfidation state, which predominantly controls sulphide assemblages, and solution pH, which is a dominant control on alteration types, means that distinct opaque mineral assemblages will form with specific alteration types (Sillitoe, 2010 and references therein). In general, porphyry copper deposits have higher grade bornite-rich cores, that grade outwards into chalcopyrite-rich and outer pyrite-rich halos (Holliday and Cooke, 2007). The predominantly magmatic-hydrothermal fluids that produce the characteristic alteration zonation in porphyry deposits are also responsible for the mineralization, with the sulfur and metals in the deposits understood to have largely magmatic sources (Hedenquist and Richards, 1998; Holliday and Cooke, 2007). A meteoric fluid source is understood to be a critical component in the formation of supergene mineralization and oxidation of hypogene mineralization (Kirkham and Sinclair, 1996).

6.2 Results

6.2.1 Epidote mineral chemistry

Epidote was prevalent across most of the porphyry environment at Pemberton Hills and was observed in the majority of samples collected. Thirty-two epidote-bearing samples were selected for LA-ICP-MS analysis from across the property, resulting in 649 valid spot analyses (Fig. 6.2). In order to be considered valid, analyses were required to contain: 1) between 143,000 to 185,000 ppm Ca; 2) below 5000 ppm K; 3) above 75,000 ppm Al; 4) above 25,000 ppm Fe; 5) below 2000 ppm Na; 6) below 5000 ppm Mg; 7) below 2500 ppm Ti; and 8) below 200 ppm Zr. Vein epidote was the primary target for LA-ICP-MS analysis given the larger target size in veins compared to groundmass accumulations or grain replacements, however, there were a number of samples that did not contain any epidote veins. The concentrations of Ag, Al, As, Au, B, Ba, Bi, Ca, Ce, Co, Cr, Cu, Eu, Fe, Gd, Hf, K, La, Li, Lu, Mg, Mn, Na, Nb, Ni, Pb, Sb, Si, Sn, Sr, Ta, Th, Ti, Tl, U, V, Y, Yb, Zn, and Zr were obtained for all analyses (Table 6.1; Appendix F).

The epidote had concentrations > 1 wt. % for major elements such as Ca, Fe, Al, and Si and > 100 ppm for minor elements such as Mg, Mn, Sr, Ti, and V that could also reach up to the wt. % level. Trace elements that were the main focus of this study were detected over a range of concentrations, predominantly between 0.1 - 100 ppm. The LA-ICP-MS analysis was necessary in order to characterize effectively trace elements in epidote given their low concentrations. Trace elements that displayed average concentrations close to or > 10 ppm include As, B, Ce, Cr, K, La, Na, Pb, Sb, Y, and Zr, while elements such as Ag, Au, Ba, Bi, Co, Cu, Eu, Gd, Hf, Li, Lu, Nb, Ni, Sn, Ta, Th, Tl, U, Yb, and Zn typically showed average concentrations < 10 ppm.

Table 6.1. Summary of epidote LA-ICP-MS results at Pemberton Hills.

(n = 649)	n.N	n.BDL	Min.	Max.	Mean	Median	σ
Major Elements (wt. %)							
Ca	649	0	14.9	17.7	16.3	16.3	0.4
Al	649	0	9.9	14.2	12.2	12.2	0.8
Fe	649	0	5.3	12.9	9.2	9.3	1.4
Si	649	0	16.7	18.6	17.8	17.9	0.3
Minor Elements (ppm)							
Mg	649	0	37.50	4799	529.2	305.9	617.1
Mn	649	0	286.7	16,874	2352	1870	1867
Sr	649	0	253.9	5577	1575	1438	791.2
Ti	649	0	0.80	2342	424.3	333.2	360.9
V	649	0	4.79	1630	309.3	252.1	261.8
Trace Elements (ppm)							
Ag	7	642	0.05	1.45	0.27	0.06	0.49
As	647	2	0.26	228.5	14.72	9.30	21.02
Au	26	623	0.01	0.11	0.01	0.01	0.02
B	649	0	1.01	875.5	40.93	27.23	56.53
Ba	649	0	0.03	118.3	7.45	3.51	11.86
Bi	497	152	0.01	70.22	2.83	0.29	7.22
Ce	645	4	0.002	1188	26.15	4.75	84.12
Co	637	12	0.02	3.84	0.81	0.60	0.67
Cr	179	470	0.51	406.2	19.09	2.23	54.96
Cu	81	568	0.26	36.72	2.38	0.75	4.89
Eu	647	2	0.01	46.61	2.47	1.04	4.49
Gd	609	40	0.01	359.7	3.07	0.70	15.83
Hf	488	161	0.01	3.15	0.35	0.13	0.53
K	310	339	3.33	1204	64.20	16.27	130.6
La	644	5	0.002	647.0	15.05	2.73	43.35
Li	513	136	0.09	4.80	0.42	0.31	0.41
Lu	598	51	0.002	18.08	0.22	0.08	0.82
Na	495	154	7.01	1969	140.2	28.51	292.1
Nb	621	28	0.003	13.56	0.33	0.10	0.90
Ni	537	112	0.06	19.12	1.37	0.69	1.88
Pb	626	23	0.004	128.8	23.08	17.33	19.37
Sb	610	39	0.07	630.9	9.53	2.89	29.42
Sn	649	0	0.11	56.28	3.48	2.31	4.72
Ta	345	304	0.002	1.62	0.04	0.01	0.12
Th	410	239	0.003	145.5	1.13	0.06	7.95
Tl	12	637	0.01	0.05	0.02	0.02	0.01
U	580	69	0.003	70.81	1.99	0.44	5.39
Y	648	1	0.003	1660	15.45	4.35	70.17
Yb	616	33	0.01	149.0	1.42	0.49	6.33
Zn	648	1	0.56	42.32	7.38	5.89	5.72
Zr	637	12	0.01	169.8	9.73	2.62	17.69

* n.N is number of valid analyses, n.BDL is number of analyses below detection limit

6.2.2 Chlorite mineral chemistry

Chlorite was widely observed across the porphyry environment at Pemberton Hills and was present in the majority of samples collected. Thirty-two chlorite-bearing samples were selected for LA-ICP-MS analysis from across the property, resulting in 515 valid analyses (Fig. 6.3). In order to be considered valid, analyses were required to contain: 1) between 100,000 and 225,000 ppm Si; 2) below 1000 ppm K; 3) below 1000 ppm Ti; 4) below 30,000 ppm Ca; and 5) below 3 ppm Zr. Vein chlorite was the primary target for LA-ICP-MS analysis given the larger target size in veins compared to groundmass accumulations or grain replacements, however, the majority of samples selected for this study did not contain vein chlorite. The concentrations of Ag, Al, As, Au, B, Ba, Bi, Ca, Ce, Co, Cr, Cu, Eu, Fe, Gd, Hf, K, La, Li, Lu, Mg, Mn, Na, Nb, Ni, Pb, Sb, Si, Sn, Sr, Ta, Th, Ti, Tl, U, V, Y, Yb, Zn, and Zr were obtained for all analyses (Table 6.2; Appendix G).

Chlorite displayed concentrations > 1 wt. % for major elements such as Al, Fe, Mg, and Si and generally between 1000 ppm – 1 wt. % for minor elements such as Ca and Mn. Trace elements were detected over a wide range of concentrations, typically between 0.1 - 1000 ppm. Trace elements that displayed average concentrations between 100 – 1000 pm include B, Co, Cr, Na, Ni, V, and Zn while elements such as As, Ba, Ce, Cu, K, Li, Pb, Sn, Sr, Ti, and Y showed average concentrations between 1 - 100 ppm. Trace elements with average concentrations < 1 ppm include Ag, Au, Bi, Eu, Gd, Hf, La, Lu, Nb, Sb, Ta, Th, Tl, U, Yb, and Zr.

Table 6.2. Summary of chlorite LA-ICP-MS results at Pemberton Hills.

(n = 515)	n.N	n.BDL	Min.	Max.	Mean	Median	σ
Major Elements (wt. %)							
Al	515	0	5.8	12.9	9.5	9.7	1.0
Fe	515	0	7.4	29.6	18.0	18.5	4.0
Mg	515	0	2.4	16.8	10.4	10.2	2.6
Si	515	0	10.3	19.2	13.3	13.1	1.3
Minor Elements (ppm)							
Ca	515	0	165.3	26,853	2488	1004	3743
Mn	515	0	902.5	16,480	5212	5058	2680
Trace Elements (ppm)							
Ag	28	487	0.02	0.60	0.10	0.06	0.12
As	421	94	0.15	176.1	4.25	0.73	15.17
Au	32	483	0.004	0.04	0.01	0.01	0.01
B	512	3	0.62	2287	139.6	14.29	306.4
Ba	515	0	0.10	175.9	10.31	3.66	17.53
Bi	95	420	0.003	1.05	0.11	0.05	0.16
Ce	495	20	0.002	47.73	1.46	0.21	4.31
Co	515	0	1.15	1084	103.9	81.83	105.8
Cr	463	52	0.44	3846	149.6	15.46	461.9
Cu	487	28	0.21	2095	63.74	3.44	258.3
Eu	413	102	0.002	2.15	0.09	0.03	0.25
Gd	408	107	0.01	7.01	0.36	0.11	0.82
Hf	296	219	0.004	0.27	0.04	0.03	0.04
K	515	0	4.84	984.5	88.53	45.64	128.9
La	468	47	0.002	19.30	0.85	0.15	2.15
Li	515	0	10.33	251.4	67.31	63.38	29.51
Lu	413	102	0.002	0.38	0.03	0.01	0.05
Na	509	6	5.46	30,363	429.5	70.53	2155
Nb	324	191	0.002	0.82	0.03	0.02	0.06
Ni	515	0	6.73	3472	143.3	54.06	270.8
Pb	456	59	0.002	96.67	2.83	0.23	9.07
Sb	101	414	0.04	3.47	0.27	0.14	0.48
Sn	511	4	0.11	7.69	1.64	1.50	0.94
Sr	515	0	0.44	556.4	14.70	5.36	36.42
Ta	168	347	0.002	0.06	0.01	0.005	0.01
Th	294	221	0.002	69.89	0.45	0.02	4.10
Ti	515	0	5.68	916.7	83.83	61.95	77.95
Tl	66	449	0.01	0.80	0.07	0.03	0.12
U	383	132	0.002	4.19	0.19	0.03	0.54
V	515	0	56.33	1162	279.6	228.2	197.3
Y	514	1	0.005	36.72	1.90	0.61	4.18
Yb	433	82	0.006	2.42	0.16	0.06	0.29
Zn	515	0	74.02	6477	573.8	467.4	474.0
Zr	505	10	0.004	2.96	0.60	0.29	0.69

* n.N is number of valid analyses, n.BDL is number of analyses below detection limit

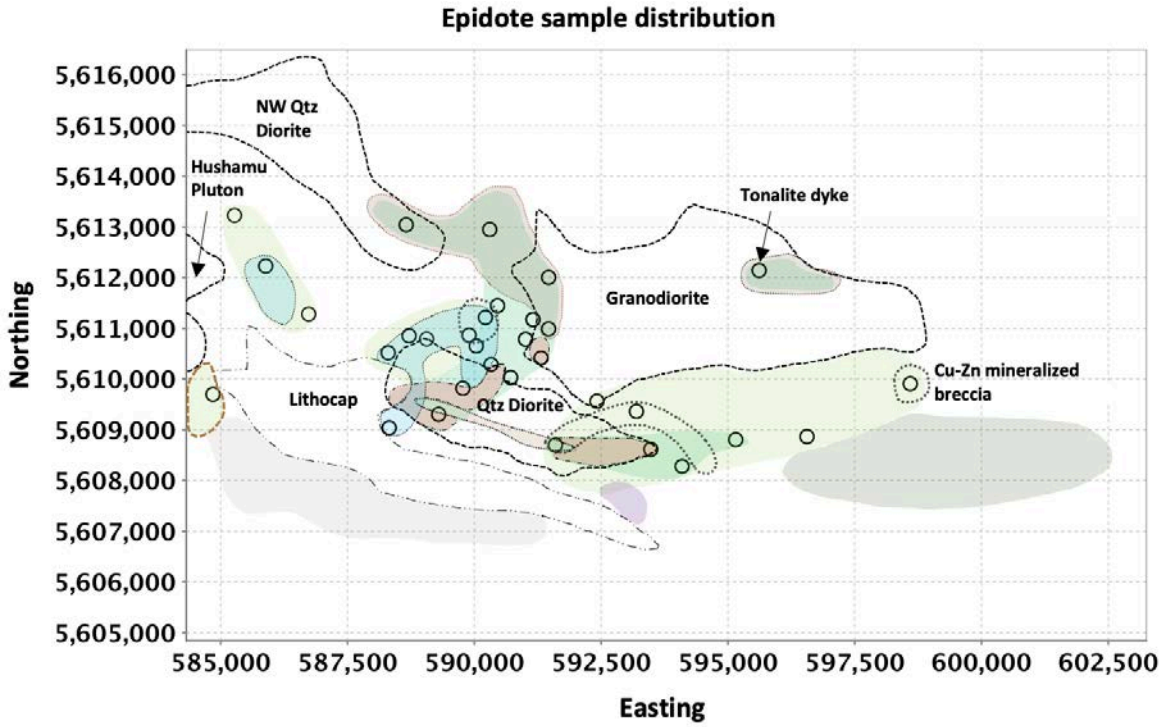


Figure 6.2. Map showing locations of samples used for epidote mineral chemistry analysis at Pemberton Hills. Outlines of plutonic units modified after Nixon et al. (2011a, b).

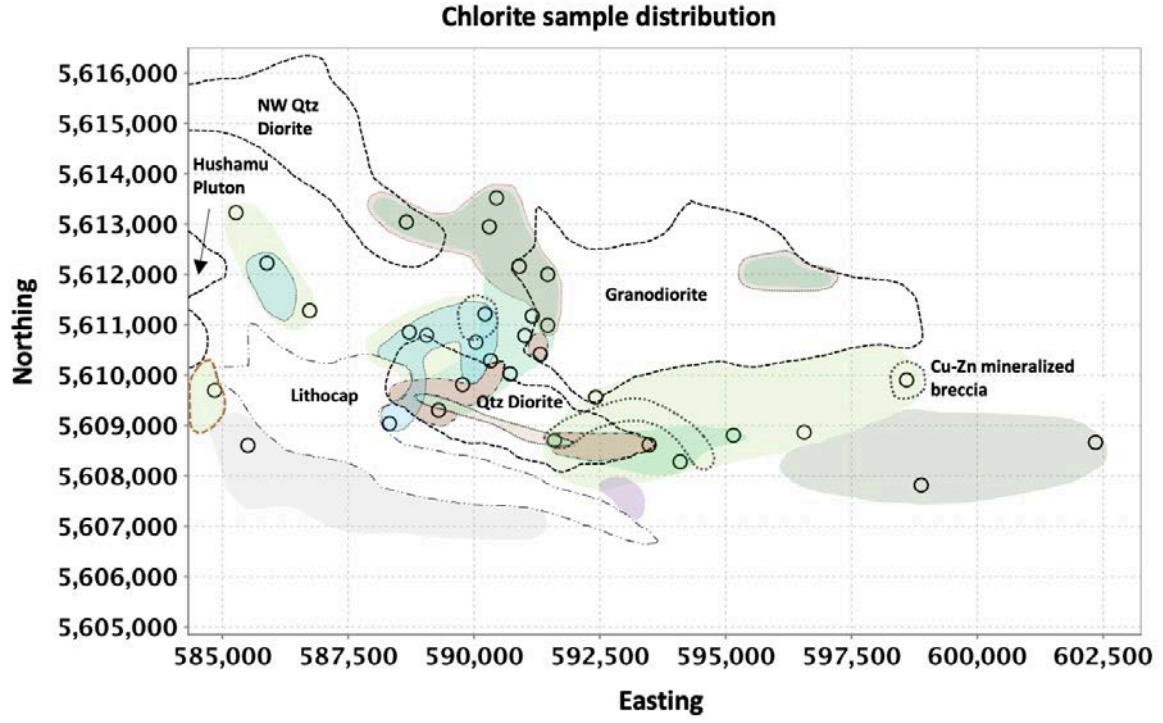


Figure 6.3. Map showing locations of samples used for chlorite mineral chemistry analysis at Pemberton Hills. Outlines of plutonic units modified after Nixon et al. (2011a, b).

6.2.3 Pyrite mineral chemistry

Pyrite was observed throughout most of the porphyry environment at Pemberton Hills, generally occurring in greater abundances towards the center of the study site and was observed less on the south side of the lithocap and in the northern regions of the study site. Chemical etching was completed on all pyrite samples used for LA-ICP-MS analysis to highlight any compositional zoning. Twenty pyrite-bearing samples were selected for LA-ICP-MS analysis (Fig. 6.4). The concentrations of Ag, As, Au, Bi, Co, Cu, Mn, Mo, Ni, Pb, Re, Sb, Se, Te, Ti, V, and Zn were obtained for all analyses (Table 6.3; Appendix H).

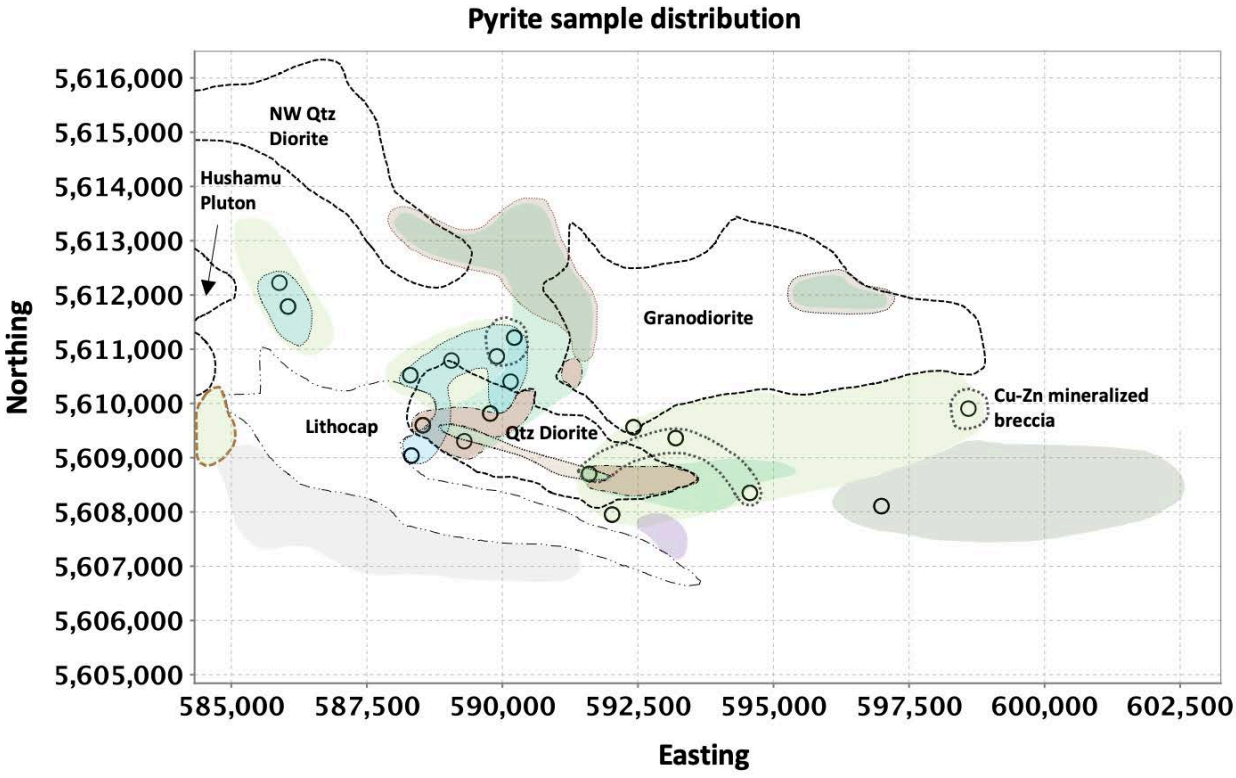


Figure 6.4. Map showing locations of samples used for pyrite mineral chemistry at Pemberton Hills. Outlines of plutonic units modified after Nixon et al. (2011a, b).

Precious metal concentrations in pyrite showed varying mean concentrations of 0.11 ppm Au, 3.73 ppm Ag, and 0.21 ppm Re. Maximum values of Au, Ag, and Re were 6.31 ppm, 150.7

ppm, and 22.42 ppm, respectively. Metalloids such as Sb, As, and Te displayed mean concentrations of 3.87 ppm, 414 ppm, and 31.8 ppm and maximum values of 158 ppm, 7820 ppm, and 808 ppm, respectively. Transition metals such as Bi and Pb showed mean concentrations of 8.65 ppm and 82.67 ppm and maximum values of 906 ppm and 12,207 ppm, respectively. Metals such as Co, Ni, Cu, Zn, and Mo displayed mean concentrations of 479 ppm, 373 ppm, 98.05 ppm, 33.38 ppm, and 22.35 ppm, and maximum values of 23,497 ppm, 13,199 ppm, 4975 ppm, 1167 ppm, and 1999 ppm, respectively. Non-metals such as Se showed a mean and maximum concentration of 132 ppm and 1472 ppm, respectively. Other elements of interest including Mn, Ti, and V displayed mean concentrations of 224 ppm, 650 ppm, and 19.95 ppm and maximum values of 11,519 ppm, 30,808 ppm, and 1018 ppm, respectively.

Table 6.3. Summary of pyrite LA-ICP-MS results for select elements at Pemberton Hills

(n = 400)	n.N	n.BDL	Min.	Max.	Mean	Median	σ
Elements (ppm)							
Ag	354	46	0.007	150.7	3.73	0.49	12.51
As	394	6	0.82	7820	413.6	94.20	973.2
Au	228	172	0.003	6.31	0.11	0.02	0.44
Bi	373	27	0.002	906.1	8.65	0.24	59.97
Co	399	1	0.08	23,497	479.3	160.1	1551
Cu	392	8	0.19	4975	98.05	10.90	394.4
Mn	348	52	0.24	11,519	224.2	26.70	900.2
Mo	269	131	0.007	1999	22.35	0.16	155.1
Ni	400	0	0.09	13,199	372.6	42.98	1625
Pb	394	6	0.01	12,207	82.67	13.95	625.9
Re	145	255	0.002	22.42	0.21	0.01	1.85
Sb	349	51	0.01	158.1	3.87	0.86	12.11
Se	374	26	2.84	1472	131.9	44.57	206.2
Te	364	36	0.14	808.5	31.80	10.67	72.20
Ti	396	4	0.84	30,808	649.8	9.09	2583
V	350	50	0.01	1018	19.95	3.83	71.77
Zn	281	119	0.44	1167	33.38	4.52	111.1

* n.N is number of valid analyses, n.BDL is number of analyses below detection limit

6.2.4 Pyrite element maps

Pyrite element maps were generated using LA-ICP-MS analysis as a way to observe any compositional variations within pyrite grains from across the Pemberton Hills study site. The pyrite grain from sample PM18AJ031 displays discrete zones of elevated Zn, Ag, Cu, Sb, Pb, Bi and Ni towards the center of the grain, while As and Co are enriched in roughly concentric zones surrounding the outer core of the grain and along parts of the rim (Fig. 6.5). Zones of elevated Se occur along parts of the rim specifically where As and Co are low (Fig. 6.5). The pyrite grain from sample PM18AJ281 displays an As, Au, Te, and Sb enriched core (Fig. 6.6). Nickel and Co are enriched in a thin band that surrounds most of the inner grain, which shows elevated levels of Au, Cu, Mo, and Sb and is depleted in Se (Fig. 6.6). The pyrite grain from sample PM18AJ201-A exhibits patchy Re enrichment throughout the grain, whereas Se and Te enrichment is more evenly distributed throughout the grain except in the rim (Fig. 6.7). The rim of the pyrite grain displays enrichment in Co, Ni, As, Cu, Pb, and Bi (Fig. 6.7). The pyrite grain from sample PM18AJ201-B similarly displays patchy Re and Te enrichment throughout the center of the grain (Fig. 6.8). Cobalt is enriched in concentric bands that occur throughout the inner parts of the grain and along parts of the rim (Fig. 6.8). The pyrite grain also displays a Cu and partially Ni and As enriched rim (Fig. 6.8). The pyrite grain from sample PM18AJ215 exhibits a Te, Cu, Bi, and Pb enriched core, with elevated Sb occurring in the outer margins of the core (Fig. 6.9). Concentric bands of elevated As and Co occur throughout the grain (Fig. 6.9). Elevated Ni occurs along the outer margins and rim of the pyrite grain (Fig. 6.9). The rim of the pyrite grain displays enrichment in Mo, Bi, Pb, Sb, and partial enrichment in Ni (Fig. 6.9). The pyrite grain from sample PM18AJ290 displays an As, Te, and partially Co enriched core, with elevated zones of Co and Ni surrounding

the core (Fig. 6.10). The rim of the pyrite grain is enriched in Pb an Cu (Fig. 6.10). The pyrite grain from sample PM18AJ222-A displays a Co, As and partially Ni enriched core that is surrounded by zones of elevated Se, Te, Pb, Cu, Zn, and Au (Fig. 6.11). The pyrite grain from sample PM18AJ222-B also displays a Co, As, and partially Ni and Zr enriched core surrounded by elevated zones of Pb, Te, Cu, Se, and Au (Fig. 6.12).

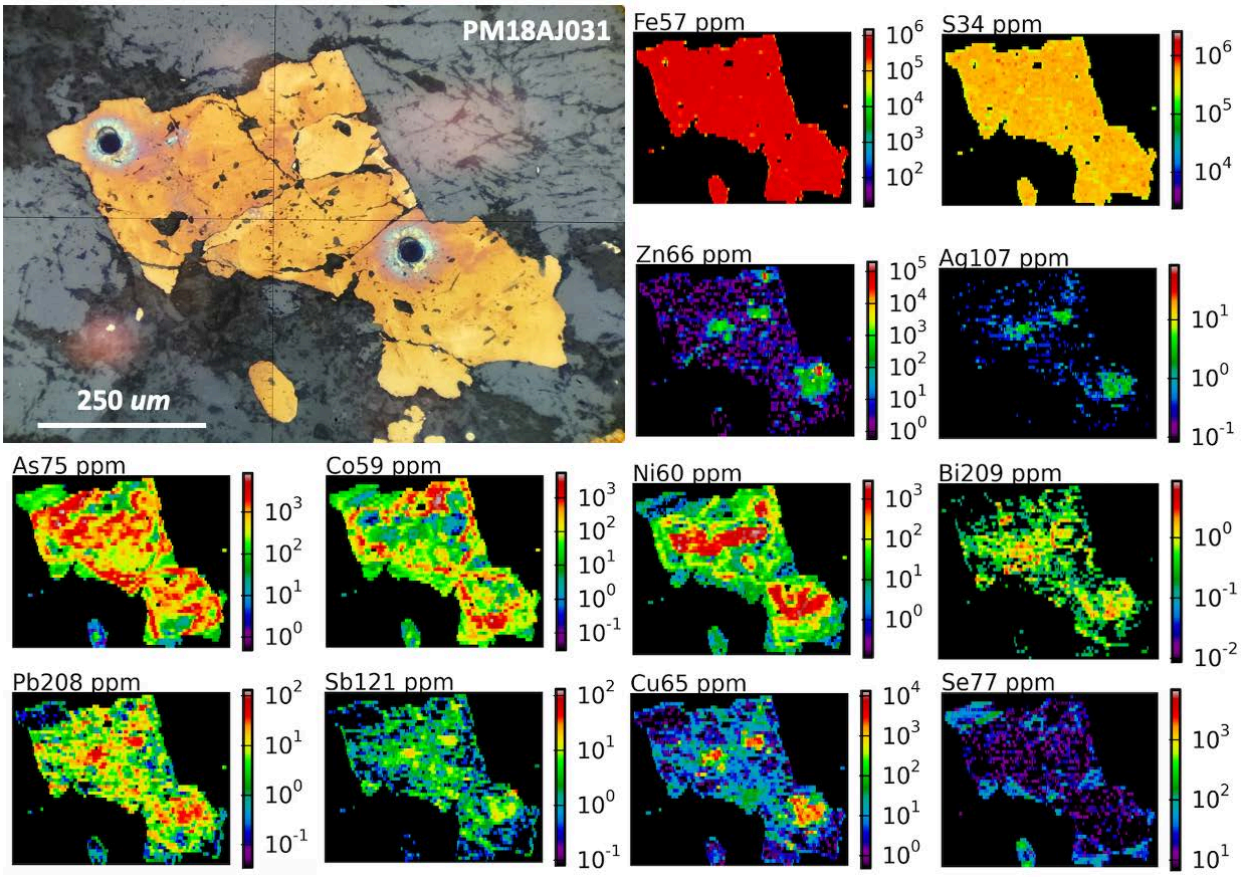


Figure 6.5. Elemental maps of Fe, S, Zn, Ag, As, Co, Ni, Bi, Pb, Sb, Cu, and Se generated by LA-ICP-MS analysis of pyrite from sample PM18AJ031.

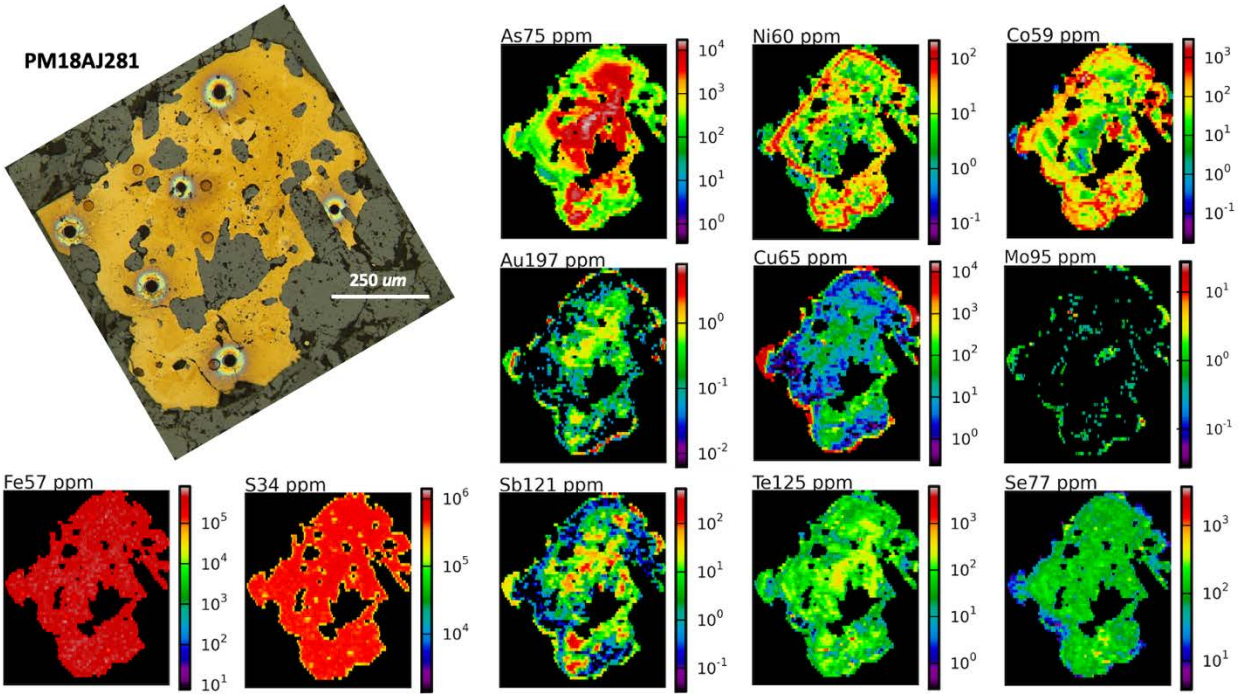


Figure 6.6. Elemental maps of Fe, S, As, Ni, Co, Au, Cu, Mo, Sb, Te, and Se generated by LA-ICP-MS analysis of pyrite from sample PM18AJ281.

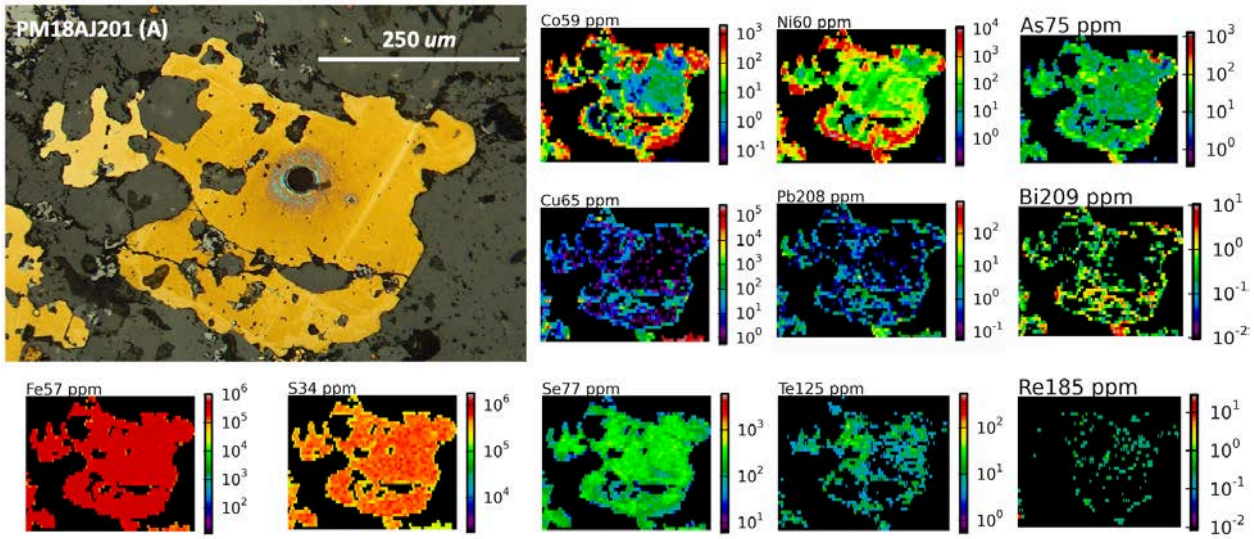


Figure 6.7. Elemental maps of Fe, S, Co, Ni, As, Cu, Pb, Bi, Se, Te, and Re generated by LA-ICP-MS analysis of pyrite from sample PM18AJ201-A.

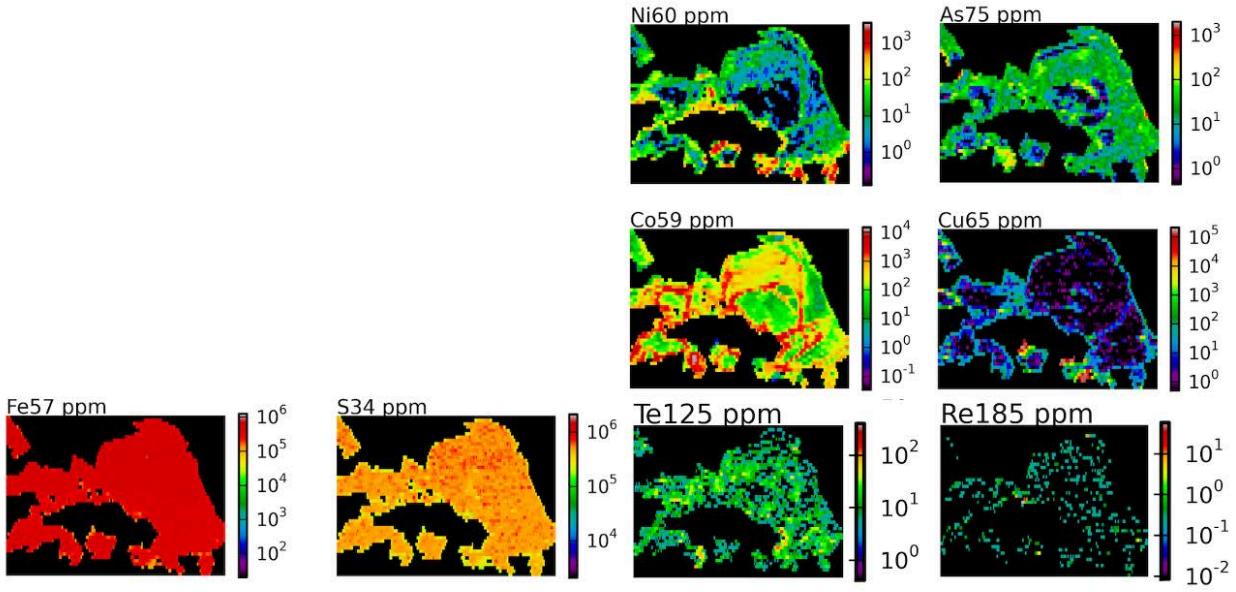


Figure 6.8. Elemental maps of Fe, S, Co, Ni, As, Cu, Te, and Re generated by LA-ICP-MS analysis of pyrite from sample PM18AJ201-B. No reflected light image of the pyrite grain available.

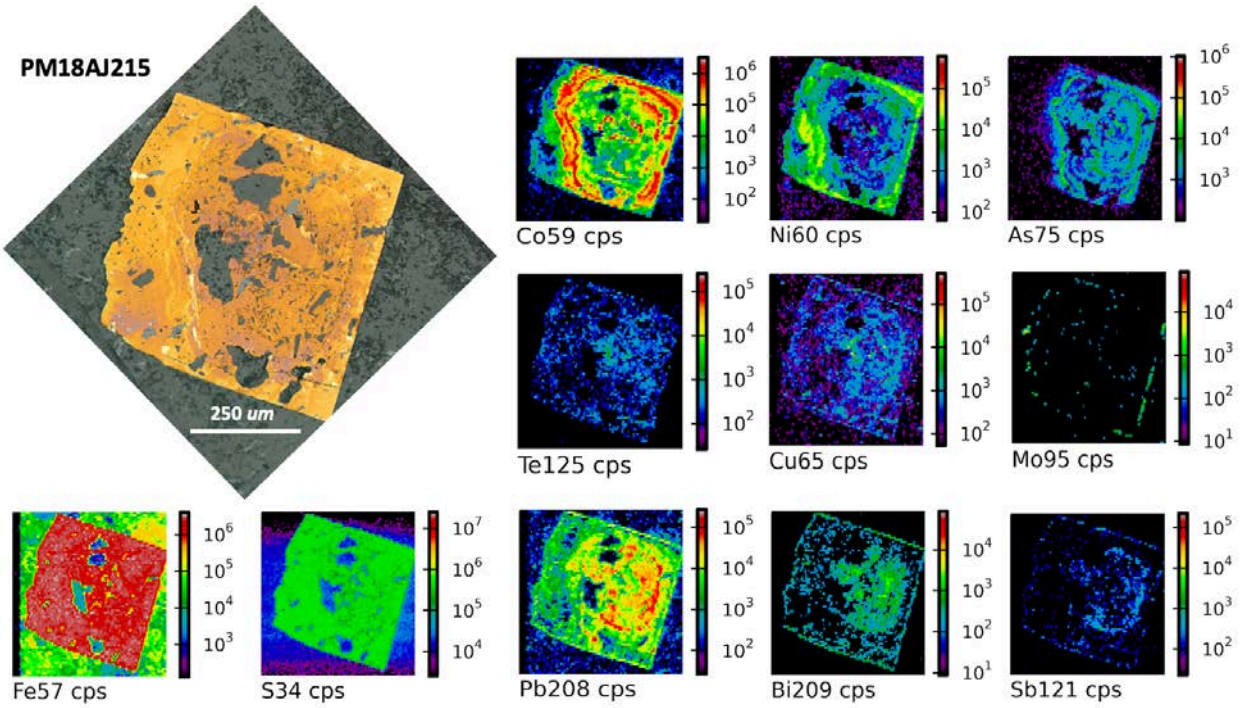


Figure 6.9. Elemental maps of Fe, S, Co, Ni, As, Te, Cu, Mo, Pb, Bi, and Sb generated by LA-ICP-MS analysis of pyrite from sample PM18AJ215.

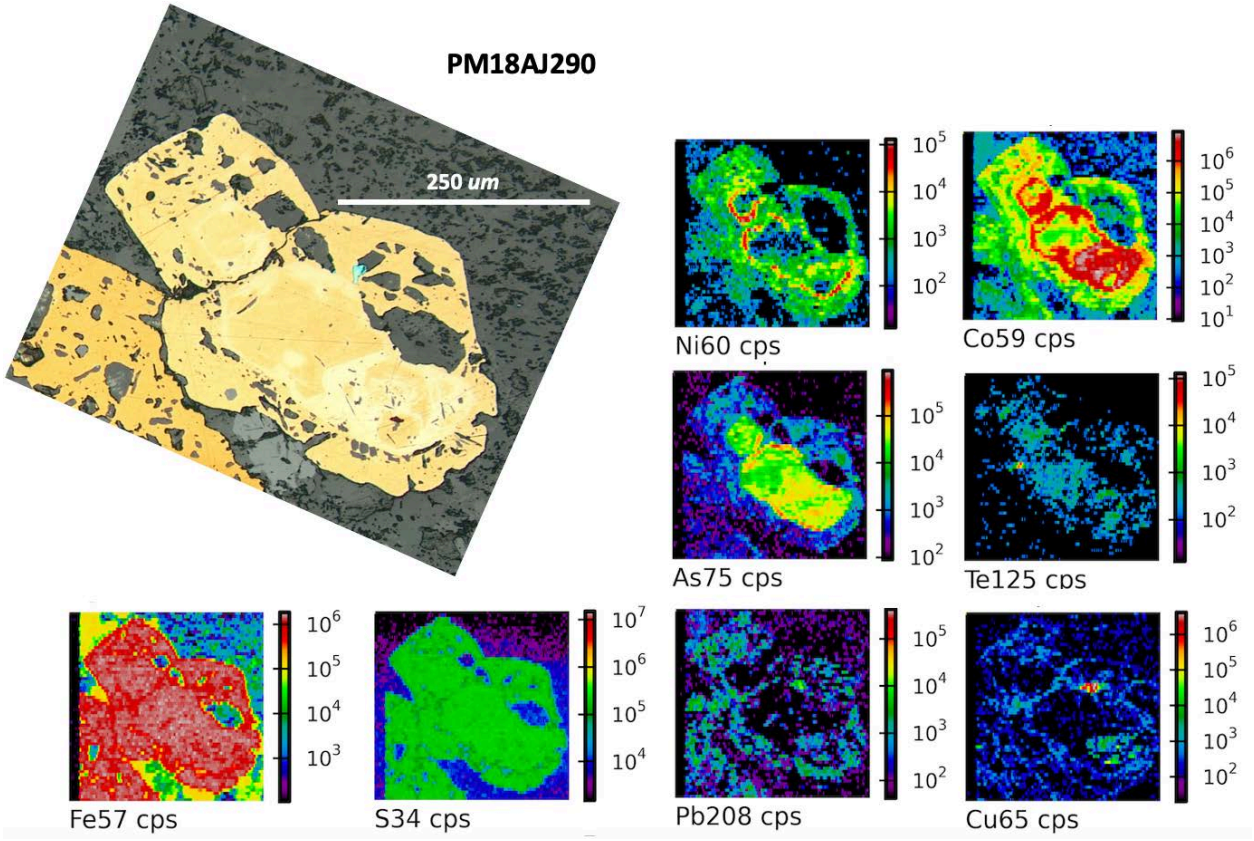


Figure 6.10. Elemental maps of Fe, S, Co, Ni, As, Te, Pb, and Cu generated by LA-ICP-MS analysis of pyrite from sample PM18AJ290.

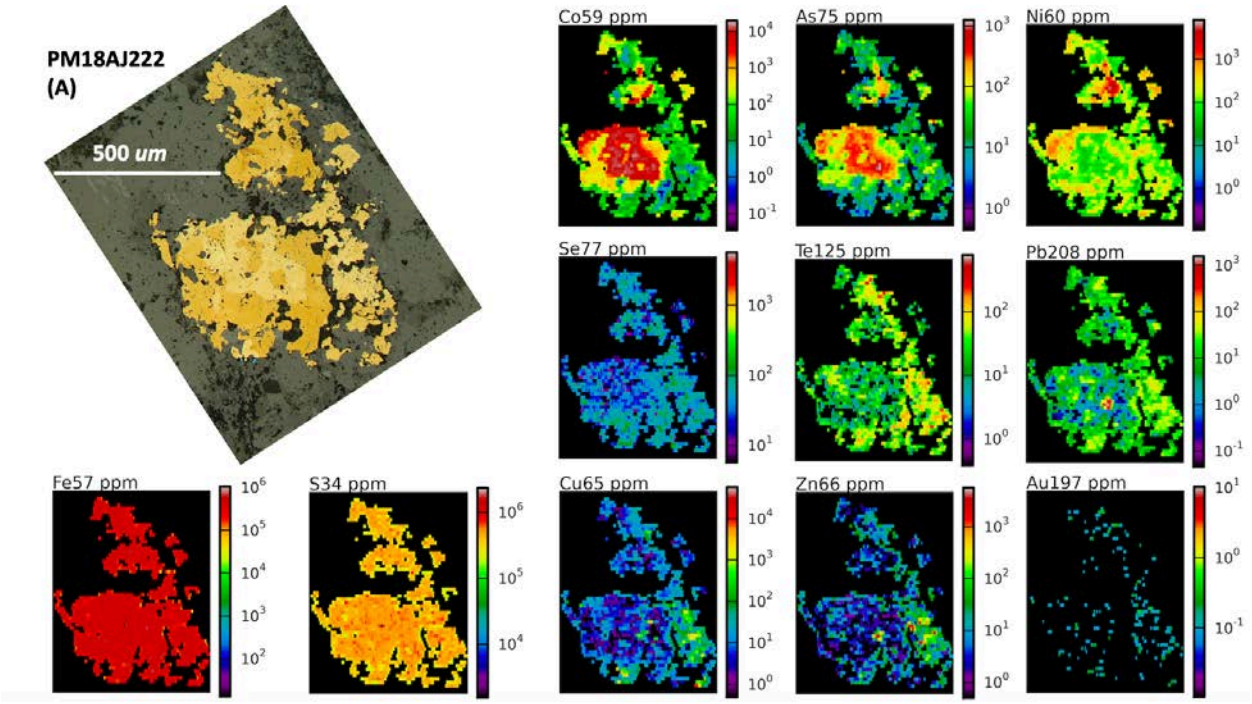


Figure 6.11. Elemental maps of Fe, S, Co, As, Ni, Se, Te, Pb, Cu, Zn, and Au generated by LA-ICP-MS analysis of pyrite from sample PM18AJ222-A.

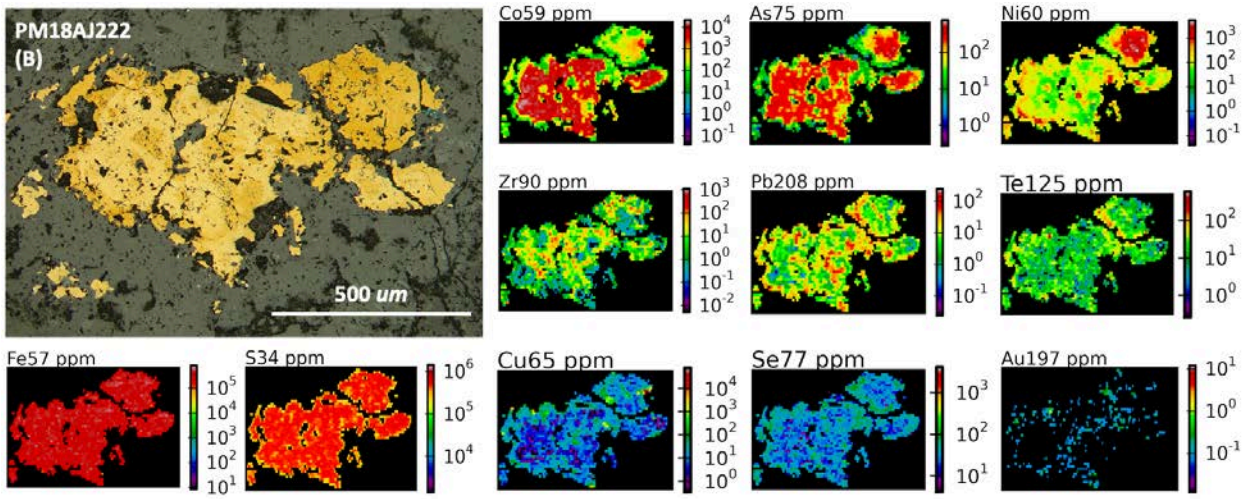


Figure 6.12. Elemental maps of Fe, S, Co, As, Ni, Zr, Pb, Te, Cu, Se, and Au generated by LA-ICP-MS analysis of pyrite from sample PM18AJ222-B.

6.2.5 Whole-rock carbon and oxygen isotopes

Whole-rock carbon and oxygen compositions as well as total carbon contents are reported together with the dominant rock and alteration types for 40 samples from the Pemberton Hills study site in Table 6.4. Rock types have been subdivided into felsic plutonic rocks, hydrothermal breccias, intermediate plutonic rocks, mafic volcanic rocks, volcanic breccias, and mafic dykes in order to best characterize the samples used in this study. Similarly, alteration has been subdivided into groups that reflect the most dominant alteration type observed in each sample and includes clay, phyllic, potassic, propylitic-actinolite, propylitic-epidote, propylitic-chlorite, and skarn alteration.

Quartz-carbonate-epidote hydrothermal breccia samples have the lowest overall $\boldsymbol{\delta}^{13}$C values (-12.5 to -8.6‰) while exhibiting relatively moderate $\boldsymbol{\delta}^{18}$O values (10.0 to 13.0). Potassic altered samples display a narrow range of relatively low $\boldsymbol{\delta}^{13}$C values (-10.2 to -7.7‰) and have moderately high $\boldsymbol{\delta}^{18}$O values (11.5 to 16) with the exception of one outlier sample that has high $\boldsymbol{\delta}^{13}$C and $\boldsymbol{\delta}^{18}$O values of 1.4‰ and 19.7‰, respectively. Actinolite altered samples display two sub-populations of $\boldsymbol{\delta}^{13}$C and $\boldsymbol{\delta}^{18}$O values, the first characterized by relatively high $\boldsymbol{\delta}^{13}$C values (-5.2 to -3.4‰) and moderate $\boldsymbol{\delta}^{18}$O values (11.0 to 16.5‰) and the second consisting of two samples that display the lowest overall $\boldsymbol{\delta}^{13}$C values (-34.2 to -22.5‰) and high $\boldsymbol{\delta}^{18}$O values (16.5 to 18.2‰). Epidote altered samples display a similar range in $\boldsymbol{\delta}^{13}$C and $\boldsymbol{\delta}^{18}$O values to the first sub-population of actinolite altered samples (-7.7 to -4.8‰ and 12.5 to 13.3‰, respectively). Distal chlorite altered samples are characterized by high $\boldsymbol{\delta}^{13}$C values (-3.36 to 1.3‰), while displaying low to moderate $\boldsymbol{\delta}^{18}$O values (4 to 10.7‰). One sample of skarn alteration (PM18AJ242) has a relatively high $\boldsymbol{\delta}^{13}$C value of -3‰ and a low $\boldsymbol{\delta}^{18}$O value of 6.0‰. Phyllic altered

samples have a narrow range in high $\delta^{13}C$ values (-4.0 to -5.0‰) and display the lowest overall $\delta^{18}O$ values (3.8 to 9.5‰). Lastly, clay altered samples display the widest overall range in $\delta^{13}C$ and $\delta^{18}O$ values observed between alteration types in this study (-13.3 to 4.4‰ and 5.3 to 19‰, respectively).

Table 6.4. Summary of Whole-Rock ^{13}C and ^{18}O Isotope Results from Pemberton Hills

Sample	Easting	Northing	Elevation (meters)	Rock type	Alteration type(s)	Total C (%)	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)
PM18AJ202	588684	5609604	313.66	Intermediate Intrusive Rock	Propylitic > Phyllic	0.05	-4.58	11.54
PM18AJ208	589196	5610654	501.39	Intermediate Volcanic Rock	Propylitic	0.02	-5.09	12.41
PM18AJ212	588714	5610855	492.19	Intermediate Volcanic Rock	Phyllic > Propylitic	0.13	-4.17	6.82
PM18AJ213	588686	5610644	437.28	Intermediate Intrusive Rock	Potassic > Phyllic	0.06	-9.24	15.45
PM18AJ219	589897	5610868	531.83	Intermediate Volcanic Rock	Phyllic > Propylitic	0.19	-4.14	9.55
PM18AJ222	590151	5610402	521.53	Mafic Volcanic Rock	Propylitic	0.05	-4.65	11.83
PM18AJ236	590895	5610935	412.10	Mafic Volcanic Rock	Propylitic	0.1	-5.24	16.55
PM18AJ237	590909	5611194	427.58	Mafic Volcanic Rock	Propylitic	0.06	-3.41	13.39
PM18AJ242	584847	5609697	232.12	Intermediate Volcanic Rock	Skarn	0.46	-3.00	5.95
PM18AJ244	585508	5608606	180.36	Volcanic Breccia	Clay	0.05	-8.17	15.73
PM18AJ246	588773	5610060	362.75	Intermediate Intrusive Rock	Potassic	0.26	-7.71	11.46
PM18AJ248	589249	5609431	237.54	Intermediate Intrusive Rock	Potassic > Propylitic	0.1	-10.19	14.66
PM18AJ250	591309	5607354	24.42	Intermediate Volcanic Rock	Clay	0.88	-2.61	5.27
PM18AJ254	587798	5607041	55.53	Intermediate Volcanic Rock	Clay	1.23	4.36	15.01
PM18AJ257	587410	5607222	55.15	Volcanic Breccia	Clay	0.21	-2.81	18.98
PM18AJ261	586053	5611432	435.81	Intermediate Volcanic Rock	Phyllic > Propylitic	0.17	-5.03	4.55
PM18AJ263	586536	5611168	409.55	Volcanic Breccia	Phyllic > Propylitic	0.35	-4.66	6.51
PM18AJ264	586734	5611280	403.16	Intermediate Volcanic Rock	Propylitic	0.11	-4.82	12.53
PM18AJ274	591465	5612000	152.41	Felsic Plutonic Rock	Potassic > Propylitic	0.45	-9.72	16.04
PM18AJ275	591599	5608702	144.53	Intermediate Intrusive Rock	Potassic > Propylitic	0.86	-9.25	14.21
PM18AJ276	593223	5607289	53.86	Intermediate Volcanic Rock	Clay > Propylitic	1.01	-1.73	7.92
PM18AJ277	593071	5607690	90.44	Volcanic Breccia	Clay > Propylitic	0.47	-6.43	9.54
PM18AJ278	592629	5607800	85.43	Intermediate Volcanic Rock	Clay	0.94	-5.99	15.09
PM18AJ280	585842	5609165	120.13	Intermediate Volcanic Rock	Clay	0.22	-5.26	11.35
PM18AJ282	593196	5609362	193.09	Hydrothermal Breccia	Propylitic	0.86	-11.96	10.04
PM18AJ283	593480	5608618	187.88	Intermediate Intrusive Rock	Propylitic > Potassic	0.1	-22.50	18.18
PM18AJ284	594564	5608352	140.20	Volcanic Breccia	Propylitic	0.3	-3.38	10.96
PM18AJ285	595154	5608807	215.91	Volcanic Breccia	Propylitic	0.06	-34.17	16.54
PM18AJ288	595618	5612145	266.10	Pyroxenite Dyke	Potassic	0.03	-7.70	15.81
PM18AJ289	595615	5612138	267.82	Felsic Plutonic Rock	Potassic > Propylitic	0.08	-6.96	14.08
PM18AJ291	584668	5609068	128.02	Hydrothermal Breccia	Carbonate (Propylitic?)	1.68	-8.64	11.99
PM18AJ295	588998	5610565	426.34	Intermediate Volcanic Rock	Propylitic	0.07	-7.72	14.34
PM18AJ296	588321	5610484	402.24	Intermediate Volcanic Rock	Phyllic	0.17	-4.02	3.84
PM18AJ300	589276	5612717	396.15	Intermediate Intrusive Rock	Potassic > Propylitic	0.06	1.39	19.75
PM18AJ305	598885	5607817	60.17	Intermediate Volcanic Rock	Propylitic > Background?	0.63	-3.65	10.72
PM18AJ306	591051	5607013	20.82	Volcanic Breccia	Clay	0.09	-13.34	18.49
PM18AJ307	596991	5608108	60.44	Intermediate Volcanic Rock	Clay > Propylitic	1.08	-2.57	3.94
PM18AJ309	598595	5609905	132.05	Hydrothermal Breccia	Propylitic	0.47	-12.53	12.96
PM18AJ311	602349	5608664	73.92	Intermediate Volcanic Rock	Propylitic > Background?	0.56	1.29	10.59

*Instrumental precision was +/- 0.10 ‰ for $\delta^{13}C$ and 0.09‰ for $\delta^{18}O$ measurements

6.2.6 Cathodoluminescence imaging

A small sub-study using cathodoluminescence (CL) imaging was completed on three samples to observe any potential zonation features in minerals such as apatite and in particular titanite. Apatite did not show any discernable zoning in the grains analyzed using CL imaging and

were homogenous (Fig. 6.13A, B). Titanite, however, was found to display bright green rims around select grains from each of the three samples, which included a Cu-Zn mineralized hydrothermal breccia sample (PM18AJ309; Fig. 6.14A), and two felsic plutonic units with varying degrees of potassic and propylitic alteration (PM18AJ273, PM18AJ302; Fig. 6.14B, C, and D). The green rims on the titanite crystals were analyzed in each sample using the scanning electron microscope (SEM) and found to contain elevated concentrations of Al and F relative to the inner domains of the titanite grains. Although F data could only be used semi-quantitatively given that the SEM was not properly equipped for precisely measuring F concentrations, the analyses revealed markedly higher Al and F values that reached up to multiple wt. % in these rims relative to the inner cores of the grain. Aluminium and F enriched titanite has been documented in other mineral deposits and is known as the mineral grothite (Avchenko et al., 2012). Thus, it is apparent that grothite was a late-stage mineral that crystallized on previously formed titanite grains from three samples of differing lithologies and alteration assemblages at the Pemberton Hills study site.

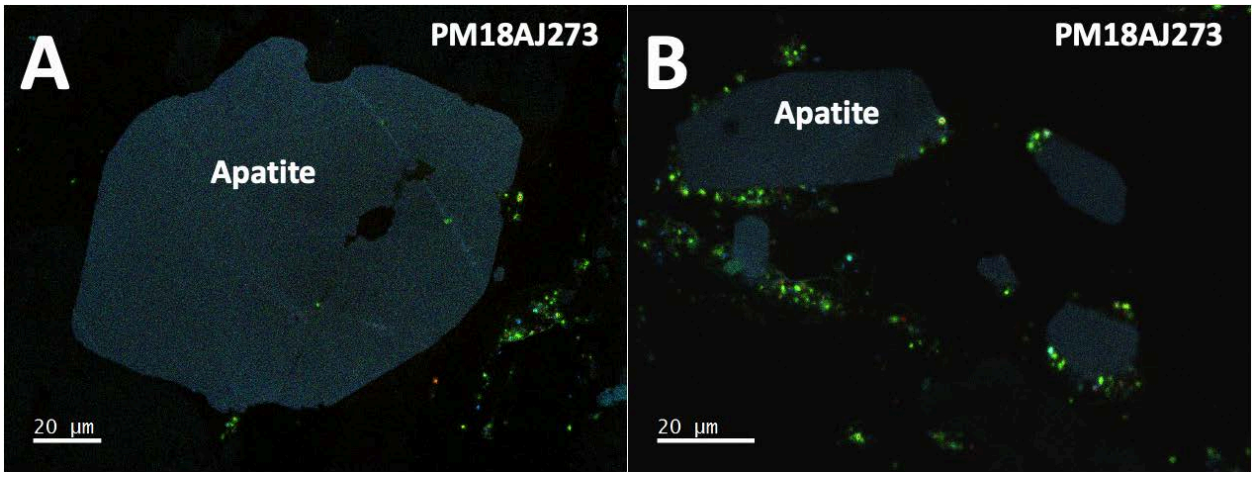


Figure 6.13. (A) CL image of homogenous apatite grain (PM18AJ273). (B) CL image of multiple homogenous apatite grains (PM18AJ273).

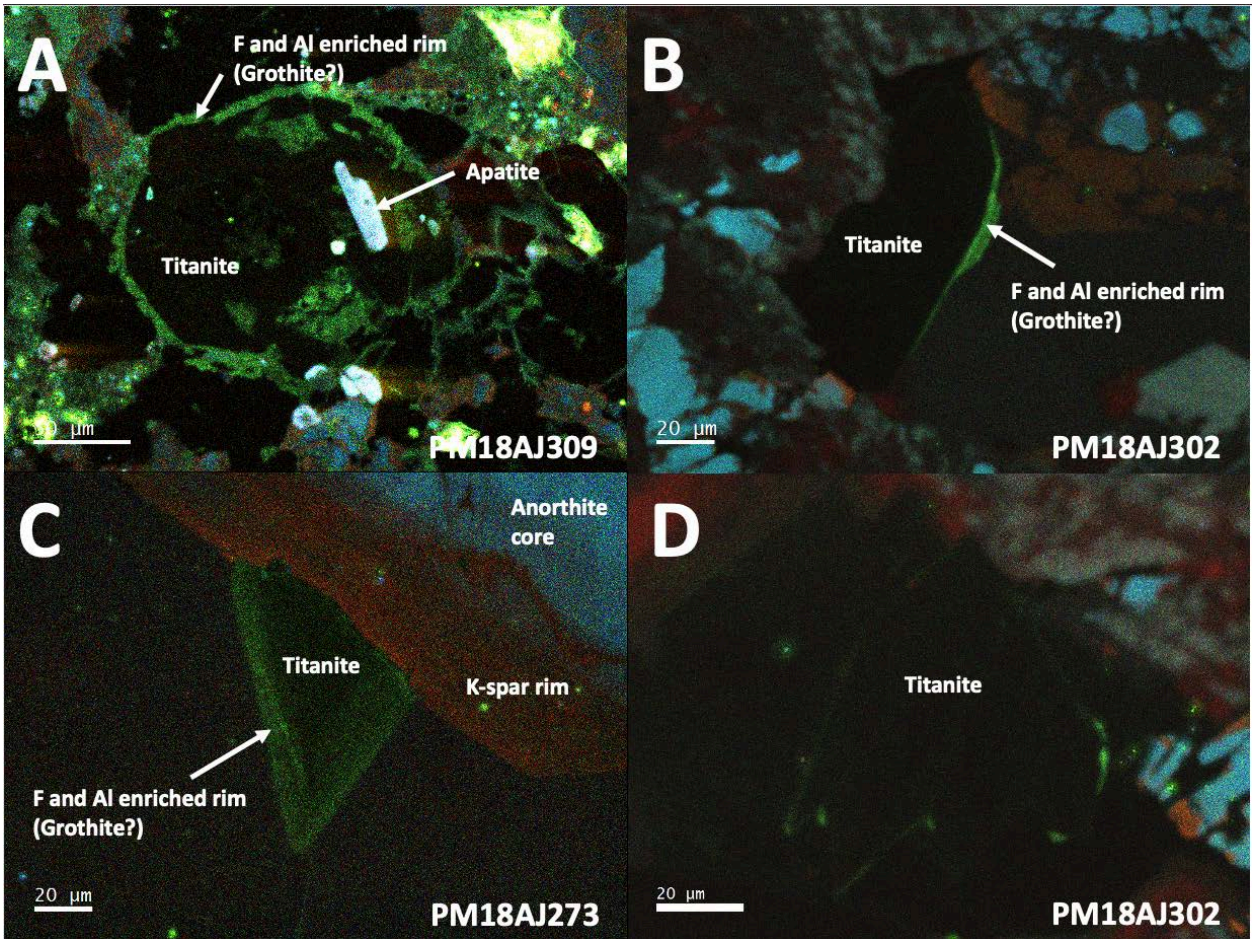


Figure 6.14. (A) CL image of a titanite grain displaying a green coloured Al-F enriched rim as well as an apatite inclusion (PM18AJ309). (B) CL image of a titanite grain displaying a partially green coloured Al-F enriched rim (PM18AJ302). (C) CL image of a titanite grain displaying a weak green coloured Al-F enriched rim. This image also shows potassium feldspar (red colour) replacement of an anorthite grain (blue colour; PM18AJ273). (D) CL image of a titanite grain displaying a weak green coloured Al-F enriched rim (PM18AJ302).

6.3 Discussion

Porphyry ore deposits produce the majority of the world's copper, in addition to considerable amounts of gold and molybdenum (Sillitoe, 2010). With continued exploration in some of the world's most recognized porphyry districts comes the challenge of finding new ways to detect and discover porphyry ore deposits that may be buried at depth and are not readily identified at surface. Much of the research in this area has been focused on using chemical

compositions and related spectral characteristics of hydrothermal minerals such as epidote and chlorite as porphyry vectoring and fertility tools that can provide insight into the direction, distance, and potential metal endowment of a mineral district and/or deposit (Cooke et al., 2020 and references therein). This research has benefited from advancements in laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) and short-wave infrared (SWIR) data acquisition and data processing as well as greater availability of microanalytical techniques such as cathodoluminesence (CL) imaging (Cooke et al., 2020).

The primary focus of this study was to build on the preliminary findings of Cooke et al. (2014) and Wilkinson et al. (2015), who developed new insights into the use of epidote and chlorite as exploration tools in the propylitic alteration halo or "green-rock environment" around porphyry deposits. Moreover, a series of recently published works by Lee et al. (2020), Ahmed et al. (2020), Baker et al. (2020), Cooke et al. (2020), Pacey et al. (2020) and Wilkinson et al. (2020), has further demonstrated and refined the use of propylitic alteration minerals as tools for porphyry deposit exploration and serve as important additional resources for this study.

Unlike other published works on the use of green rock mineral chemistry in the porphyry environment, the Pemberton Hills study site is not known to host any porphyry ore body(s) at surface or at depth despite the presence of a well-developed lithocap in the study area (see Hamilton, in prep), and its proximity to the world class Island Copper Mine to the southeast as well as other porphyry deposits and prospects to the northwest (i.e., Hushamu deposit, Red Dog property; Fig. 2.7). This provides an excellent opportunity to test epidote, chlorite, and pyrite mineral chemistry as vectoring and fertility tools in a large, underexplored region with limited

geologic context and evaluate potentially prospective locations for porphyry deposit-related mineralization at Pemberton Hills.

All whole rock and mineral geochemistry data in this section was binned using the geochemical plotting program ioGAS built-in Progressive binning range. This function statistically splits the data into seven groups based on percentiles of the data using the following cut-offs: 30%, 60%, 80%, 90%, 95%, and 98%. Specific colours and sizes were given to each bin to symbolize how anomalous values are with larger, warmer colours (i.e., pink, red, yellow) corresponding to higher and more anomalous values. These data have subsequently been plotted on spatial variation diagrams in the following sections to evaluate changes in the concentration of specific elements across the porphyry environment. Epidote, chlorite, and pyrite mineral chemistry data is represented as median values for each sample on the spatial variation diagrams.

6.3.1 Whole-rock geochemistry

Whole rock geochemical analysis was completed on 113 samples in this study, including all samples containing minerals that were used for LA-ICP-MS analysis (Appendix A). This was completed in order to evaluate the tectonomagmatic evolution of volcanic and plutonic rocks throughout the study site (see Chapter 5) and as a way to highlight geochemical anomalies and compare to the mineral geochemistry LA-ICP-MS data (this chapter). The elements used in the spatial plots below are based on the work of Cooke et al. (2014), who used proximal (Au, Mo, Sn, Cu) and distal (As, Sb, Pb, Zn) pathfinder elements, as well as REE and associated elements (La, Y, Zr, Mn), as a way to highlight geochemical anomalies from rock chip samples and compare the results to epidote mineral chemistry around the Black Mountain and Nugget Hill porphyry deposits and the Mexico skarn in the Central Baguio district, Philippines. Similarly, Baker et al.

(2020) used these same elements to highlight geochemical anomalies and compare the results to epidote mineral chemistry around the Rosario and Ujina porphyry deposits in the Collahuasi district, northern Chile**.** A study by Halley et al. (2015) highlighted characteristic changes in whole-rock major and trace element chemistry with changing alteration assemblages around porphyry Cu deposits, which also serves as an important reference to the work presented in this section (Fig. 6.15).

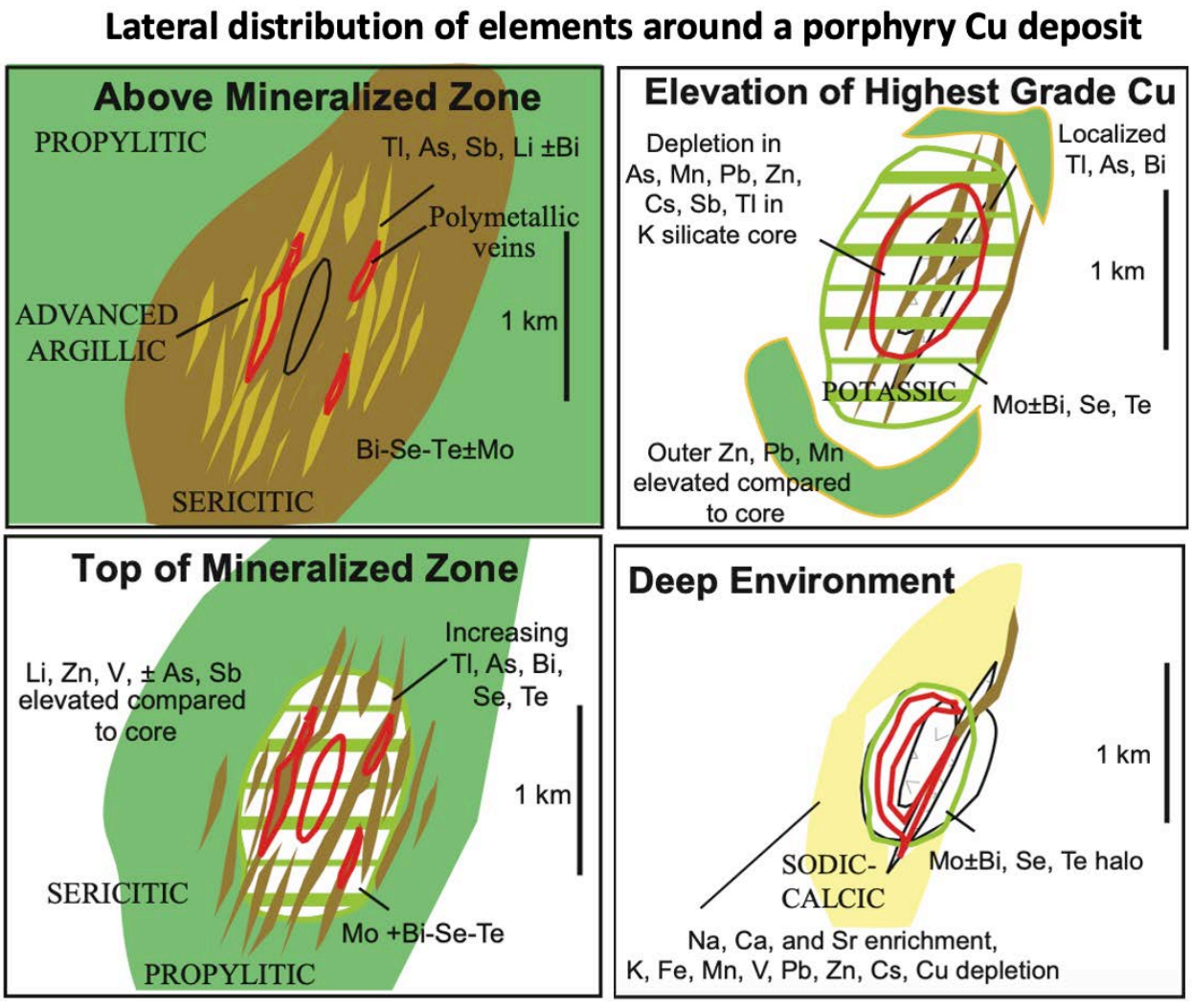


Figure 6.15. Schematic diagrams illustrating the lateral distribution of major and trace elements around a porphyry Cu deposit. Modified from Halley et al. (2015).

At Pemberton Hills, proximal pathfinder elements in whole-rock samples display different spatial distribution trends to one another. Gold was found to be occurring in low overall concentrations but still displays spatial trends across the property (Fig. 6.16). The majority of the moderate to high Au values were found in the main phyllic alteration shell (referred to as the quartz-sericite-pyrite [QSP] shell throughout the remainder of this chapter) occurring to the northeast of the lithocap (Fig. 6.16). There are a cluster of higher values in quartz-calcite hydrothermal breccia samples outlined within the QSP shell, as well as some relatively higher values centred around the eastern end of the quartz diorite pluton (Fig. 6.16). The highest Au value (0.028 ppm) comes from a sample of tonalite dyke in the NE domain of the granodiorite pluton (Fig. 6.16). Molybdenite is more spatially variable than Au, with most moderate to high values occurring in the centre of the property to the north of the lithocap but not necessarily constrained within the QSP shell (Fig. 6.17). High Mo concentrations are observed in a set of samples located around the northeast margin of the lithocap as well as in some samples within the quartz diorite (Fig. 6.17). Additionally, there are some anomalously high Mo concentrations in samples proximal to the Hushamu pluton (Fig. 6.17). Tin was found to be in concentrations below detection limit (BDL) for the majority of whole rock samples (Fig. 6.18). Highest Sn values were observed in the granodiorite and quartz diorite samples. Similar to Mo, the set of samples that wrap around the NE lobe in the lithocap also display relatively higher Sn concentrations (Fig. 6.18). Lastly, whole rock concentrations of Cu are spatially similar to Au, with the majority of moderate to high values occurring within the QSP shell, and notably within the hydrothermal breccia samples that overlaps with it (Fig. 6.19). However, there are also some anomalously high Cu values found in two sample to the east of the quartz diorite pluton; one of them being a Cu-

Zn mineralized hydrothermal breccia (Fig. 6.19). Other relatively high Cu values can be found in quartz diorite samples, as well as a pyroxenite dyke sample from the granodiorite pluton (Fig. 6.19).

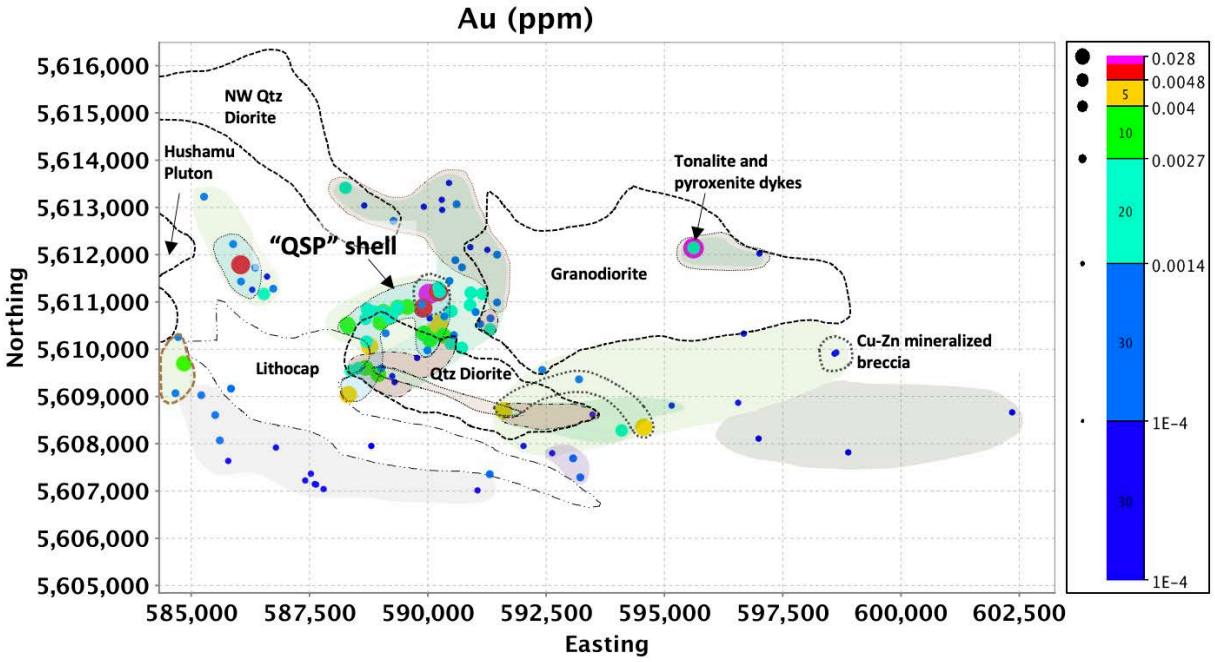


Figure 6.16. Spatial distribution of whole-rock Au concentrations across the Pemberton Hills study site. Location of the QSP shell (also referred to as phyllic alteration shell) is shown by the black arrow. Outlines of plutonic units modified from Nixon et al. (2011a, b).

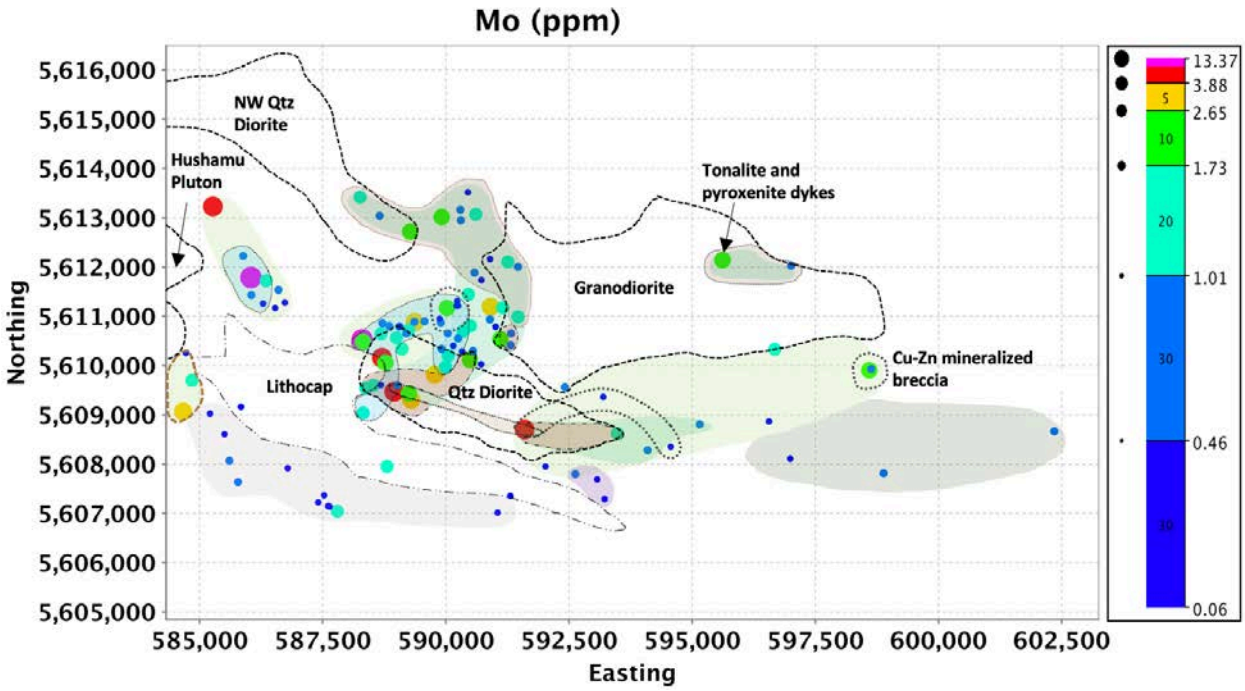


Figure 6.17. Spatial distribution of whole-rock Mo concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

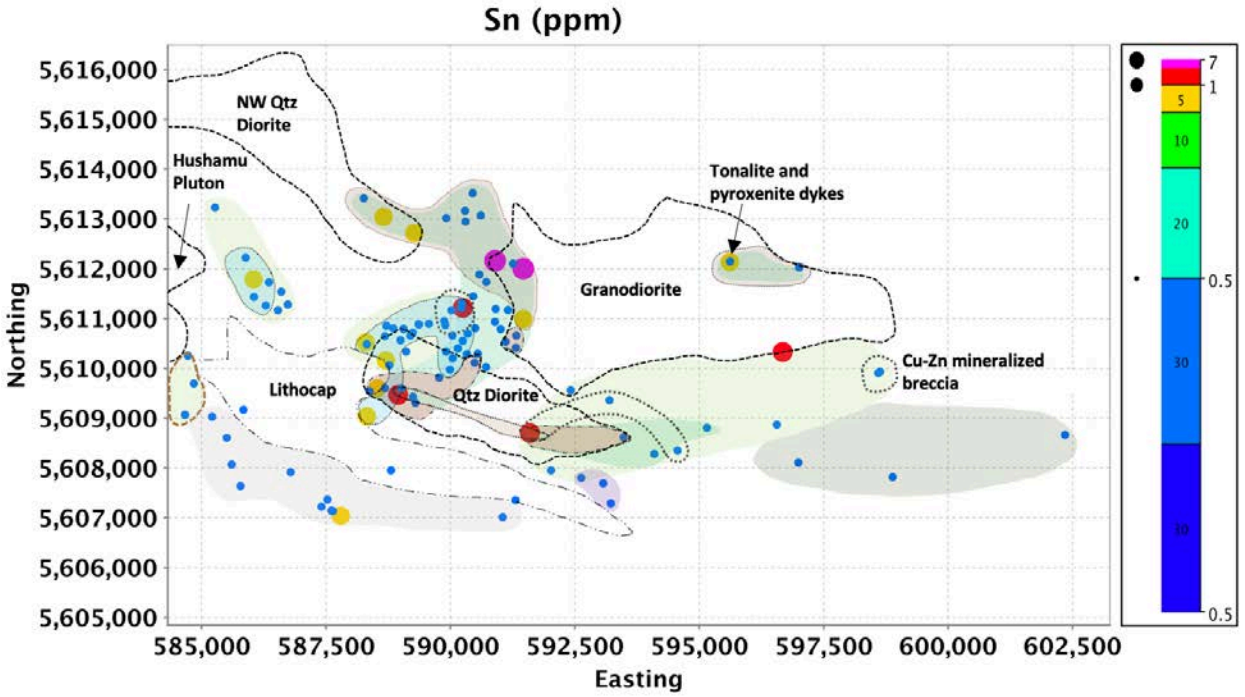


Figure 6.18. Spatial distribution of whole-rock Sn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

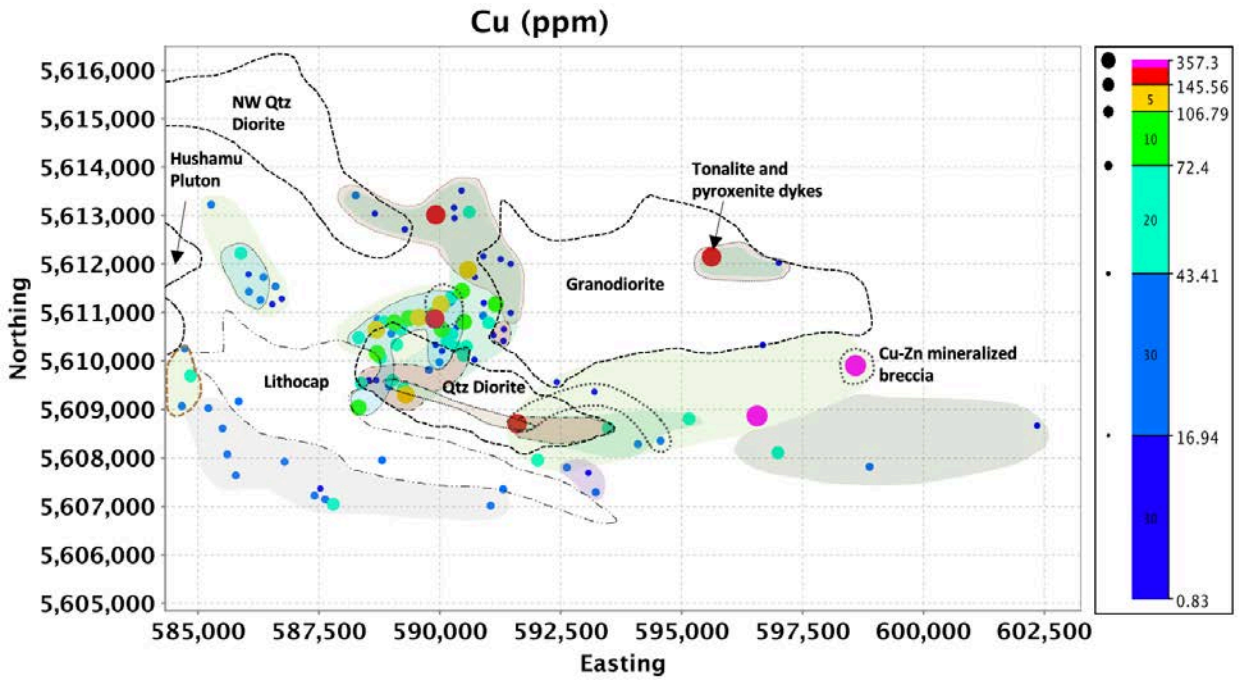


Figure 6.19. Spatial distribution of whole-rock Cu concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Distal pathfinder elements in whole rock samples from Pemberton Hills highlight various geochemical anomalies throughout the study site. High As values are sporadically observed in samples to the northeast of the lithocap, while defining areas of geochemical lows in samples to the south of the lithocap and distal chlorite alteration to the east (Fig. 6.20). A pattern of high As concentrations can also be observed in the samples centred around the southeastern margin of the quartz diorite (Fig. 6.20). Zinc defines an area of geochemical highs in the area containing significant hydrothermal breccias located within the northern extent of the QSP shell, in addition to highlighting the Cu-Zn mineralized hydrothermal breccia sample to the east of the study site (Fig. 6.21). Some anomalously higher Zn concentrations are observed in the actinolite-altered samples in the center of the study site between the QSP shell and granodiorite pluton (Fig. 6.21). Similar to As, there are some relatively higher Zn concentrations in samples centred around the

eastern margin of the quartz diorite pluton, albeit with a more sporadic distribution (Fig. 6.21). Also similar to As, Zn defines geochemical lows in the distal chlorite alteration domain (albeit with some high values observed on the fringe of the epidote – distal chlorite alteration boundary) and to the south of the lithocap (Fig. 6.21).

Lead displays overall highest concentrations in samples from within the main QSP shell to the northeast of the lithocap and like Zn, shows relatively high values in the area containing significant hydrothermal breccias in the northern extent of the QSP (Fig. 6.22). Relatively high Pb concentrations are also observed in the hydrothermal breccia samples that are centered around the southeastern margin of the quartz diorite, as well as in the northwestern quartz diorite samples (Fig. 6.22). The last of the distal pathfinder elements, Sb is highest in the hydrothermal breccia samples centered around the southeastern margin of the quartz diorite pluton, and highlights the Cu-Zn mineralized hydrothermal breccia sample to the east (Fig. 6.23). Similar to Pb, the majority of higher Sb concentrations are from samples located within the main QSP shell to the northeast of the lithocap (Fig. 6.23). Some higher Sb values also occur in samples proximal to the Hushamu pluton, as well as in the northwestern quartz diorite and select granodiorite samples (Fig. 6.23). Both Zn and Sb also highlight areas of geochemical lows in the distal chlorite alteration domain and in samples to the south of the lithocap (Figs. 6.21 and 6.23).

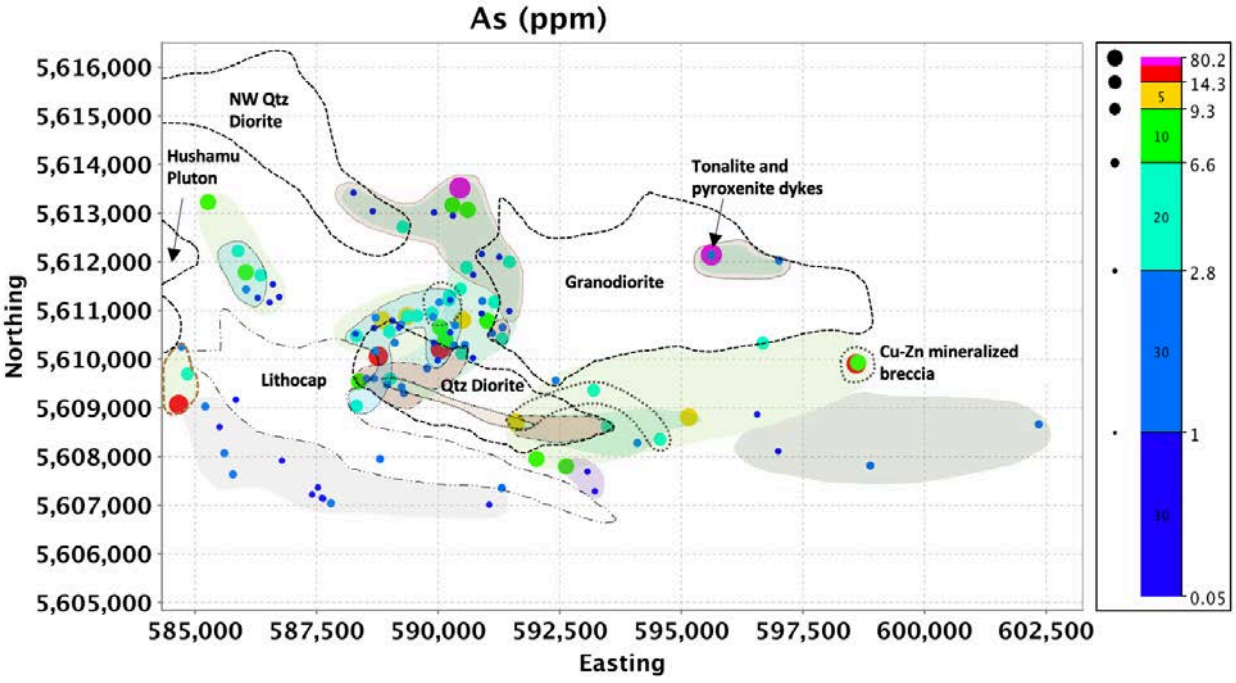


Figure 6.20. Spatial distribution of whole-rock As concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

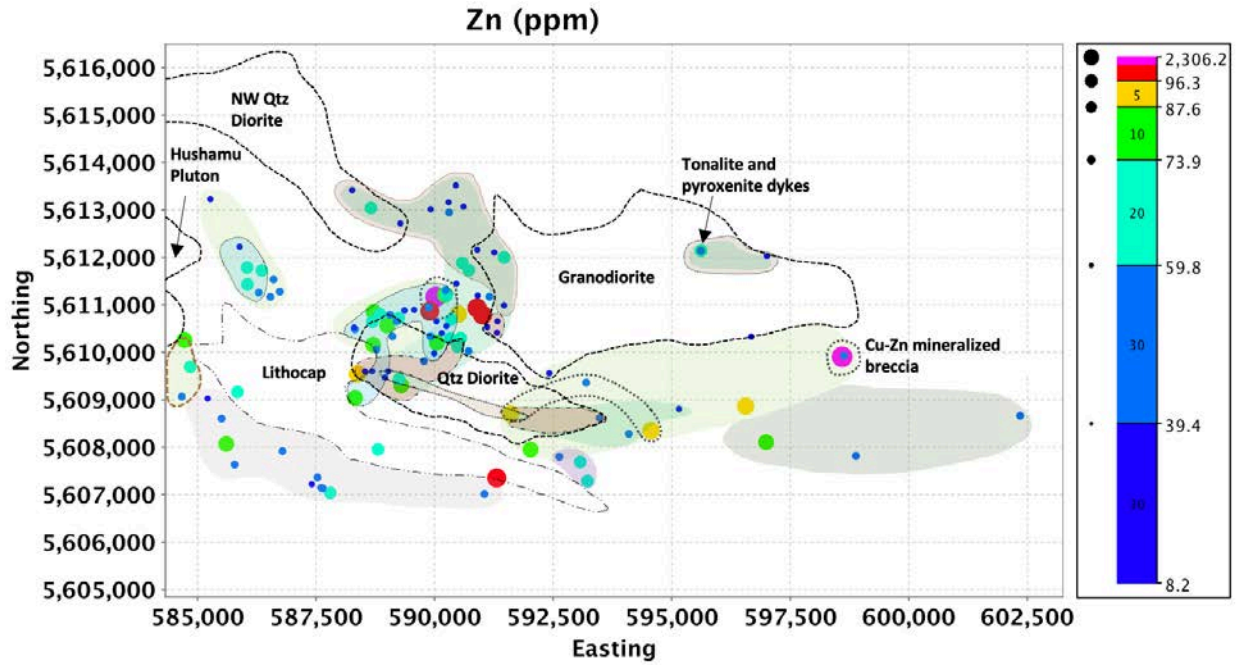


Figure 6.21. Spatial distribution of whole-rock Zn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

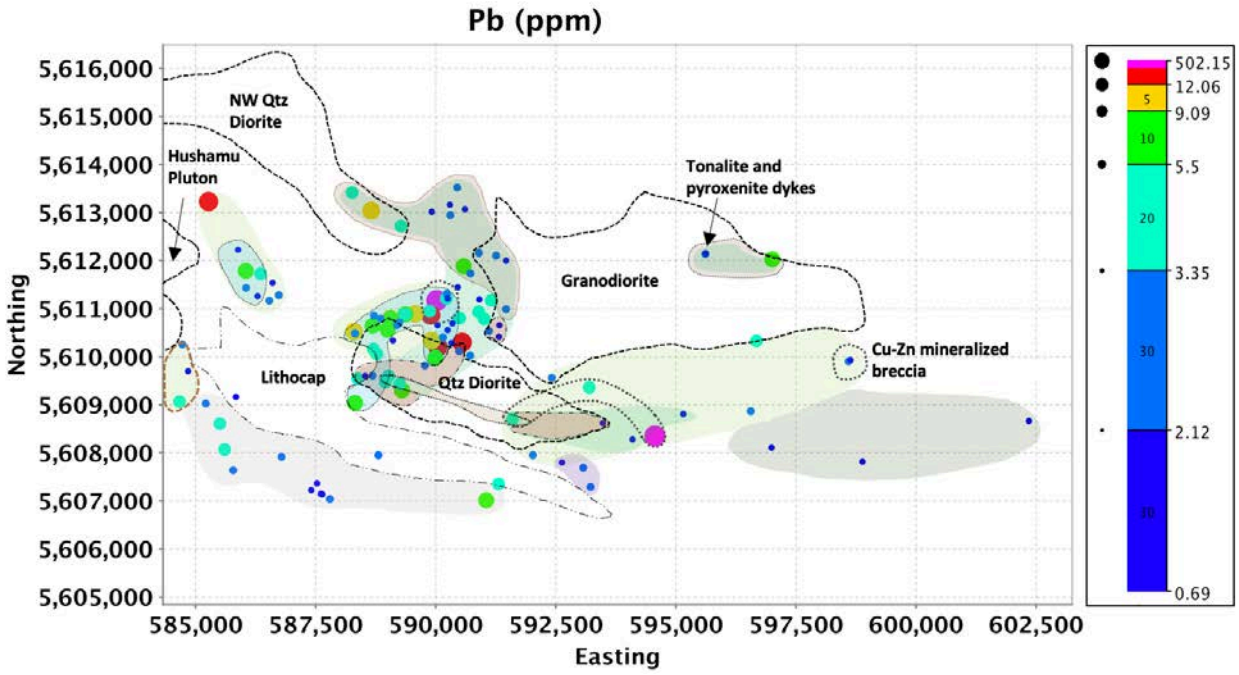


Figure 6.22. Spatial distribution of whole-rock Pb concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

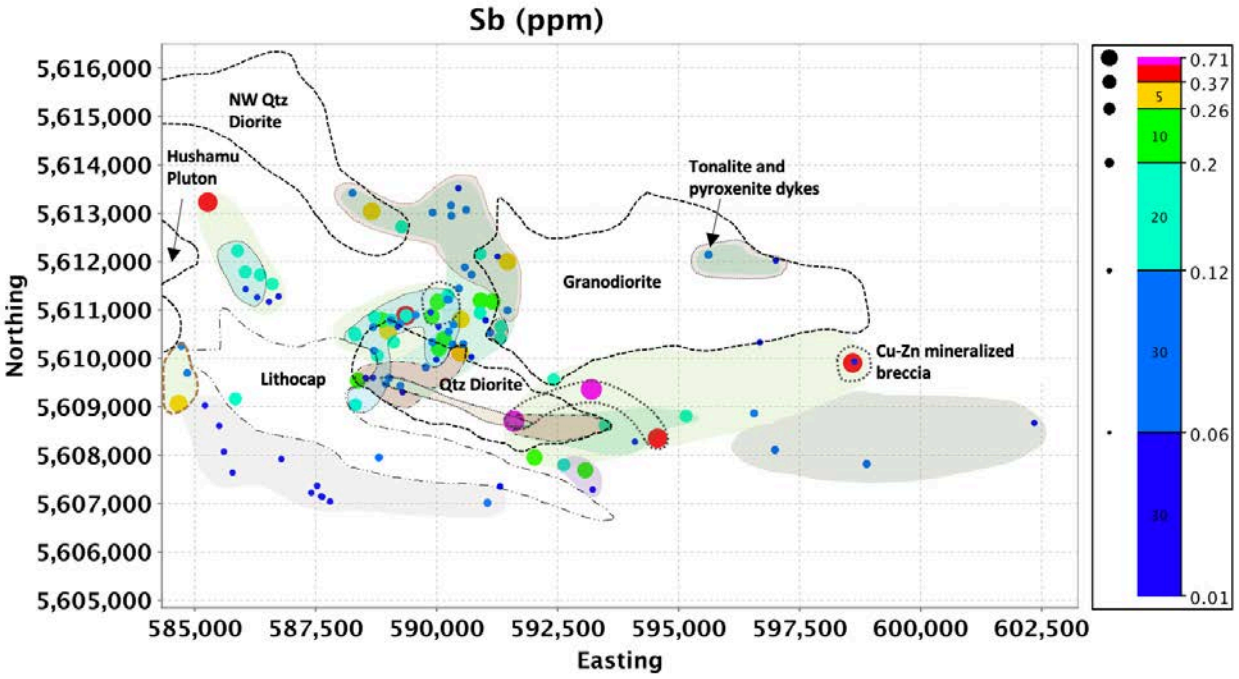


Figure 6.23. Spatial distribution of whole-rock Sb concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Rare earth elements (REE's) and associated elements in whole-rock samples highlight different geochemical anomalies at Pemberton Hills than the proximal and distal pathfinder elements. Lanthanum displays a trend of anomalously high values in the observed in samples from the western margin of the granodiorite pluton and into the southern quartz diorite pluton that correlate to strong biotite-potassium feldspar alteration (Fig. 6.24). Some elevated La values are also observed in samples directly to the east of the Hushamu pluton, as well as in the northwestern quartz diorite samples (Fig. 6.24). Anomalously high concentrations of Y are observed in samples from the western margin of the granodiorite and southern quartz diorite but are only high in samples that have pervasive quartz-potassium feldspar alteration while samples characterized by biotite-potassium feldspar alteration display low concentrations (Fig. 6.25). In contrast to La, Y defines an area of geochemical highs to the south of the lithocap (Fig. 6.25). Some moderately high Y values can also be observed in samples that are located around the northeast lobe of the lithocap (Fig. 6.25). Zirconium highlights similar geochemical anomalies to Y, however, with less high values observed in samples from the south side of the lithocap (Fig. 6.26). Lastly, Mn highlights areas of geochemical highs to the south of the lithocap, and in the distal chlorite and distal epidote altered domains to the east of the study area (Fig. 6.27). Some sporadic high Mn values can be observed in the center of the study area (6.27).

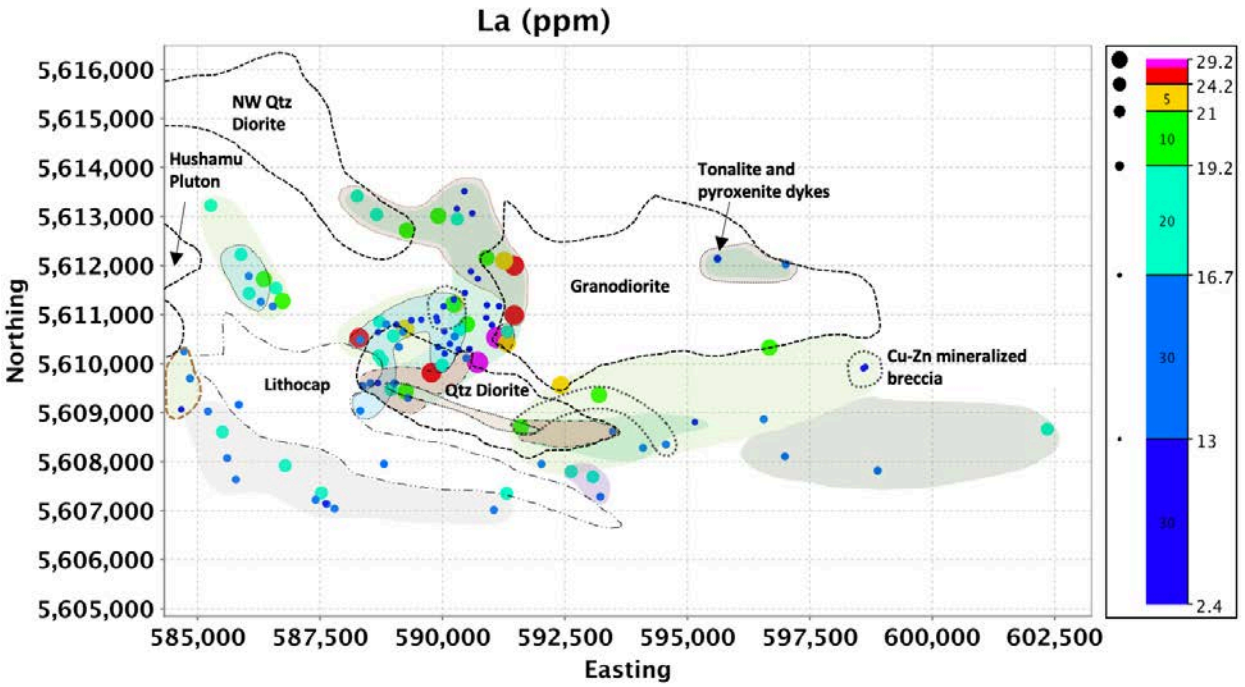


Figure 6.24. Spatial distribution of whole-rock La concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

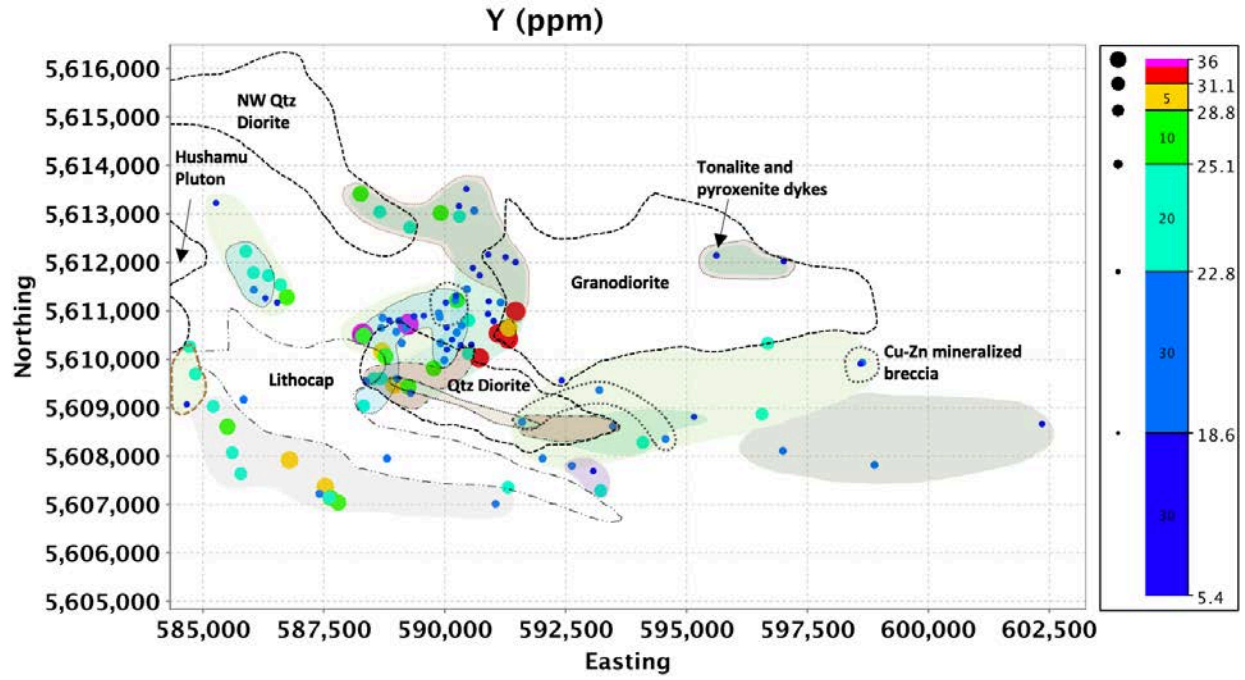


Figure 6.25. Spatial distribution of whole-rock Y concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

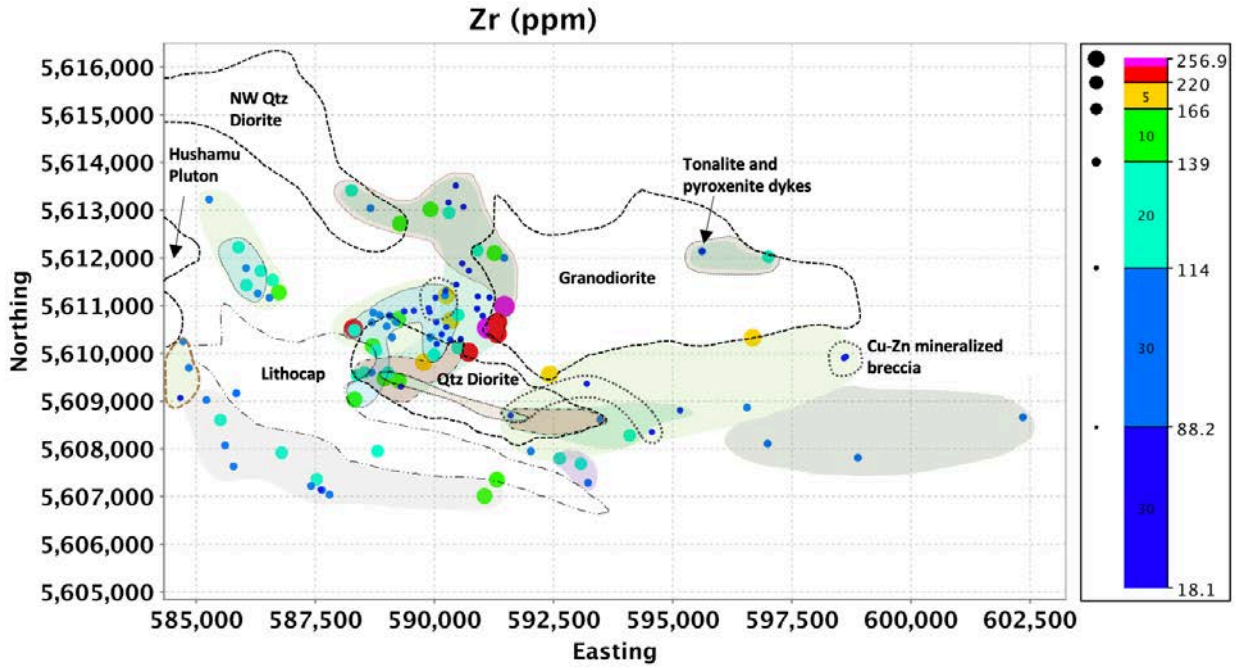


Figure 6.26. Spatial distribution of whole-rock Zr concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

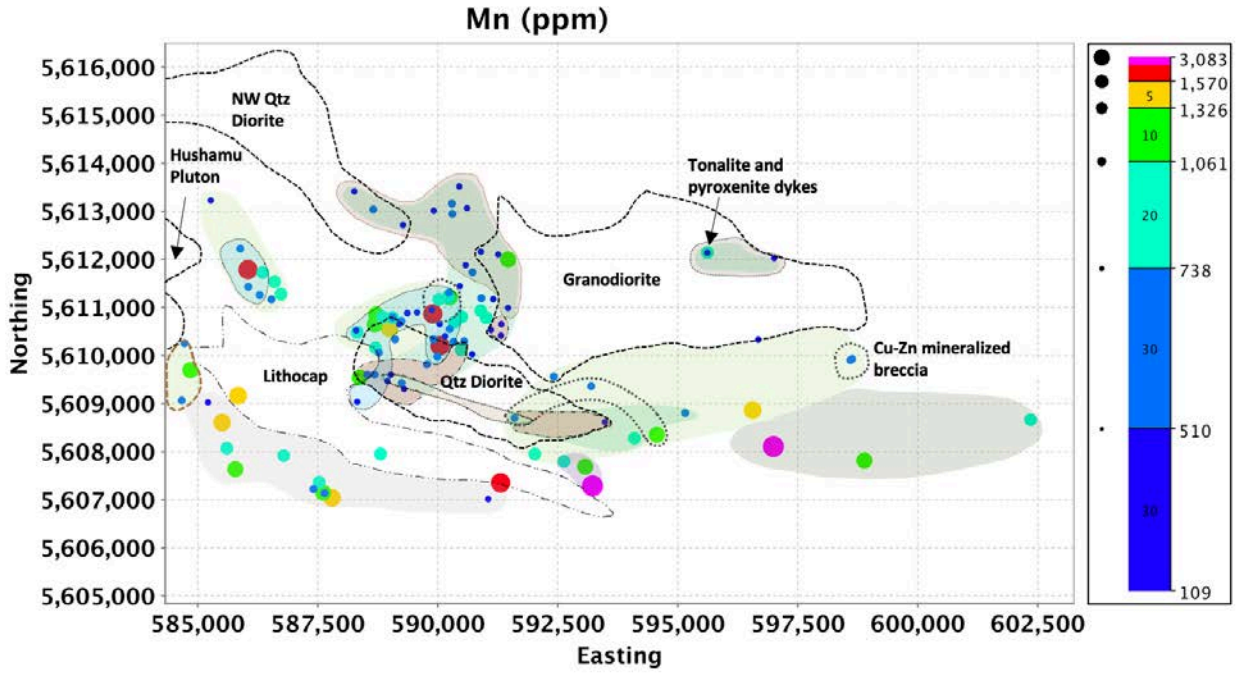


Figure 6.27. Spatial distribution of whole-rock Mn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

6.3.2 Epidote mineral chemistry

The propylitic alteration environment in most porphyry systems is typically denoted by the presence of epidote, characterized by its common bright pistachio-green colouring and vitreous luster (Cooke et al., 2014). Despite its prevalence in hydrothermal environments, epidote may also have a metamorphic or magmatic origin, and can range in colour from black to green to pink (Djouka-Fonkwé et al., 2012). It is petrographically distinct, characterized by relatively high relief and birefringence, and has a pleochroism that may be colourless to pale yellow in metamorphosed rocks and pinkish to greenish yellow in propylitically altered rocks (Djouka-Fonkwé et al., 2012).

The epidote supergroup is based on the general formula $A_2M_3[T_2O_7][TO_4](O,F)(OH,O)$. The A site is taken up by common divalent cations including Ca, Mn^{2+}, Sr, Pb, and REE amongst others, while the M site is taken up by common trivalent cations such as Al, Fe^{3+}, Mn^{3+}, V^{3+}, Cr^{3+}, and REE amongst others, and the T site is taken up by Si (Fig. 6.28; Cooke et al., 2014). Armbruster et al. (2006) and Mills et al. (2009) proposed a new nomenclature for the epidote supergroup, which led to the development of the epidote, allanite, and dollaseite groups that together combine for 24 individual mineral phases (Table 6.5).

Table 6.5. Chemical formulae of epidote supergroup minerals (from Cooke et al., 2014)[1]. Elemental substitutions that characterize each group are highlighted in green.

Name	Formula
Epidote Group	
Epidote	$Ca_2Al_2Fe^{3+}[Si_2O_7][SiO_4]O(OH)$
Epidote-(Sr)	$CaSrAl_2Fe^{3+}[Si_2O_7][SiO_4]O(OH)$
Epidote-(Pb)	$CaPbAl_2Fe^{3+}[Si_2O_7][SiO_4]O(OH)$
Clinozoisite	$Ca_2Al_3Fe^{3+}[Si_2O_7][SiO_4]O(OH)$
Clinozoisite-(Sr)	$CaSrAl_3Fe^{3+}[Si_2O_7][SiO_4]O(OH)$
Mukhinite	$Ca_2Al_2V^{3+}[Si_2O_7][SiO_4]O(OH)$
Piemontite	$Ca_2Al_2Mn^{3+}[Si_2O_7][SiO_4]O(OH)$
Piemontite-(Sr)	$CaSrAl_2Mn^{3+}[Si_2O_7][SiO_4]O(OH)$
Piemontite-(Pb)	$CaPbAl_2Mn^{3+}[Si_2O_7][SiO_4]O(OH)$
Manganipiemontite-(Sr)	$CaSrMn^{3+}AlMn^{3+}[Si_2O_7][SiO_4]O(OH)$
Allanite Group	
Allanite-(Ce), -(La), -(Y), -(Nd)	$Ca(REE)^{3+}Al_2Fe^{2+}[Si_2O_7][SiO_4]O(OH)$
Vanadoallanite-(La)	$CaLa^{3+}V^{3+}Al_2Fe^{2+}[Si_2O_7][SiO_4]O(OH)$
Dissakisite-(Ce), -(La)	$Ca(REE)^{3+}Al_2Mg[Si_2O_7][SiO_4]O(OH)$
Ferriallanite-(Ce), -(La)	$Ca(REE)^{3+}Fe^{3+}AlFe^{2+}[Si_2O_7][SiO_4]O(OH)$
Manganiandrosite-(Ce), -(La)	$Mn^{2+}(REE)Mn^{3+}AlMn^{2+}[Si_2O_7][SiO_4]O(OH)$
Vanadoandrosite-(Ce)	$Mn^{2+}Ce^{3+}V^{3+}AlMn^{2+}[Si_2O_7][SiO_4]O(OH)$
Dollaseite Group	
Dollaseite-(Ce)	$CaCe^{3+}MgAlMg[Si_2O_7][SiO_4]O(OH)$

Abbreviation: REE = Rare Earth Element

[1]After Franz and Liebscher (2004); Gieré and Sorensen (2004); Armbruster et al. (2006); Minakawa et al. (2008); Mills et al. (2009); Chukanov et al. (2012); Skoda et al. (2012); Nagashima et al. (2013)

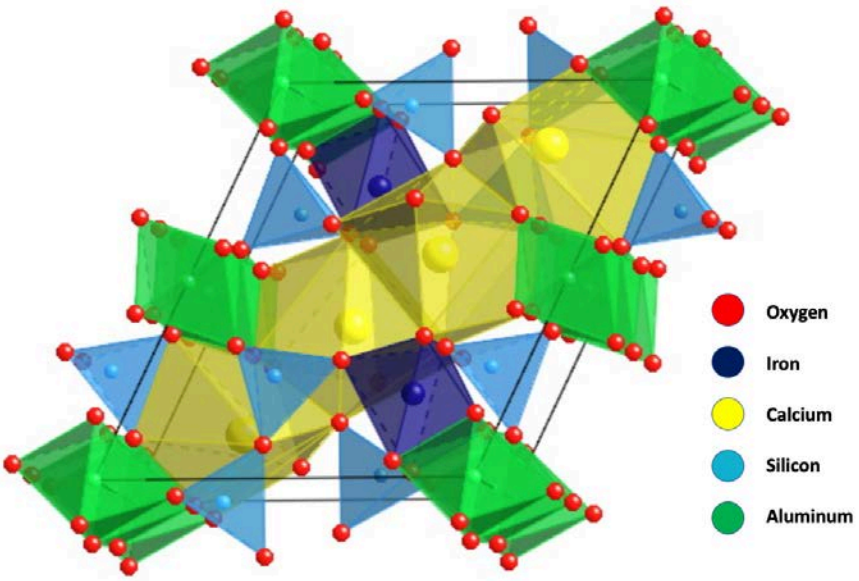


Figure 6.28. Crystal structure of epidote. Modified from image source: http://som.web.cmu.edu/structures/S091-epidote.html.

The epidote group comprises various epidote and clinozoisite species, while allanite constitutes a rare earth element rich species and dollaseite a Mg-rich species (Cooke et al., 2014). Epidote (Fe^{3+} end-member) and clinozoisite (Al end-member) exist in solid solution with one another, which can be quantified using the formula $X_{Fe} = Fe^{3+}/(Fe^{3+} + Al)$ (Armbruster et al., 2006). The substitution of Fe^{3+} and Al^{3+} into epidote is understood to be controlled by numerous factors including changes in the redox state, temperature, bulk-rock and fluid compositions, CO_2 fugacity as well as pressure (Arnason et al., 1993). Cooke et al. (2014) noted that the interplay between these factors across the propylitic alteration zone results in variable Fe and Al content of epidote that cannot be systematically defined with distance from a causative intrusion. Cooke et al. (2014) illustrated this by showing backscattered electron images of epidote grains with complex growth zoning that were the result of varying Fe and Al content. Recent work by Ahmed et al. (2020) further explored this by conducting a detailed study on the inter grain variability of elements within hydrothermal epidote from the Ann Mason fault block, Yerrington district.

Ahmed et al. (2020) showed that elements such as As, Mn, and Sr varied up to one order of magnitude and Fe up to 3 wt. % in epidote grains from the vein wall to the vein centre. Furthermore, the authors noted that sector zones in replacement-style epidote grains displayed elevated concentrations of Fe, Mn, Sr, As, Sb and Ce than in other crystal faces (Ahmed et al. 2020). These studies highlight the particular challenges of using epidote mineral chemistry as a vectoring tool in exploration, despite its overall success.

6.3.2.1 Element partitioning in epidote and whole-rock geochemistry

Cooke et al. (2014) demonstrated that in the propylitic alteration zone surrounding the Black Mountain porphyry Cu-Au deposit, elements such as Na, Mg, K, Ti, Ba, Zr, Zn, Cu, Ce, Y, Nd, La, Yb, Mo, and Lu were preferentially enriched in the host rock relative to epidote. In contrast, they noted elements such as Al, Fe, Mn, Sr, V, As, Pb, Sb, Sn, Eu, and Bi were enriched in epidote relative to the host rock. Based on these findings, Cooke et al. (2014) determined that certain pathfinder elements could vector away from or towards the centre of a porphyry deposit. These included proximal (Au, Mo, Sn, Cu) and distal (As, Sb, Pb, Zn) pathfinder elements, as well as REE and other associated elements (La, Y, Zr, Mn). Cooke et al. (2014) plotted LA-ICP-MS analyses of epidote and corresponding whole rock analyses as a comparative tool. Similar plots were generated to compare epidote and whole rock geochemistry from Pemberton Hills to show the relative enrichment of key elements. Figure 6.29 illustrates elements that are enriched in epidote relative to the host rock (excluding Al), and includes Fe, Mn, Sr, V, As, Pb, Sb, Sn, Eu, and Bi. In contrast, Figure 6.30 highlights elements that are enriched in the host rock relative to epidote, and includes Na, Mg, K, Ti, Ba, Zr, Zn, Cu, Ce, Y, La, Yb, and Lu. With the exception of Al, these results are consistent with the observations made by Cooke et al. (2014) and Baker et al. (2020).

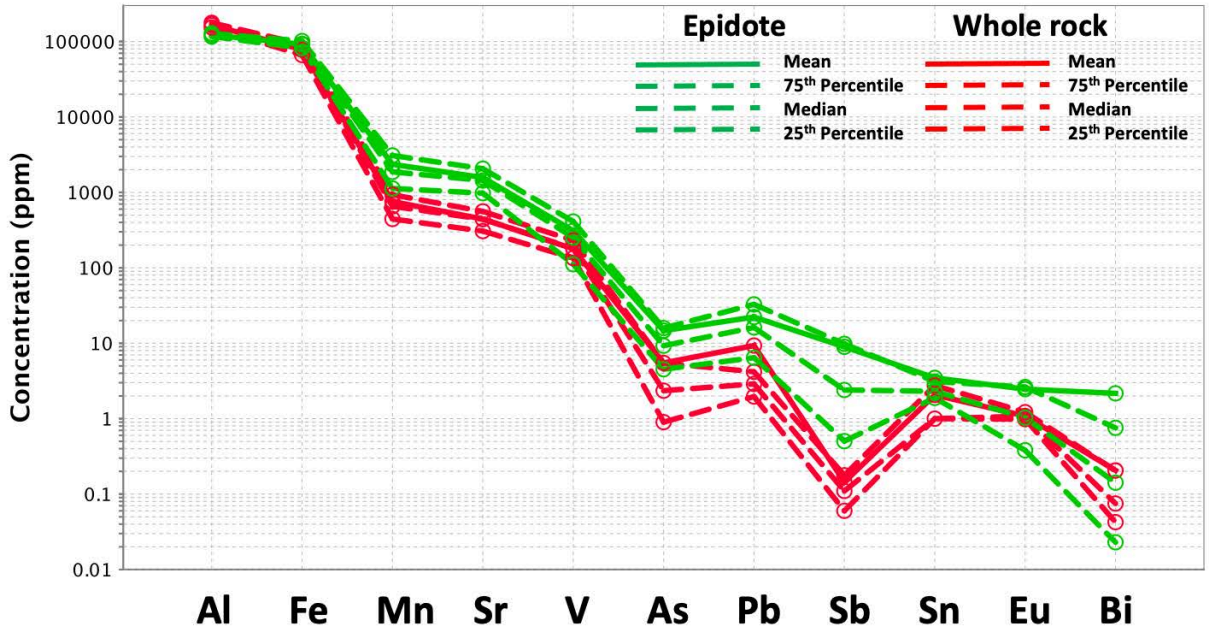


Figure 6.29. Comparison of epidote LA-ICP-MS and whole rock geochemical data that highlights mean, median, 25th percentile, and 75th percentile values. This plot displays elements enriched in epidote relative to whole rock.

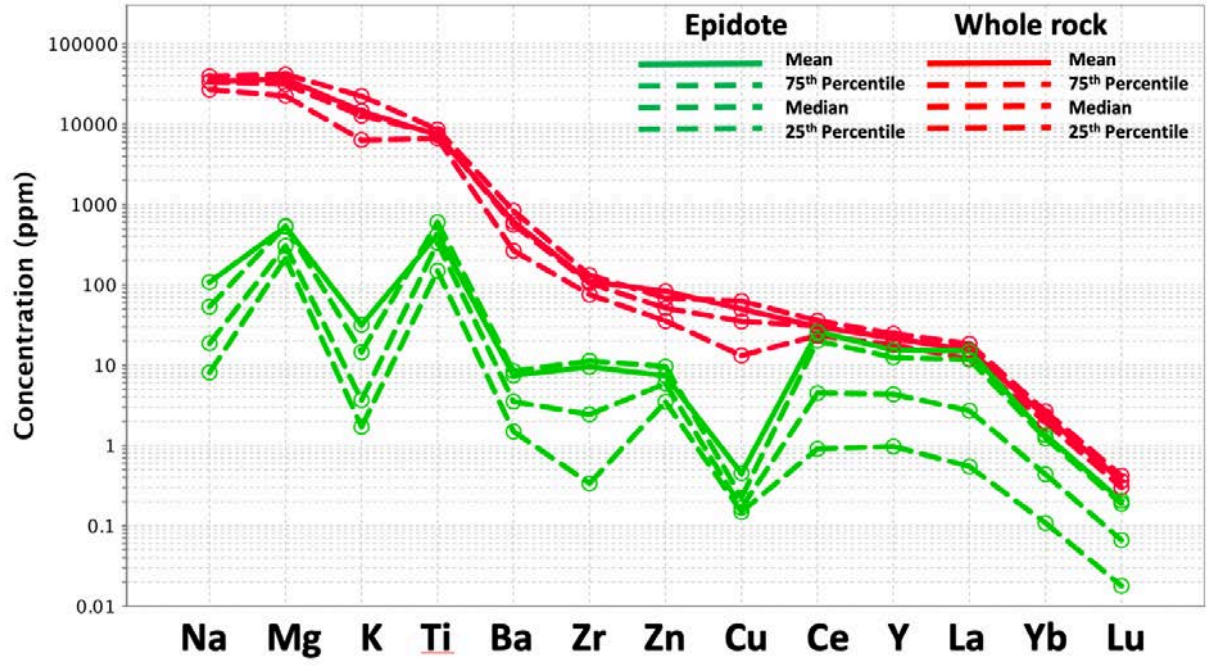


Figure 6.30. Comparison of epidote LA-ICP-MS and whole rock geochemical data that highlights mean, median, 25th percentile, and 75th percentile values. This plot displays elements enriched in whole rock relative to epidote.

6.3.2.2 Epidote trace element pathfinders at Pemberton Hills

A number of studies (i.e., Cooke et al., 2014, 2017, 2020; Ahmed et al., 2020; Baker et al., 2020; Pacey et al., 2020; Wilkinson et al., 2020) have demonstrated that proximal and distal pathfinder elements in epidote can be used as effective tools to vector away from or towards the centre of a porphyry deposit, and that these elements consistently show similar behaviours. Cooke et al. (2014) highlighted that at the Black Mountain porphyry deposit in the Philippines, proximal pathfinder elements were predominantly enriched in epidote that crystallized within the pyrite halo and adjacent to centres of mineralization and potassic alteration. In contrast, they noted distal pathfinder elements to be enriched in epidote at a distance from the mineralized centres and outside of the pyrite halo. This was interpreted to primarily be the result of lateral migration, cooling, and depletion of H_2S in magmatic-hydrothermal fluids moving away from the centre of a porphyry deposit outwards into distal host rock. Cooke et al. (2014) suggested that elevated concentrations of proximal pathfinder elements such as Au, Cu and Mo in epidote occurring within the pyrite halo was either the consequence of high concentrations of these metals in the mineralizing fluids so that they were incorporated into the epidote crystal structure, or that the sulphides of these metals were precipitated as nanoparticles and manifested as micro-inclusions within crystallizing epidote grains. For distal pathfinder elements such as As, Sb, and Pb in epidote, Cooke et al. (2014) proposed that the concentrations of these elements was depleted in the pyrite halo as a result of their preferential incorporation into crystallizing pyrite. Outside of the pyrite halo where lower temperatures and H_2S activities prevail, sulphide phases become unstable and these elements subsequently partition into epidote (Cooke et al., 2014). Cooke et al. (2014) showed that rare earth elements such as Y, Zr, and La were enriched at the

outer limits of pyrite halos from the Nugget Hill and Black Mountain porphyry deposits, and Mn displayed elevated concentrations up to 1.5 km from the center of Nugget Hill.

Prior to this study, the porphyry environment at Pemberton Hills had been the target of limited exploration, with most of the mineral exploration focused on the lithocap, and the best geological context of the study area derived from large-scale geological maps from the British Colombia Geologic Survey (Nixon et al., 2011a, b). The mineral chemistry and isotope data presented in this study relies heavily on alteration and lithologic interpretations, with limited understanding of what is occurring at depth, and no direct knowledge of any one heat source or causative intrusive center. This presents challenges with the interpretation of the mineral chemistry data given the large lateral extent of the study area and potential for multiple porphyry centres. Furthermore, the study site is characterized by heterogeneous host rock lithologies, and complex alteration overprinting relationships (discussed later in this chapter). This does however, present a valuable opportunity to test whether mineral chemistry can be a useful vectoring tool in green-field porphyry environments with complex lithological and alteration zones such as at Pemberton Hills.

Previously identified epidote proximal pathfinder elements identified at other study sites showed only limited success as vectoring tools at Pemberton Hills. This is largely a consequence of Au and Cu being below detection limits for the majority of analyses (only 26 and 81 out of 649 analyses above detection limit, respectively). The highest Au values above detection limit in epidote come from two samples of strongly potassium feldspar-quartz altered rocks in the southwestern corner of the granodiorite pluton (Fig. 6.31). No discernable trends were observed for Cu (Fig. 6.32), although the highest value was found in the same sample that yielded the

highest Cu value in the whole rock data (PM18AJ286; Fig. 6.19). Tin returned all 649 analyses above detection limit and anomalously high concentrations of Sn in epidote appear to be correlated to samples from the granodiorite pluton (Fig. 6.33). Given that the most anomalously high concentrations of Sn in whole rock samples were also from granodiorite, it is likely that this may be a function of lithological control.

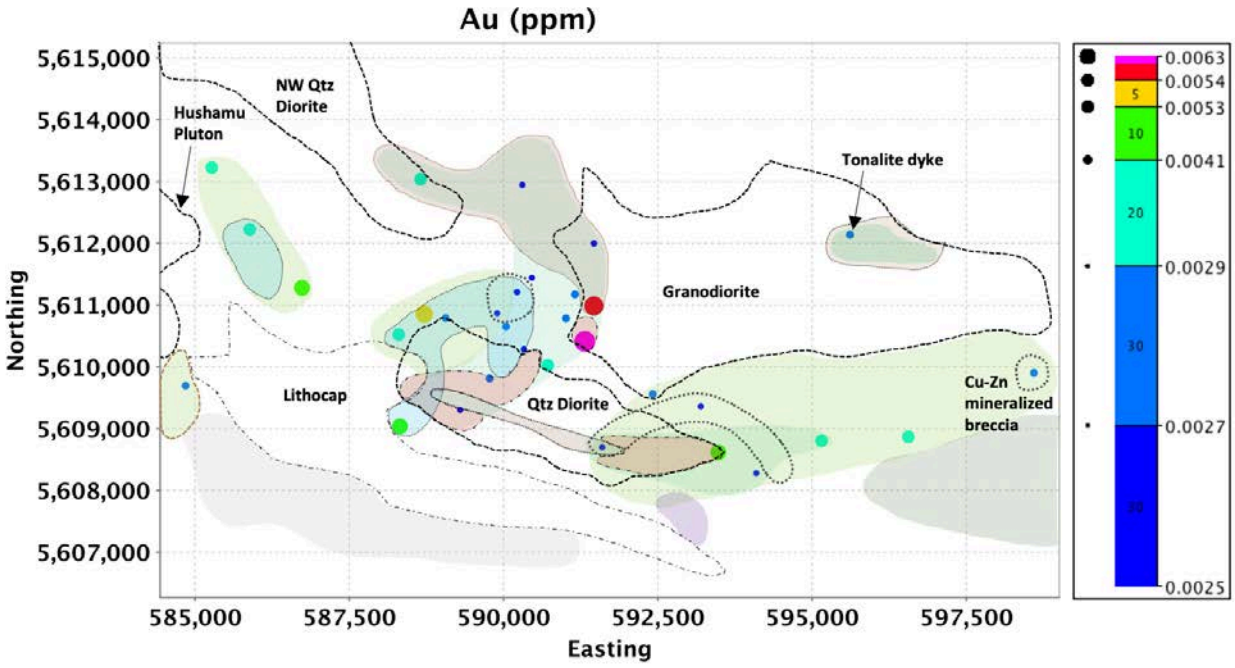


Figure 6.31. Spatial distribution of median epidote Au concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

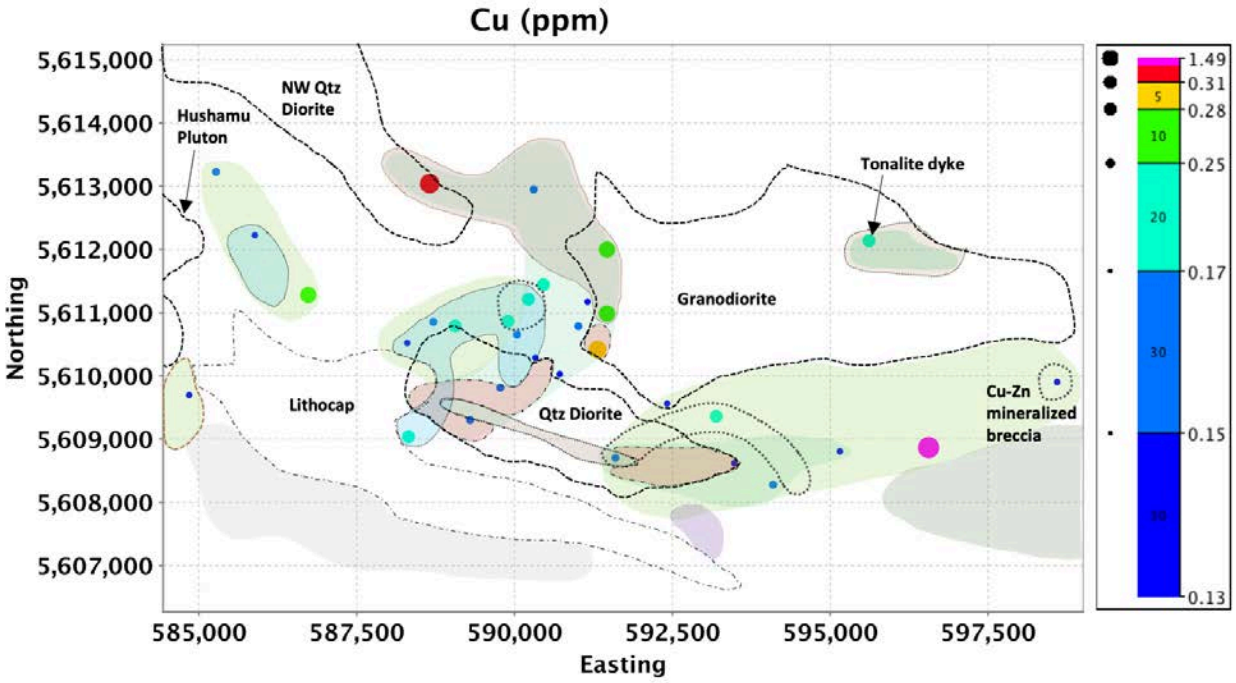


Figure 6.32. Spatial distribution of median epidote Cu concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

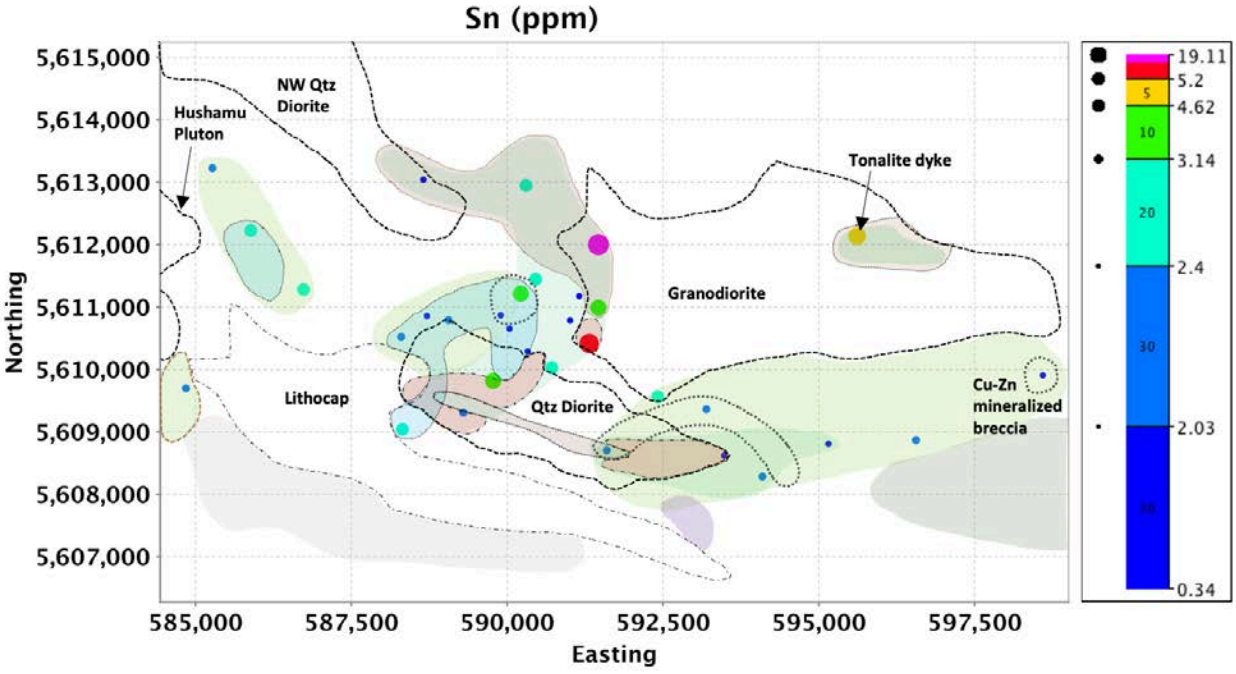


Figure 6.33. Spatial distribution of median epidote Sn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Unlike the proximal pathfinder elements, distal pathfinder elements including As, Zn, Pb, and Sb in epidote yielded clearer results. All four of these elements registered at least 610 out of 649 analyses above BDL values. Overall, the most anomalously high values of these four elements are observed in samples located within the center of the study site (i.e., to the northeast of the center of the lithocap), while the samples to the west (i.e., proximal to the Hushamu pluton) and to the east (i.e., to the east of the southern quartz diorite) generally display lower values (Figs. 6.34 to 6.37). This is best exemplified by Sb, which exhibits relatively high values in a tight group of samples mainly occurring between the granodiorite and quartz diorite plutons (denoted by the red circle; Fig. 6.34). In contrast, Sb is lowest in samples to the west and east of the study site, as well as in samples proximal to the northeast margin of the lithocap (Fig. 6.34). Antimony is also relatively high in the northwest quartz diorite sample and in the sample of the tonalite dyke in the northeast of the granodiorite (Fig. 6.34). Arsenic displays more spatial variation across the study site than the other distal pathfinder elements (Fig. 6.35). Arsenic most noticeably exhibits a trend of anomalously high values in the three actinolite and epidote altered samples extending off the southeast margin of the quartz diorite pluton (denoted by the red oval; Fig. 6.35). Like Sb, most of the other relatively high values of As are observed in samples located within the center of the study site, albeit less tightly constrained. In addition, moderately high As values are observed in two of the samples proximal to the Hushamu pluton (Fig. 6.35).

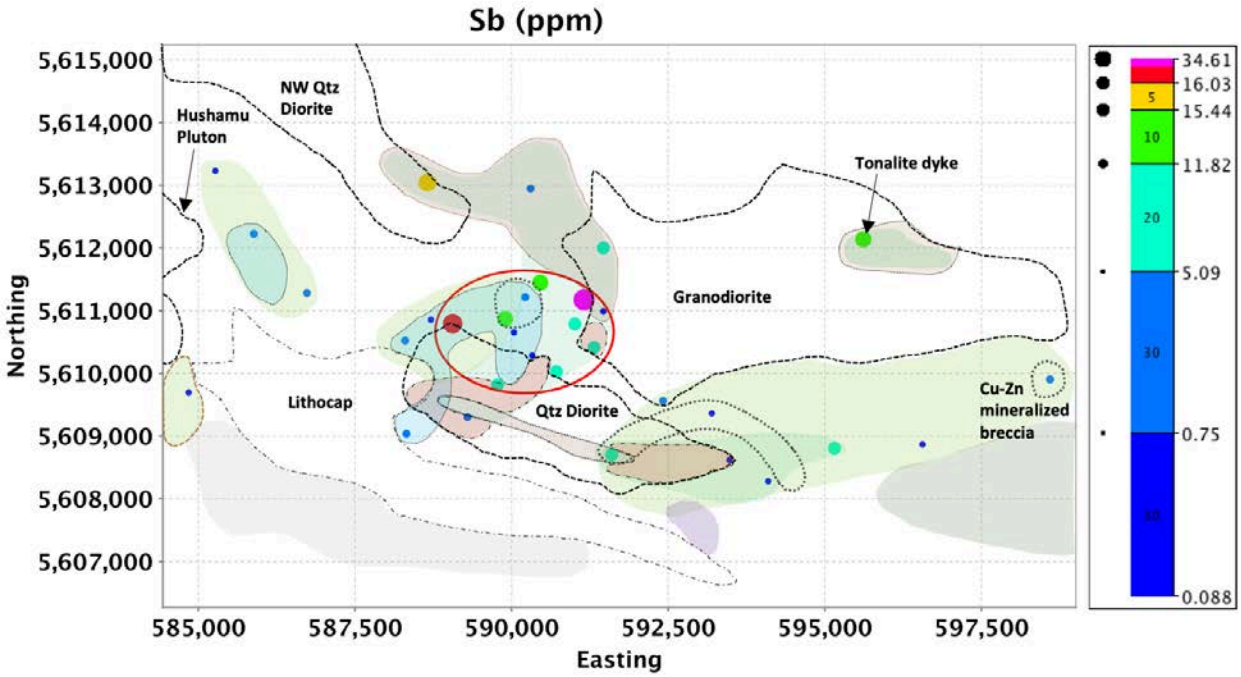


Figure 6.34. Spatial distribution of median epidote Sb concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

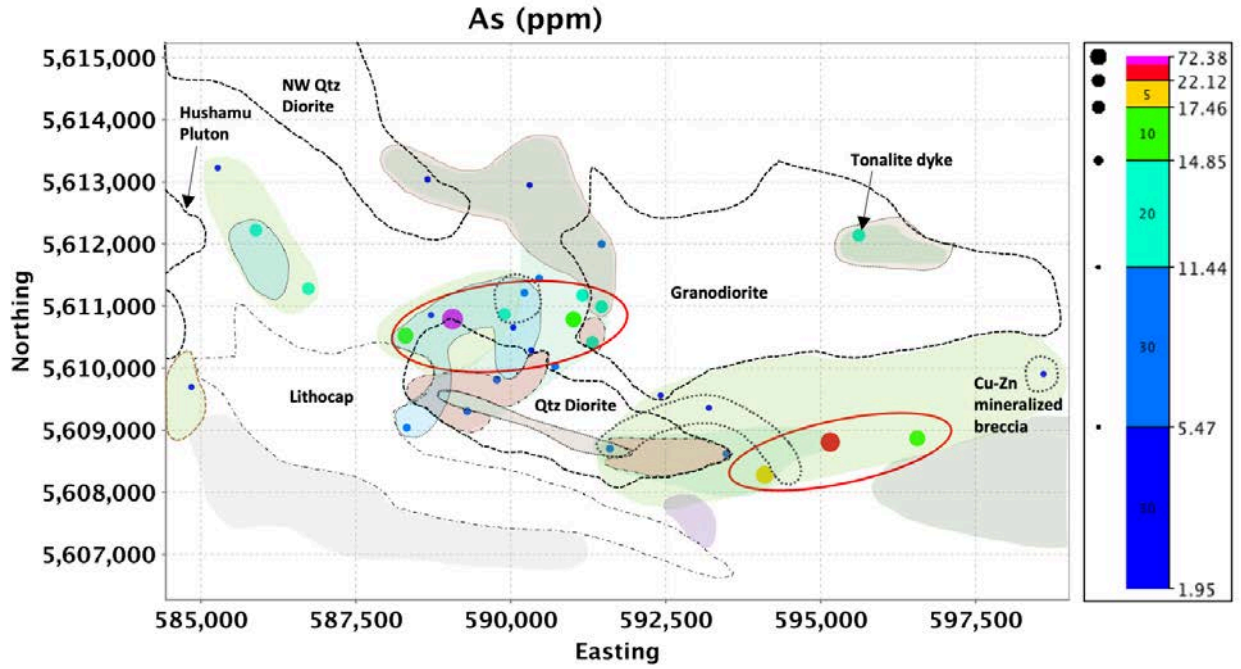


Figure 6.35. Spatial distribution of median epidote As concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Zinc and Pb values in epidote are similar to Sb and As in that they are collectively highest in samples from the center of the study site (Figs. 6.36 and 6.37). However, Zn and (in particular) Pb display relatively high values in epidote from all of the samples within the quartz diorite pluton, with the exception of the southeastern-most sample (Figs. 6.36 and 6.37). The highest Zn values are from the tonalite dyke sample in the northwestern portion of the granodiorite, whereas the highest Pb value is from the northwest diorite sample (Figs. 6.36 and 6.37). Both Zn and Pb also display moderate to moderately high values in the same two samples proximal to the Hushamu pluton (Figs. 6.36 and 6.37). Lead also displays some moderately high values in some of the samples extending east from the southeast margin of the quartz diorite pluton (Fig. 6.37).

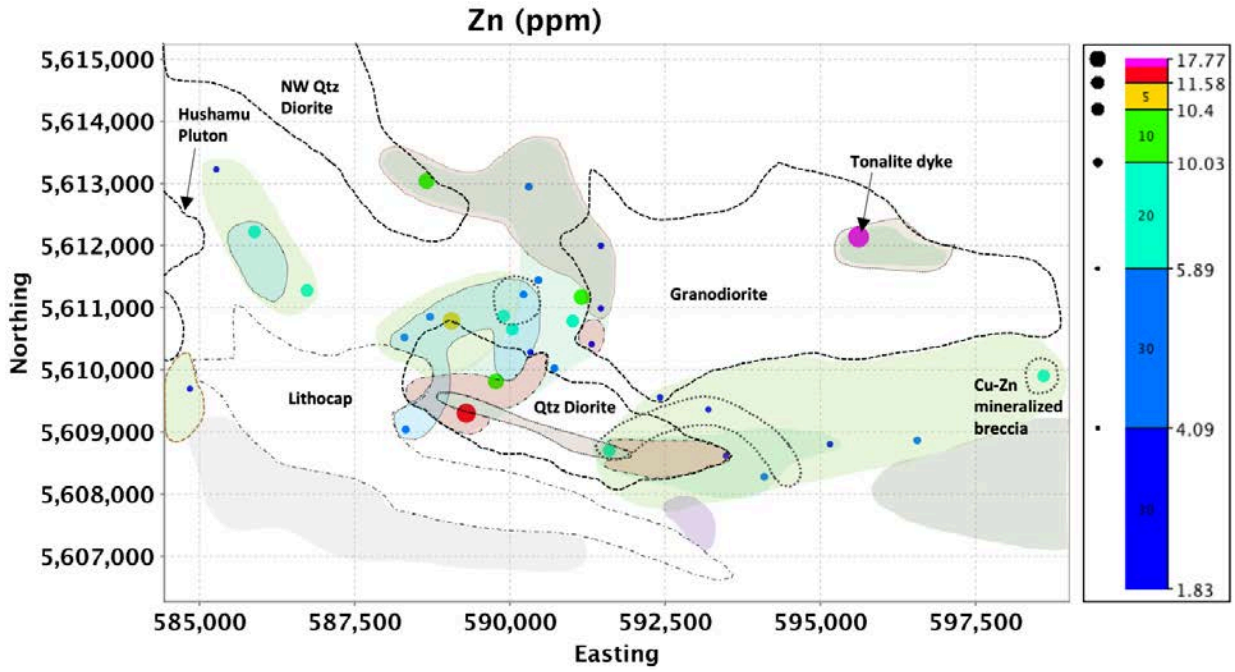


Figure 6.36. Spatial distribution of median epidote Zn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

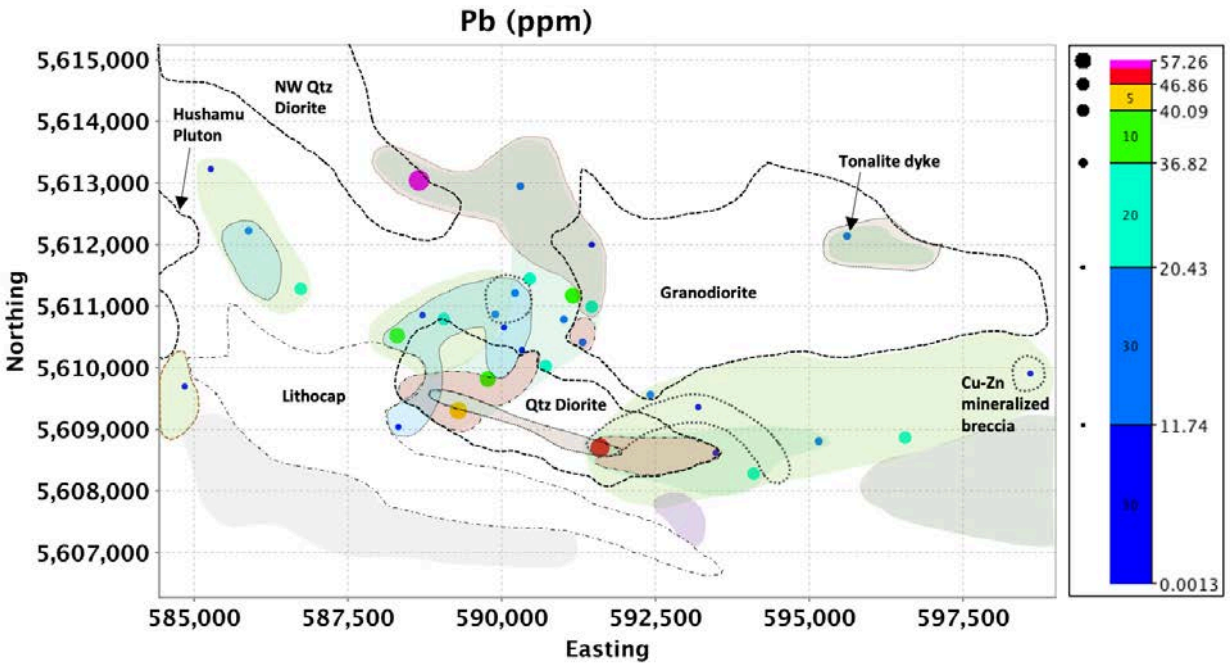


Figure 6.37. Spatial distribution of median epidote Pb concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Rare earth elements in epidote including La, Y, and Zr yielded at least 637 out of 649 analyses above BDL values. Collectively, these elements exhibit high values in the outer most samples that comprise the center of the study area (Figs. 6.38 – 6.40). This is best illustrated by La, which shows an outer margin of samples with high values around a central sample cluster containing all low values (denoted by the red circle; Fig. 6.38). This pattern can also be observed with Y (Fig. 6.39). Zirconium does not show this trend but still displays some high values around the southwest margin of the granodiorite pluton (Fig. 6.40). All three of these elements have their highest values in samples from the granodiorite pluton, suggesting some possible lithological control. All three of these elements decrease in concentration in the three samples proximal to the Hushamu pluton moving away from the center of the study area (Figs. 6.38 – 6.40).

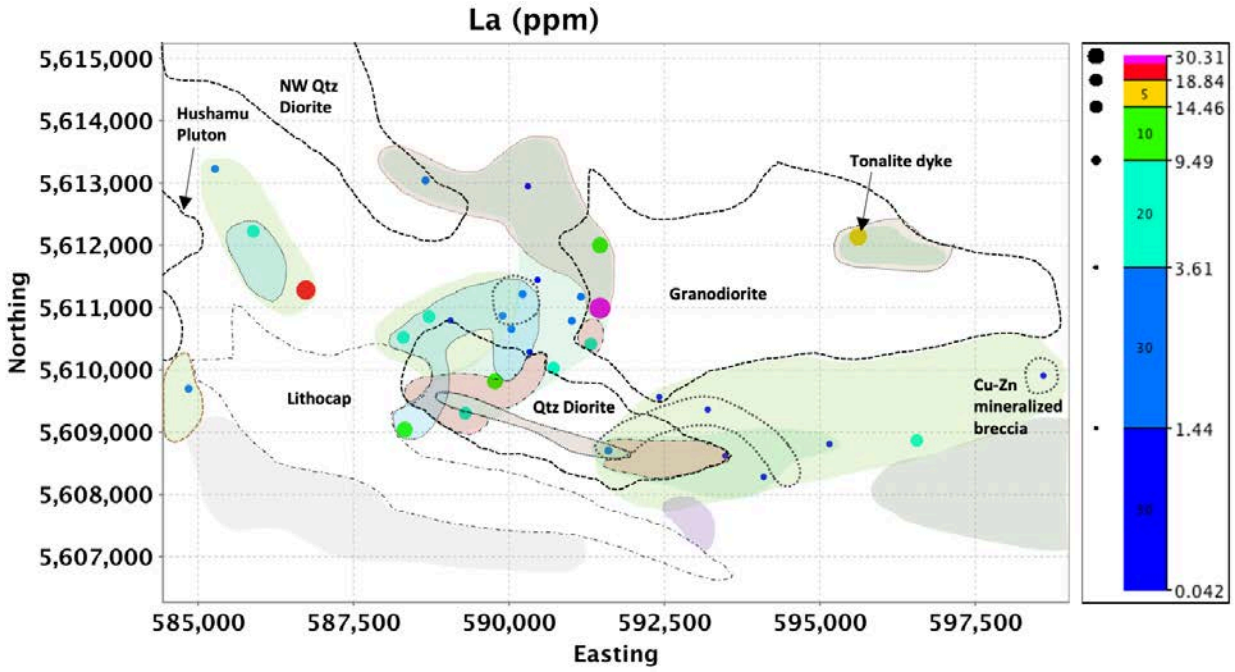


Figure 6.38. Spatial distribution of median epidote La concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

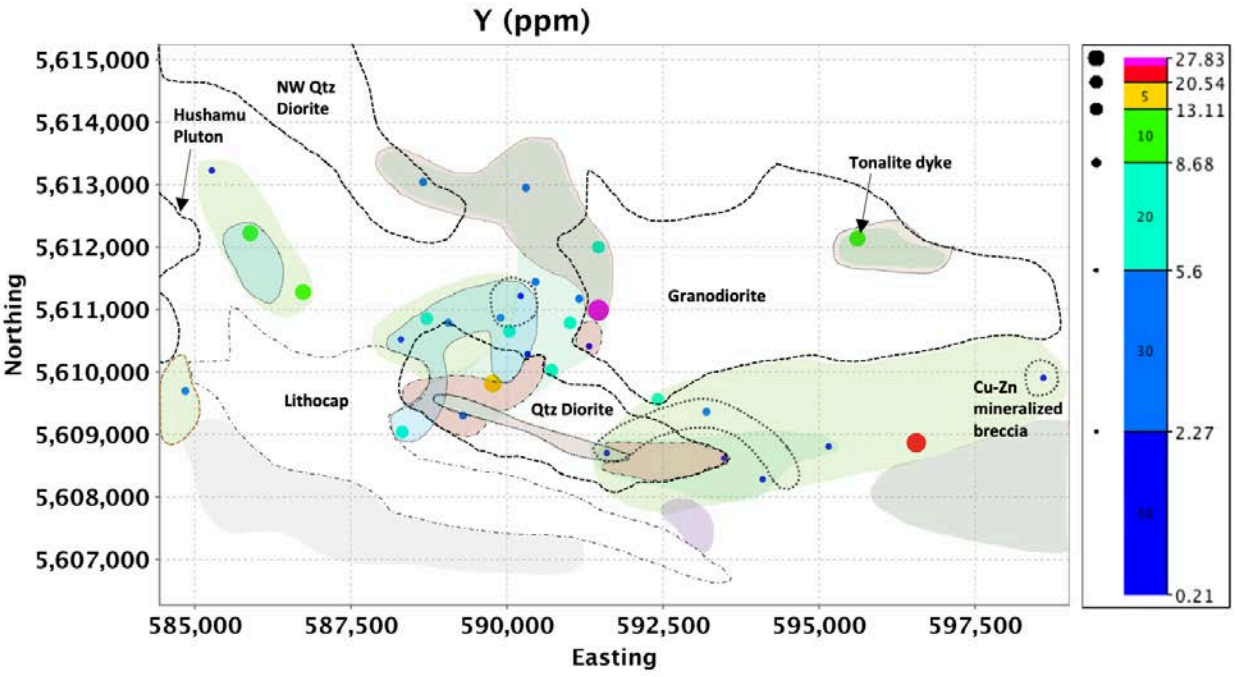


Figure 6.39. Spatial distribution of median epidote Y concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

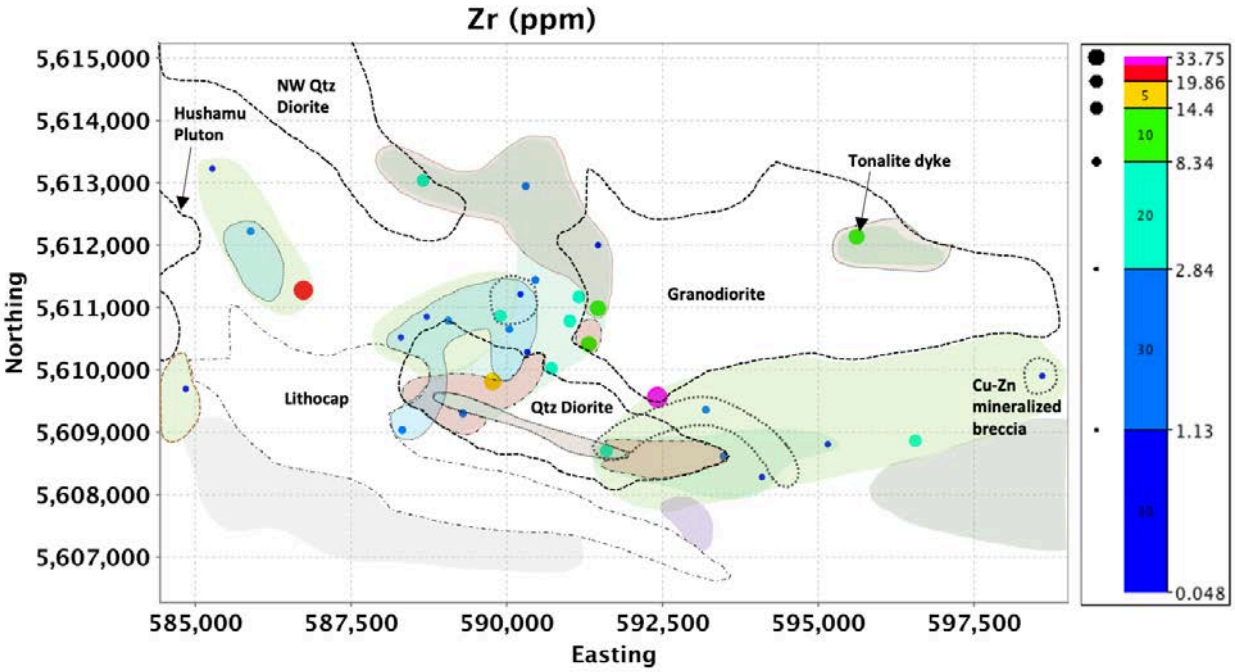


Figure 6.40. Spatial distribution of median epidote Zr concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

The spatial variation plots shown above demonstrate that distal pathfinder elements including Sb, As, Zn, and Pb display the most systematic spatial variation at Pemberton Hills. This is particularly evident with Sb, which highlights a relatively tight cluster of samples of high values in the center of the study area to the northeast of the lithocap, and mostly low values elsewhere (Fig. 6.34). This could be a potential indication of porphyry-deposit mineralization at depth in this area. High As values also characterize samples from this area, albeit with slightly more spatial variability (Fig. 6.35). Furthermore, high As values are also observed in three samples of strongly actinolite and epidote altered rock proximal to potassic alteration in the southeastern quartz diorite, which suggest this may also be a potential area of interest (Fig. 6.35). Zinc and Pb display high overall values in samples from the center of the study area (Figs. 6.36 and 6.37), albeit less

tightly constrained than Sb and As (Figs. 6.34 and 6.35), in addition to having high values in samples throughout the southern quartz diorite.

Multiple porphyry-related alteration events at Pemberton Hills have led to overprinting of alteration assemblages that may be complicating some of the vectoring signatures in the distal pathfinder and other associated elements (i.e., epidote may be from proximal and distal heat sources). Furthermore, epidote (particularly from within the main QSP shell) is often observed to be overprinted by phyllic alteration assemblages, and may be partially destroyed or obscured by K- and Na-bearing phyllic-associated alteration minerals such as muscovite and illite/montmorillonite (see Fig. 4.15). This is supported by the box and whisker plots shown in Figure 6.41 that clearly demonstrates an enrichment of Na and K in replacement epidote compared to vein epidote.

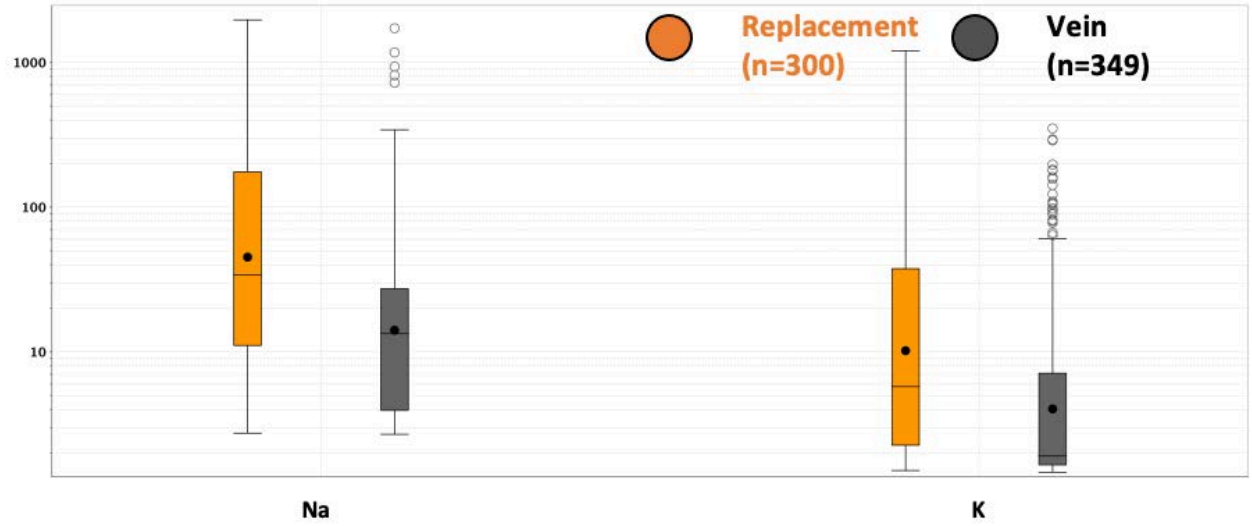


Figure 6.41. Log box and whisker plot comparing Na and K concentrations in vein vs. replacement epidote from the Pemberton Hills study site.

Additionally, epidote from Pemberton Hills was commonly observed to be zoned (Fig. 4.11). Ahmed et al. (2020) demonstrated that various zoning styles in epidote corresponded to

changes in the abundances of certain trace elements in epidote, and thus cannot be ruled out as an additional factor effecting the variability of distal pathfinder and other associated elements in epidote from samples across the study site.

6.3.2.3 Epidote fertility at Pemberton Hills

It has been proposed that the most productive porphyry systems should flux greater volumes of mineralizing fluids, which in turn should be reflected in stronger trace metal enrichment in epidote (Cooke et al., 2014; Wilkinson et al., 2020). Baker et al. (2020) further supported this by showing that epidote from the Rosario and Ujina deposits in the well-endowed Collahuasi district displayed high concentrations of As (up to 343 ppm), Sb (up to 258 ppm) and Pb (up to 640 ppm), whereas Cooke et al. (2014) reported that epidote from the smaller Black Mountain porphyry deposit, Philippines contained lower concentrations of As (up to 180 ppm), Sb (up to 65 ppm), and Pb (up to 120 ppm). At Pemberton Hills, epidote contains relatively high concentrations of As (up to 228 ppm), Sb (up to 630 ppm; with most upper limit samples around 100 ppm), and Pb (up to 129 ppm; Table 6.1; Fig. 6.42). Trace metal concentrations in epidote from this study suggest the potential for porphyry-related mineralization event(s) at Pemberton Hills.

Figure 6.42 shows Sb vs. As concentrations of epidote from the Pemberton Hills study site represented as a heat map based on point density (green to pink colours), compared with Sb and As concentrations of epidote from a range of porphyry-related Cu-Au deposits and metamorphic terrains from different regions of the world from the AMIRA database (in blue-purple shade). The green arrows on the plot illustrate the approximate range of small porphyry copper deposits (PCD's) based on Sb and As concentrations, whereas the red arrows show the approximate range

of giant PCD's. The purple arrow on the plot shows that metamorphic epidote is associated with low and decreasing Sb and As values. Epidote analyses from Pemberton Hills essentially plot in the middle of the AMIRA epidote database cloud, extending into the upper limits towards giant PCD's, as well as into the lower limits around the transition to metamorphic epidote (Fig. 6.42). As a whole, Sb and As values in epidote from Pemberton Hills show a fertile porphyry deposit signature that suggests the potential for a medium sized deposit to exist. However, the broad range in Sb and As values in epidote may suggest that there are groups of epidote related to multiple porphyry mineralization events (i.e., a small PCD and a medium-large PCD), consistent with multiple porphyry alteration events observed at the study site. It is acknowledged that other factors must be carefully considered when comparing epidote fertility to other porphyry deposits (i.e., tectonic setting, deposit type, host rock and intrusive rock types).

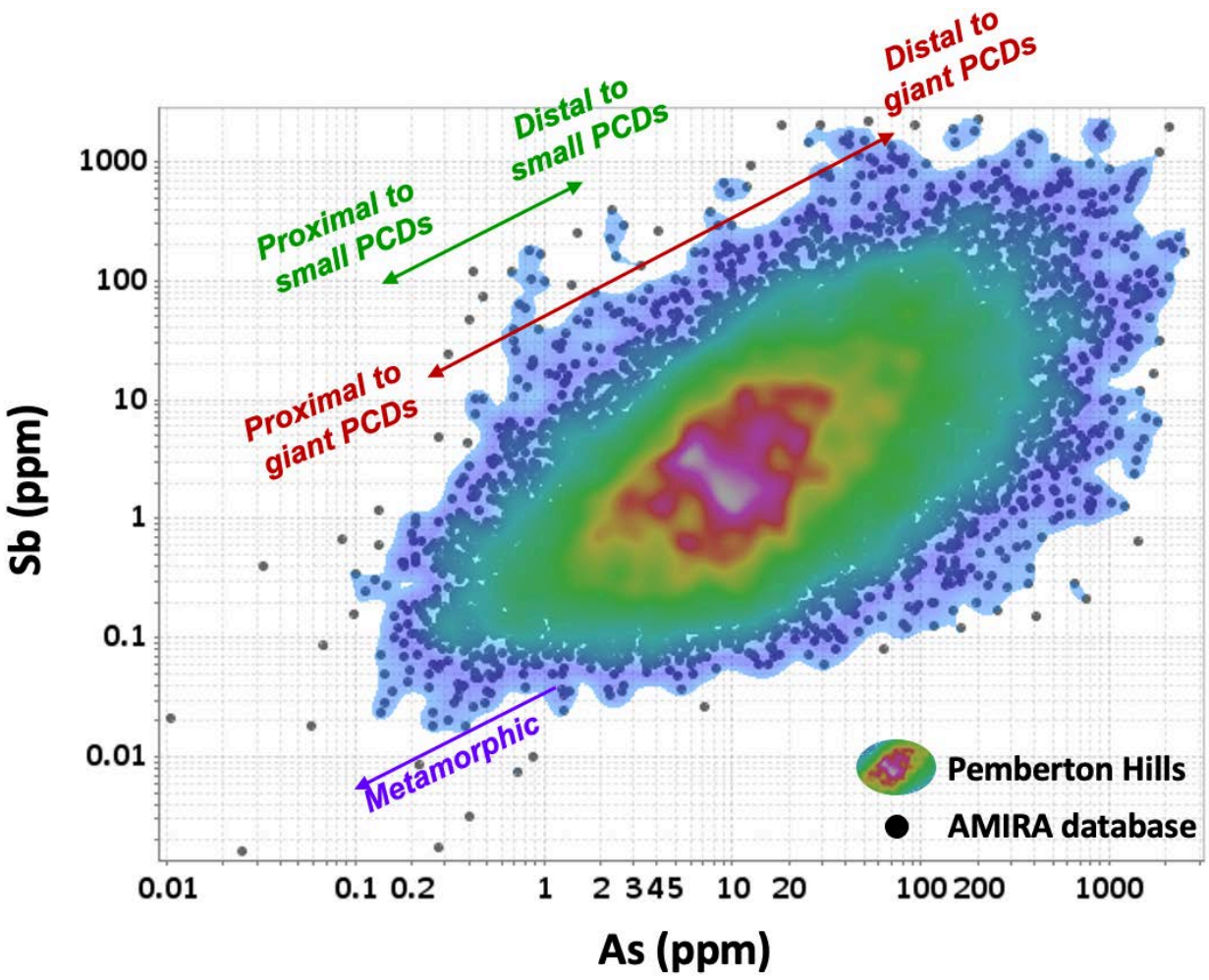


Figure 6.42. Sb vs. As concentrations in epidote from Pemberton Hills compared with the AMIRA database. PCD = porphyry copper deposit.

Baker et al. (2020) argued that concentrations of proximal and distal pathfinders in propylitic epidote are consistently higher than in regional metamorphic epidote. They noted that this observation is most prominent in distal pathfinder elements, which may show concentrations up to one order of magnitude higher in propylitic epidote. This is particularly important to recognize in regions such as the Collahuasi district, where propylitic alteration may grade out into lower greenschist facies metamorphism (Baker et al., 2020). The regional metamorphic grade of Bonanza volcanic rocks is zeolite to lower greenschist facies (DeBari et al.,

1999). As such, there is the possibility for metamorphic epidote to exist at Pemberton Hills. In order to avoid analyzing metamorphic epidote, the vast majority of epidote sampled from Pemberton Hills had indications of a hydrothermal origin (i.e., veins, clots, chemical reaction fronts, association with magmatic sulphides). Inspection of the epidote with the lowest values of As and Sb concentrations suggests that the epidote from these samples are derived from porphyry-related hydrothermal breccias and a metamorphic origin can be ruled out. However, it remains possible that other epidote from Pemberton Hills with low Sb and As may be metamorphic in origin, or reflect a metamorphic overprint.

In addition to using epidote Sb and As concentrations as an effective means of evaluating epidote fertility, these elements can also discriminate epidote from different porphyry-related alteration events at Pemberton Hills. The southeastern margin of the quartz diorite pluton is characterized by potassic alteration that concentrically grades outwards to actinolite alteration, through epidote alteration, and into distal chlorite alteration, which is characteristic of a typical propylitic alteration halo (Figs. 4.8 and 6.1; Cooke et al., 2014). In contrast, the center of the study area is a complex assortment of overprinting potassic, propylitic, phyllic, and clay-dominated alteration assemblages occurring in a wide range of spatially variable rock types (Fig. 4.8). Figure 6.43 illustrates that epidote from samples within the potassic and propylitic alteration domains extending to the east from the southeastern margin of the quartz diorite (highlighted in red) display lower Sb and As concentrations than epidote in samples from the central and north-central areas of the study site (highlighted in green). One sample from the center of the quartz diorite is highlighted in pink (PM18AJ275), as it is unclear whether or not this epidote is associated with the sample group from the center of the study area, or the sample group to the

southeast (Fig. 6.43). Samples highlighted in black are from the western domain of the study area and display low to moderate Sb and As concentrations (Fig. 6.43). Changes in the epidote mineral chemistry of these samples with increasing or decreasing proximity to the Hushamu pluton suggests it has some influence on samples in the western domain of the study site. Lastly, the mineralized hydrothermal breccia sample to the east of the study site is highlighted in blue and displays moderate Sb and low As values (Fig. 6.43).

The nature of the propylitic alteration halo (actinolite → epidote → chlorite; Fig. 6.1; Cooke et al., 2014) grading outwards from potassic alteration around the southeastern end of the quartz diorite suggests that it formed by a discrete porphyry-related alteration distinct from the samples from the center of the study area. The differences in the overall As and Sb concentrations in epidote from Pemberton Hills would suggest that the porphyry-related alteration event(s) that produced epidote from the center of the study area would have fluxed greater volumes of mineralizing fluid than the porphyry-related alteration event that produced epidote from the southeastern domain. This suggests that the area within the center of the study site denoted by high Sb and As values has the greatest potential to be spatially and temporally associated with economically viable porphyry-related mineralization based on the epidote mineral chemistry work in this study. Unfortunately, a limited sample distribution particularly between the northwest quartz diorite and main phyllic shell, and large sample gap within the granodiorite pluton inhibits the ability to further discriminate sample within these areas. Furthermore, identification of mineralization (i.e., bornite in epidote veins, Au-rich pyrite, and anomalously high whole-rock Cu values) in samples proximal to the southeastern margin of the quartz diorite pluton suggest that while the porphyry-related alteration event related to these

samples may not have been as productive as the porphyry-related alteration event associated with samples in the center of the study site, there is still the potential for economic porphyry mineralization in this area.

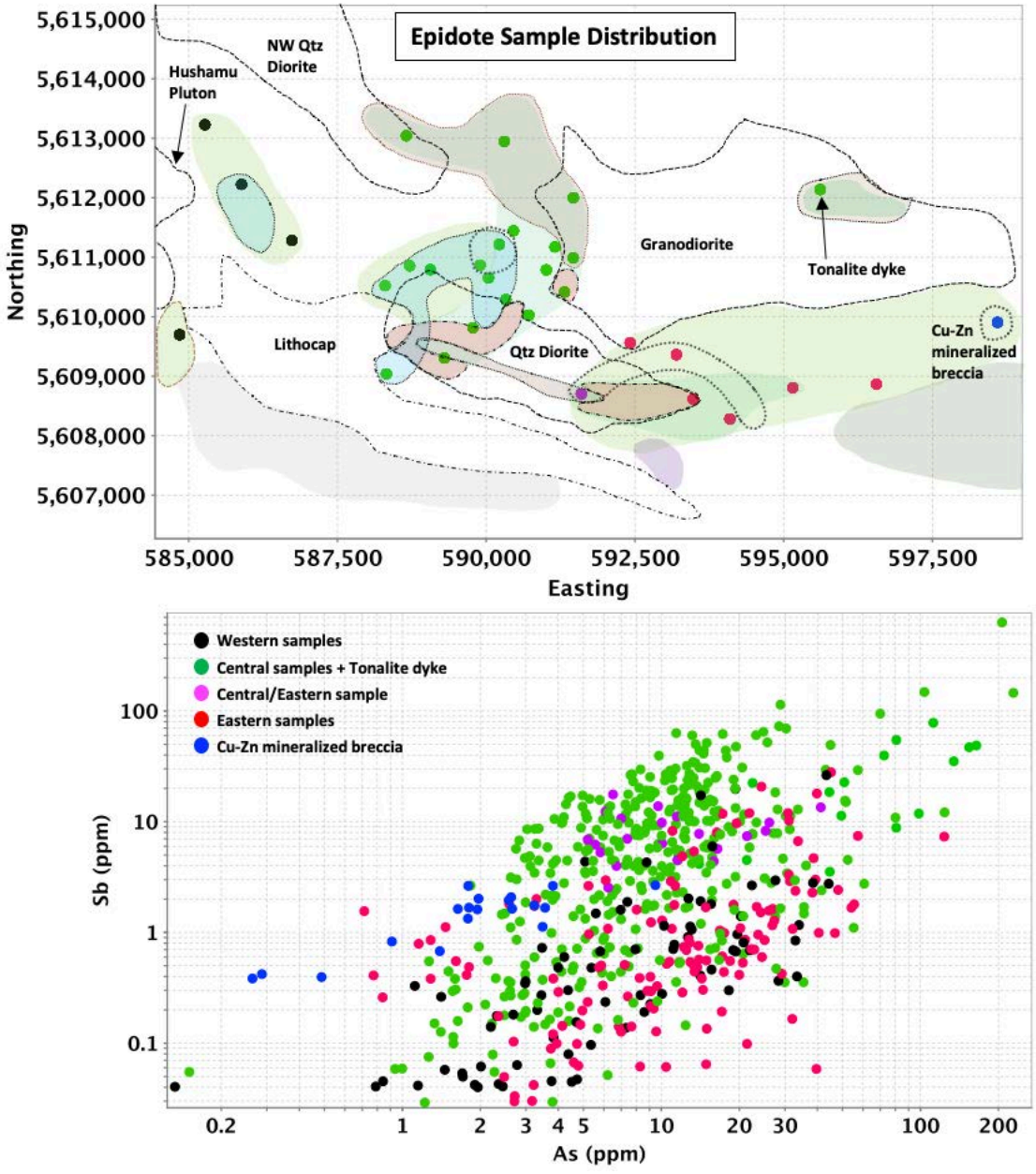


Figure 6.43. (A) Spatial distribution of epidote LA-ICP-MS samples from the Pemberton Hills study site with different sample groups of interest corresponding to different colours. (B) Plot of Sb vs. As concentrations of epidote from Pemberton Hills with colours corresponding to sample location in Figure 6.40A.

6.3.3 Chlorite mineral chemistry

Chlorite is also a characteristic mineral in the propylitic alteration environment in many porphyry and hydrothermal systems, but is also commonly observed in metamorphic and some magmatic environments (Wilkinson et al., 2015). Chlorite group minerals are micaceous phyllosilicates that have the general formula $(Mg, Fe)_3(Si, Al)_4O_{10}(OH)_2 \cdot (Mg, Fe)_3(OH)_6$ and are composed of two main layers that form an alternating crystal structure. The first being a talc-like unit ($(Mg, Fe)_3(Si, Al)_4O_{10}(OH)_2$) that exhibits a tetrahedral-octahedral-tetrahedral (T-O-T) layering, and the second being an interlayer brucite-like unit ($(Mg, Fe)_3(OH)_6$) (Fig. 6.44). The chlorite formula can be expressed as $A_{5\text{-}6}T_4Z_{18}$, where; A = Al, Fe^{2+}, Fe^{3+}, Li, Mg, or Mn, T = Al, Fe^{3+} or Si, and Z = O or OH. Substitutions within the chlorite structure predominantly occur within the octahedral site by major cations such as Mg, Al, and Fe, as well as minor cations such as Cr, Mn, Ni, V, Cu, Zn, Li, and Ti (Wilkinson et al., 2015). This wide range in elemental substitution has resulted in the identification of fourteen discrete mineral phases that comprise the chlorite group, with the most common species being clinochlore (Mg-rich), and chamosite (Fe-rich), which are end-members of a solid solution series (Bailey, 1988; Table 6.6). The other dominant control on chlorite composition is produced by tschermak exchange, which is expressed as $^{VI}Mg^{2+} + {}^{IV}Si^{4+} \leftrightarrow {}^{VI}Al^{3+} + {}^{VI}Al^{3+}$ (Bailey, 1988).

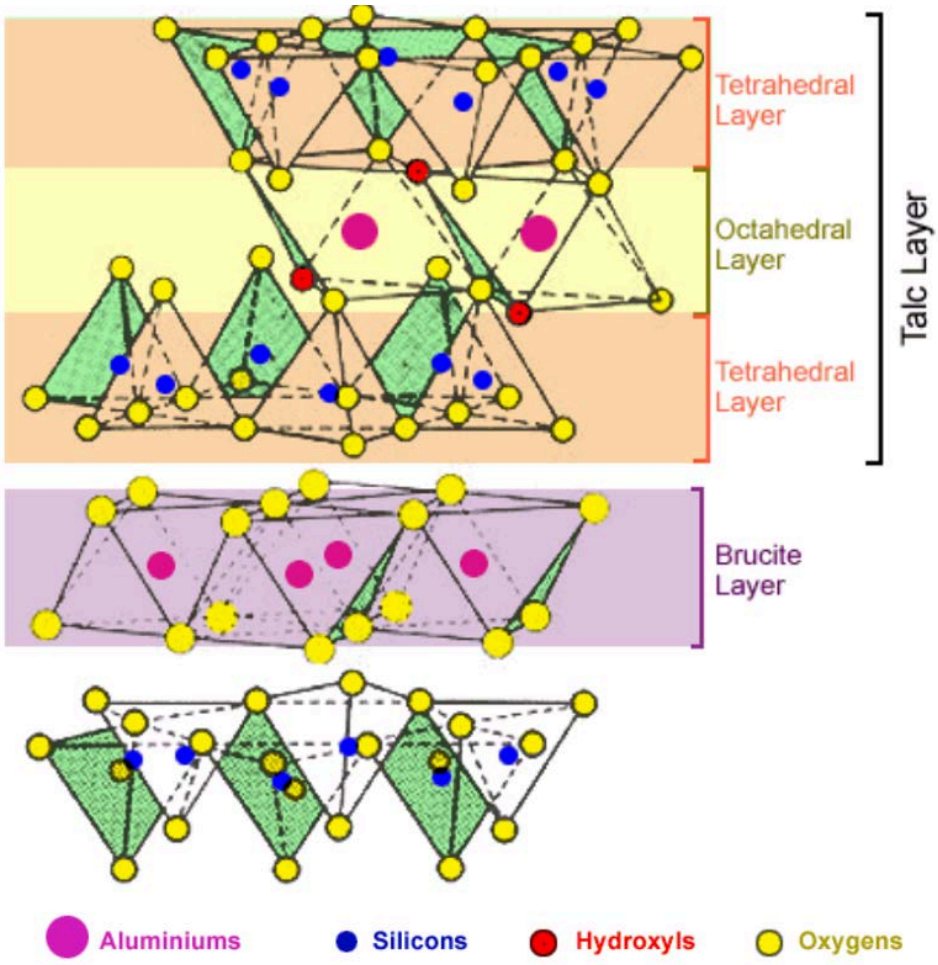


Figure 6.44. Crystal structure of chlorite. Taken from image source: https://www.ihrdc.com/els/ipims-demo/t26/offline_IPIMS_s23560/resources/data/G4105.htm

Table 6.6. Chemical formulae of chlorite group minerals. Elemental substitutions that characterize each group are highlighted in green.

Name	Formula
Chlorite Group	
Chamosite	$(Fe, Mg)_5Al(Si_3Al)O_{10}(OH)_8$
Clinochlore	$(Mg, Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$
Baileychlore	$(Zn, Fe^{2+}, Al, Mg)_6(Al, Si)_4O_{10}(O,OH)_8$
Kämmererite	$(Mg, Fe^{2+})_5(Al, Cr)_2Si_3O_{10}(OH)_8$
Cookeite	$LiAl_4(Si_3Al)O_{10}(OH)_8$
Borocookeite	$LiAl_4(Si_3B)O_{10}(OH)_8$
Donbassite	$Al_2(Al_{2.33})Si_3Al)O_{10}(OH)_8$
Gonyerite	$(Mn, Mg)_5(Fe^{3+})_2Si_3O_{10}(OH)_8$
Nimite	$(Ni, Mg, Al)_6(Si, Al)_4O_{10}(OH)_8$
Odinite	$(Fe, Mg, Al, Ti, Mn)_{2.4}(Al, Si)_2O_5(OH)_4$
Orthochamosite	$(Fe^{2+}, Mg, Fe^{3+})_5Al(Si_3Al)O_{10}(O,OH)_8$
Pennantite	$(Mn_5Al)(Si_3Al)O_{10}(OH)_8$
Ripidolite	$(Mg, Fe, Al)_6(Al, Si)_4O_{10}(OH)_8$
Sudoite	$Mg_2(Al, Fe)_3Si_3AlO(OH)_8$

6.3.3.1 Element partitioning in chlorite and whole-rock geochemistry

The use of chlorite mineral chemistry in this study mainly builds on the initial findings of Wilkinson et al. (2015), who demonstrated that patterns in the trace element chemistry of chlorite could be observed in the propylitic alteration halo of the Batu Hijau Cu-Au porphyry deposit in Indonesia. One of the most important outcomes of this study was the documentation of Ti substitution in chlorite as a function of distance from the hydrothermal center at Bata Hijau (Wilkinson et al., 2015). The authors attributed this process to be analogous to Ti substitution in biotite, whereby the substitution of Ti into the octahedral site in chlorite would be a function of the thermal crystallization temperature that requires coupled substitutions of various cations

and anions (Wilkinson et al., 2015). Additionally, Wilkinson et al. (2015) observed various elements to either display a positive correlation (i.e., Mg, Al, V) or a negative correlation (i.e., Li, Pb, Ca, Sr, Ba) with Ti (and temperature), which demonstrates their use as vectors towards or away from a mineralized porphyry ore body. Wilkinson et al. (2015) also showed backscattered electron imaging and LA-ICP-MS element maps of chlorite grains from Bata Hijau that displayed internal homogeneity with respect to element distribution, suggesting that variability in trace element concentrations in chlorite was a function of site-specific substitution as opposed to the presence of micro-inclusions. Metals such as Zn and Mn are readily accommodated into the chlorite crystal structure and demonstrate significant enrichment in chlorite relative to whole rock concentrations at Bata Hijau and other porphyry deposits (Wilkinson et al., 2015). Wilkinson et al. (2015) reported that Zn and Mn showed a maximum in chlorite at ~1.3 km from the Bata Hijau porphyry deposit center, which reflected the whole rock anomalies for these elements. This is thought to be the result of advective transport of these elements by magmatic-hydrothermal fluids migrating outwards from the porphyry deposit center (Wilkinson et al., 2015 and references therein).

Although crystallization temperature was the most likely cause of the observed substitution of Ti and other elements, Wilkinson et al. (2015) indicated that other factors such as the Al, Fe and Mg content of primary mafic phases, the oxidation state, and the pH of the fluids in question, could also affect chlorite compositions. Given the fairly homogenous protolith compositions at Bata Hijau, Wilkinson et al. (2015) suggested that additional work regarding the controls on Ti and other elemental substitutions in chlorite needed to be completed in more compositionally heterogeneous study sites. The porphyry environment at Pemberton Hills is

characterized by a wide variety of host rock lithologies (i.e., andesite, basaltic andesite, mafic flows, rhyolite, volcanic breccias, granodiorite, quartz diorite), and provides a potential opportunity to further evaluate the impact of protolith composition on chlorite chemistry.

In order to compare chlorite and whole rock chemistry, major, minor, and trace element concentrations of analyzed chlorite samples and all whole rock data are shown in Figures 6.45 and 6.46. Elements that are enriched in chlorite relative to whole rock include Fe, Mn, Co, Ni, Mg, and Zn. In contrast, elements that are enriched in whole rock relative to chlorite include Al, Sr, Sn, Eu, Bi, Na, K, Ti, Ba, Zr, Ce. Y. La, Yb, and Lu. Elements that display considerable overlap between chlorite and whole rock include V, As, Pb, Sb, and Cu and suggest partitioning between chlorite as well as other crystallizing mineral phases.

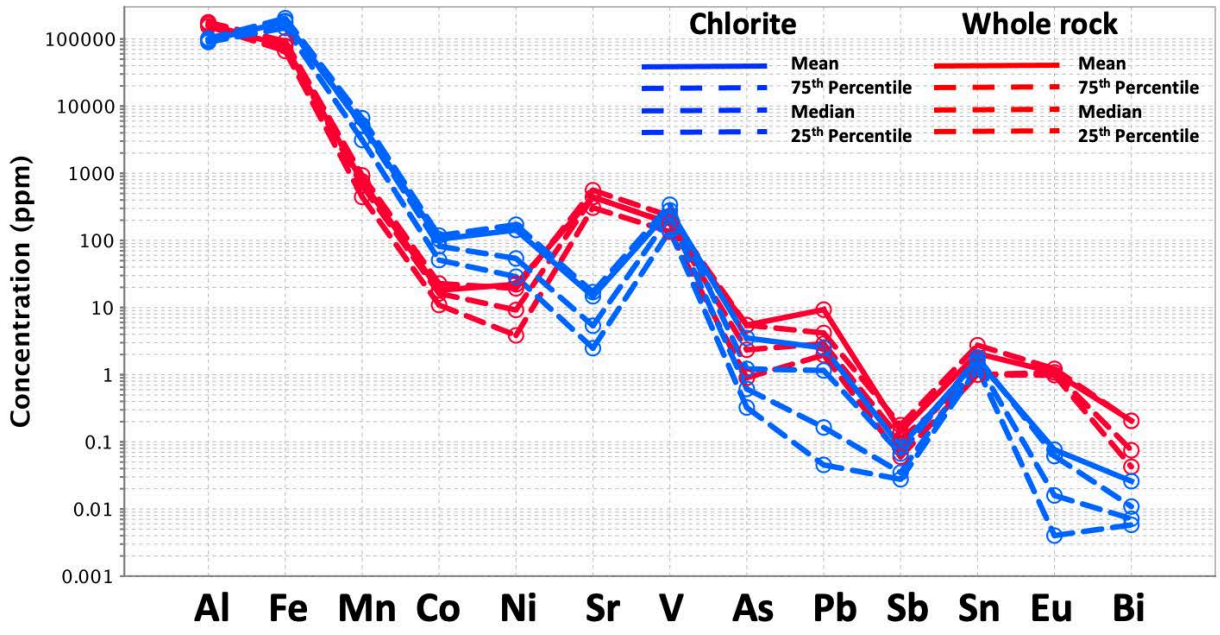


Figure 6.45. Comparison of chlorite LA-ICP-MS and whole rock geochemical data that highlights mean, median, 25th percentile, and 75th percentile values.

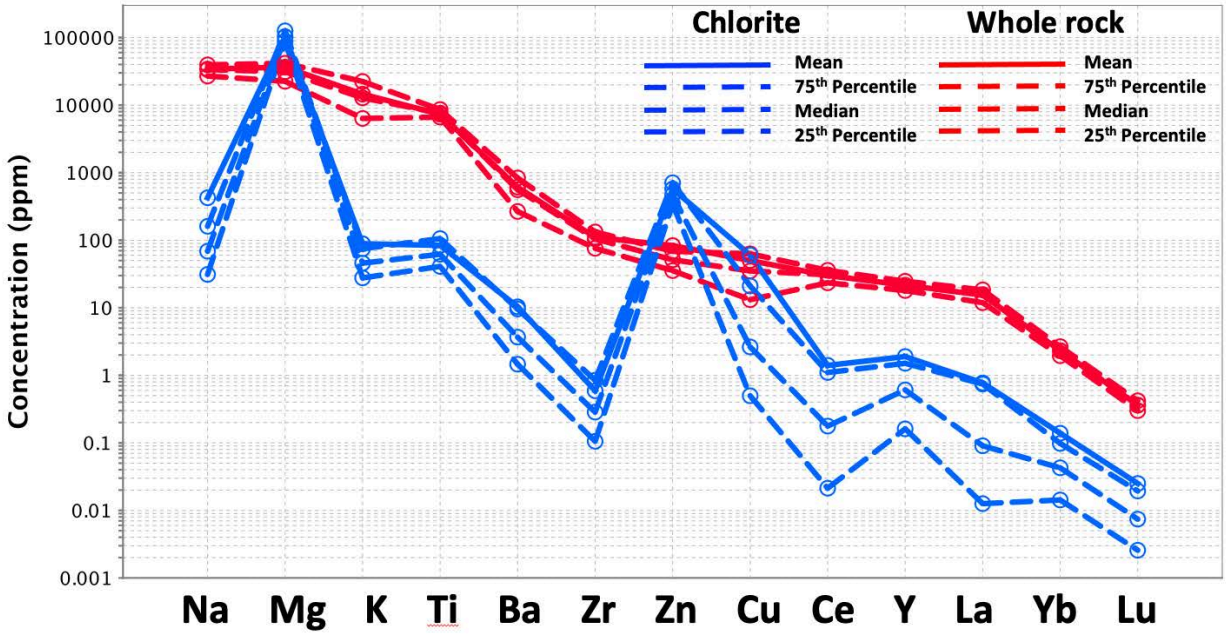


Figure 6.46. Comparison of epidote LA-ICP-MS and whole rock geochemical data that highlights mean, median, 25th percentile, and 75th percentile values.

6.3.3.2 Major and trace element variations in chlorite at Pemberton Hills

Elements that are known to increase or decrease in concentration in chlorite away from a porphyry deposit center (i.e., Ti, Mg, Fe; Wilkinson et al., 2015) do not show clear spatial variations in chlorite at Pemberton Hills, which suggests that other factors might be influencing chlorite compositions in the study area (Figs. 6.47, 6.48, and 6.50). In order to evaluate the possible effect of lithological control on chlorite composition, box and whisker plots showing Fe and Mg concentrations in chlorite with respect to rock type are shown in Figure 6.49. There is a broad range of host rock lithologies at Pemberton Hills. For the purpose of this exercise, rock types have been classified as felsic plutonic rocks (green; n = 88), hydrothermal breccias (grey; n = 15), intermediate plutonic rocks (orange; n = 80), intermediate volcanic breccias (light blue; n = 41), intermediate volcanic rock (dark blue; n = 199), mafic volcanic breccias (purple; n = 30),

and mafic volcanic rock (red; n = 61). Evaluation of Fe highlights a clear correlation between rock type and Fe content in chlorite (Fig. 6.49A). Lithologies such as felsic plutonic and intermediate volcanic rocks demonstrate a clear enrichment in chlorite Fe concentration in contrast to mafic volcanic rocks, mafic volcanic breccias, intermediate plutonic rocks and hydrothermal breccias. The opposite is observed for Mg, where lithologies such as mafic volcanic rocks, mafic volcanic breccias, intermediate volcanic rocks, and hydrothermal breccias display higher chlorite Mg concentrations in contrast to felsic plutonic and intermediate volcanic rocks, which show relatively low chlorite Mg contents (Fig. 6.49B). Intermediate volcanic breccias demonstrate the most overlap between rock types, but generally cluster towards felsic plutonic and intermediate volcanic rocks with respect to both Fe and Mg (Fig. 6.49A, B).

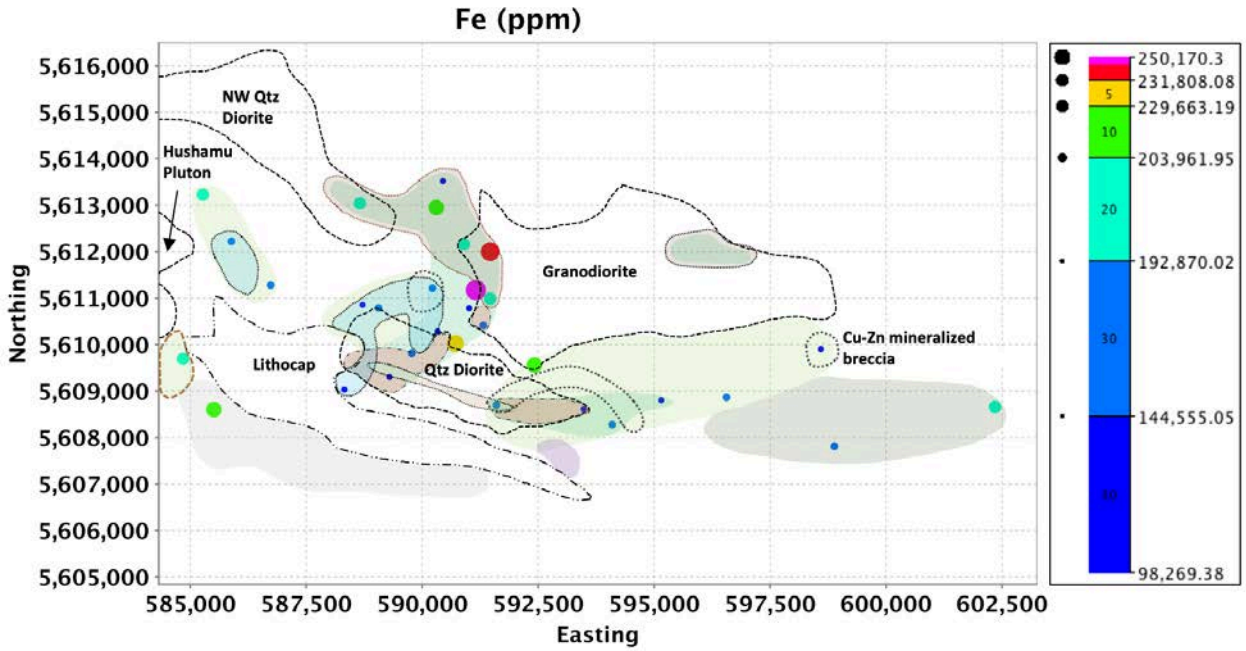


Figure 6.47. Spatial distribution of median chlorite Fe concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

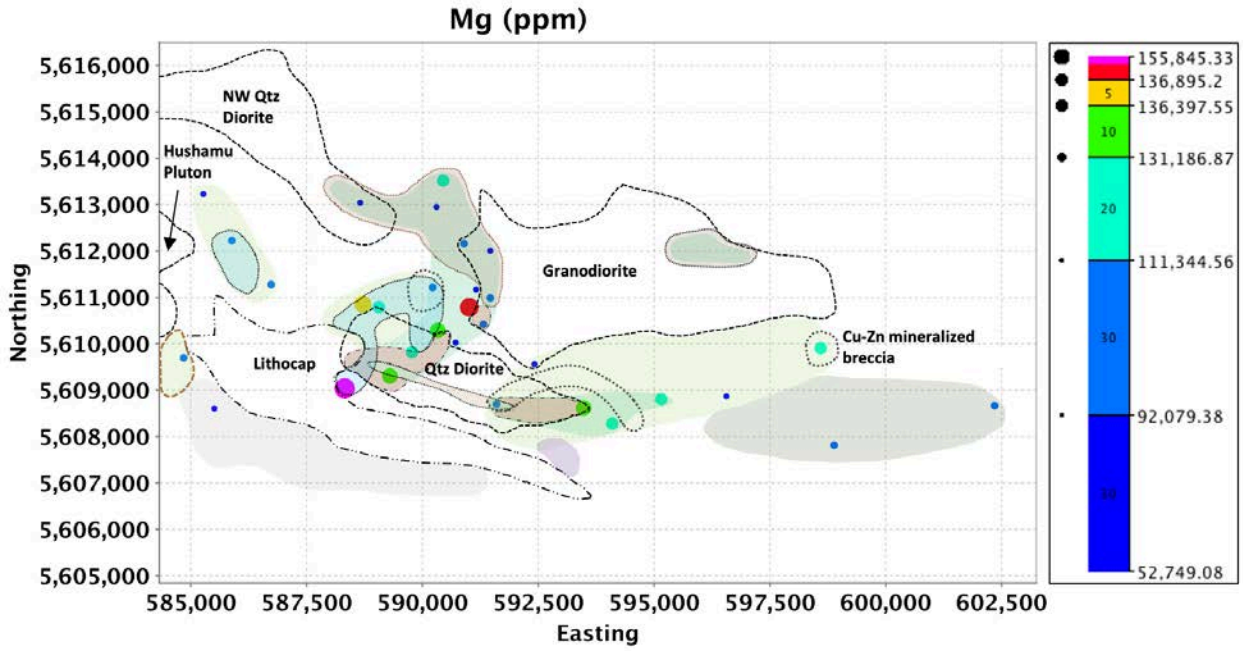


Figure 6.48. Spatial distribution of median chlorite Mg concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Wilkinson et al. (2020) showed that element ratios used for chlorite vectoring (i.e., Mg/Ca, Mg/Sr) that worked at the Bata Hijau porphyry deposit were not as successful in delineating the porphyry deposit center at El Teniente, Chile. They suggested this was the result of varying protolith composition at El Teniente, which can affect the Mg and Fe content of chlorite. Figure 6.49 suggests that the protolith composition also controls the Fe and Mg concentrations in chlorite at Pemberton Hills. This explains the variability in Fe and Mg contents in chlorite in samples from the center of the study area where lithological variation is most heterogeneous. In areas such as the southeast of the study site that are comprised of protoliths with similar ranges in Mg content in the box and whisker plots (i.e., mafic volcanic rocks, mafic breccias and intermediate intrusive rocks), there is more of a systematic spatial variation denoted by a decrease in Mg with increasing distance from the quartz diorite pluton. However, a limited

amount of chlorite was analyzed in certain lithologies (i.e., intermediate volcanic rocks), and consequently these interpretations should be treated with some degree of caution. Furthermore, given the tendency for higher Mg values to also occur within the majority of the main QSP shell, it is possible that late-stage phyllic alteration may have some additional influence on the chlorite mineral chemistry at Pemberton Hills.

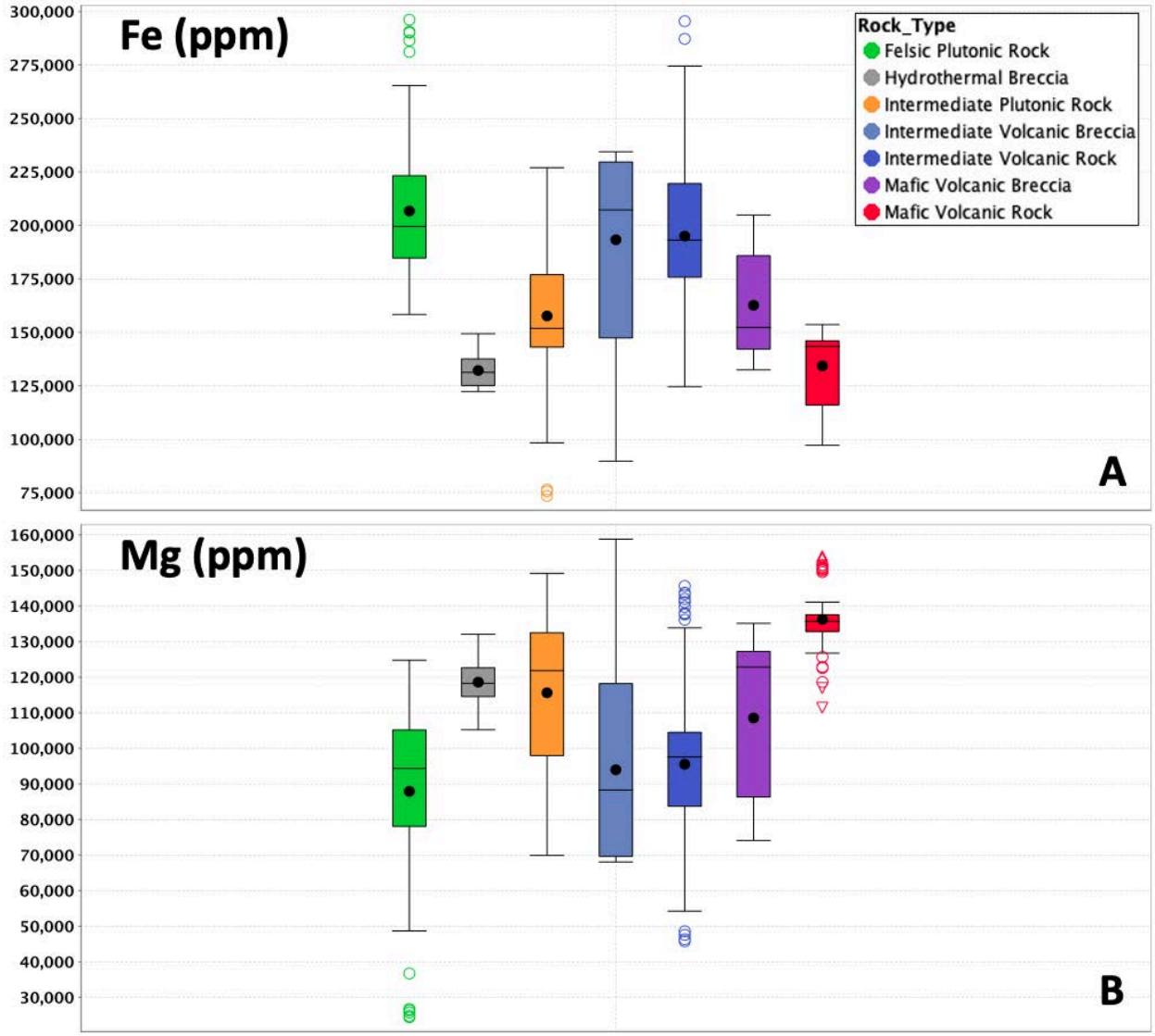


Figure 6.49. (A) Box and whisker plot of Fe content in chlorite as a function of rock type. (B) Box and whisker plot of Mg content in chlorite as a function of rock type.

According to Wilkinson et al. (2015), Ti concentration in chlorite should increase with proximity to the center of a porphyry deposit. At Pemberton Hills, Ti concentrations in chlorite are highest in mostly biotite altered samples in the north of the study area, in samples from within the QSP shell to the northeast of the lithocap, and in select samples around the eastern margin of the quartz diorite pluton (Fig. 6.50). Based on these observations, Ti does not exhibit a clear systematic spatial distribution at Pemberton Hills, which suggests that additional factors may be controlling Ti concentrations in chlorite across the study site. Unlike Fe and Mg, lithological control appears to have less of an overall effect on Ti concentrations in chlorite. Most notably, hydrothermal breccias and more importantly mafic volcanic rocks display markedly lower Ti content in chlorite than all other lithologies (Fig. 6.51). While other lithologies do show considerable overlap in Ti concentrations with one another, Ti content is slightly elevated in felsic plutonic, intermediate volcanic rocks and volcanic breccia chlorite compared to that from intermediate plutonic rocks (Fig. 6.51). While there does appear to be some lithological control on Ti content in chlorite at Pemberton Hills, there are likely additional factors to consider such as replacement of biotite by chlorite.

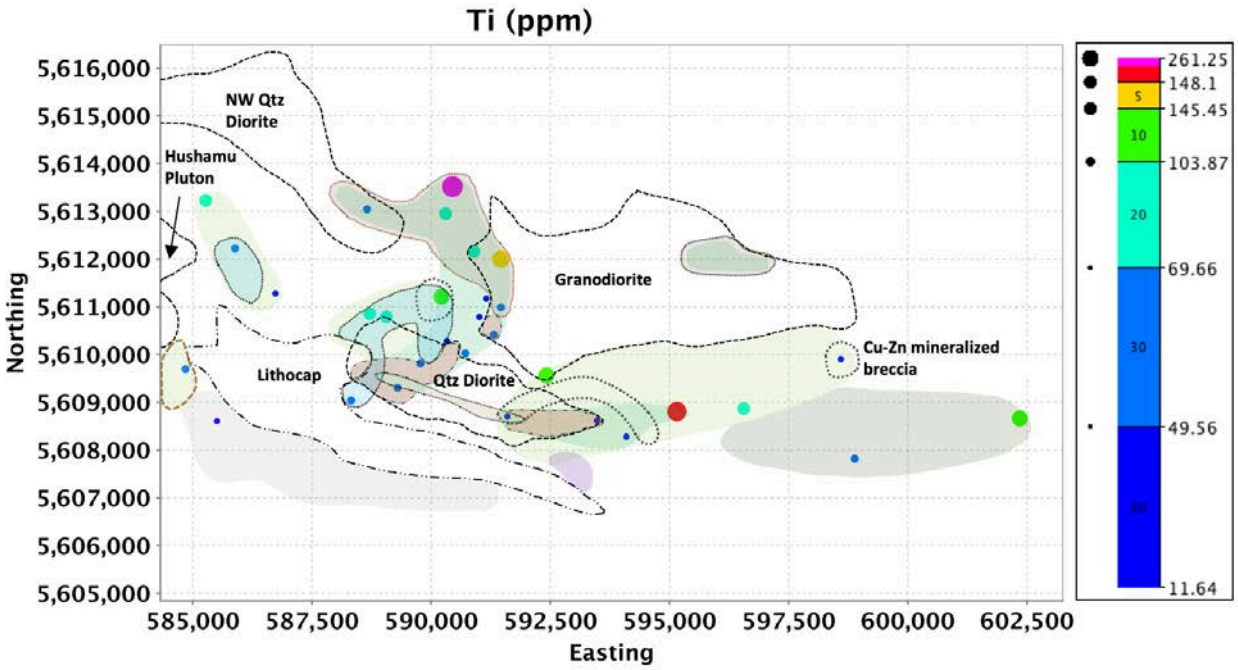


Figure 6.50. Spatial distribution of median chlorite Ti concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

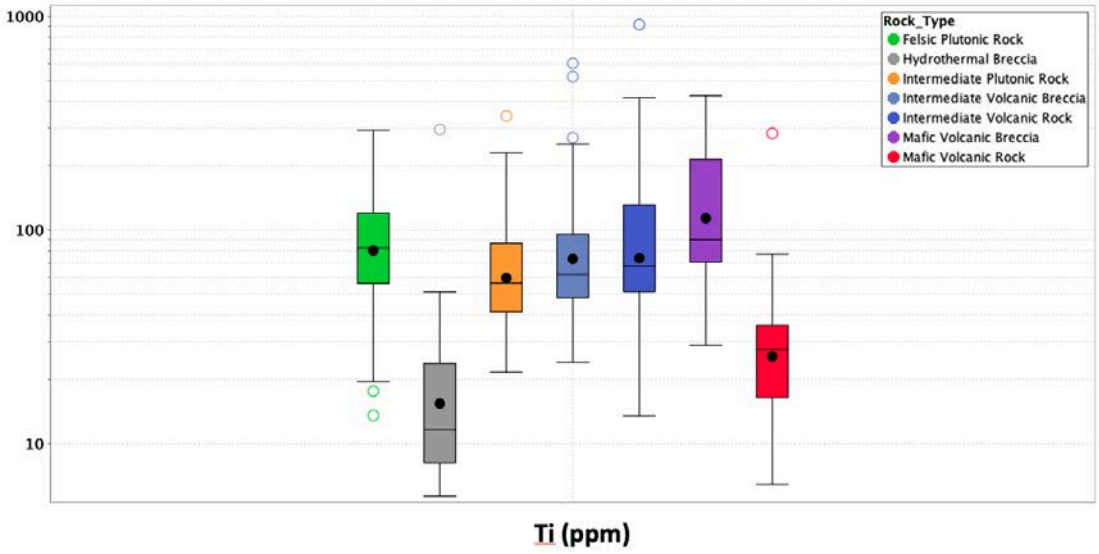


Figure 6.51. Log box and whisker plot illustrating Ti content in chlorite as a function of rock type.

Figure 4.13 displays a cross-polarized thin section image of a primary amphibole grain that was replaced by shreddy biotite and subsequently (partially) replaced by chlorite. Titanium concentrations are generally higher in biotite than chlorite, and liberation of Ti is an expected result of the biotite → chlorite reaction (Wilkinson et al., 2015). Commonly observed

hydrothermal biotite associated with potassic alteration in the northern regions of the study area and the presence of overprinting propylitic alteration assemblages, suggests that pre-existing biotite may be one of the controls on Ti content in chlorite, particularly in the granodiorite and mafic volcanic rocks in the northern area of the study site.

Other high Ti values are found in chlorite within the main QSP shell, but not in adjacent samples from the quartz diorite pluton. It is possible that chlorite from within the QSP shell are genetically related to the phyllic alteration event itself, rather than the surrounding chlorite that is more likely to be related to propylitic alteration events. As mentioned above, oxidation state may have some control on the Ti content in chlorite (Wilkinson et al., 2015). Chlorite related to a phyllic alteration event versus propylitic chlorite would presumably crystallize under different oxidation conditions given different temperature and pH ranges associated with these alteration types, which could also subsequently influence the Ti content of chlorite (Wilkinson et al., 2015).

The elements that are most consistent with one another and demonstrate the strongest systematic spatial variation in chlorite at Pemberton Hills are Ca and Sr (Figs. 6.52 and 6.53). These elements display the lowest values in the center of the study area, and higher values in the distal samples to the east, west, and south (Figs. 6.52 and 6.53). Both Ca and Sr display higher values with increasing distance from the potassic altered southeastern margin of the quartz diorite towards distal chlorite alteration in the far eastern domain of the study site (Figs. 6.52 and 6.53). They also display relatively low concentrations in chlorite from samples located in the center of the study area to the northeast of the lithocap (Figs. 6.52 and 6.53). Furthermore, Ca and Sr show high values in the two samples on the south side of the lithocap, but moderate values in the samples adjacent to the Hushamu pluton. The highest Ca values in chlorite are from the

Cu-Zn mineralized hydrothermal breccia sample near the southeastern margin of the granodiorite pluton, which also displays high Mn (Figs. 6.52 and 6.53).

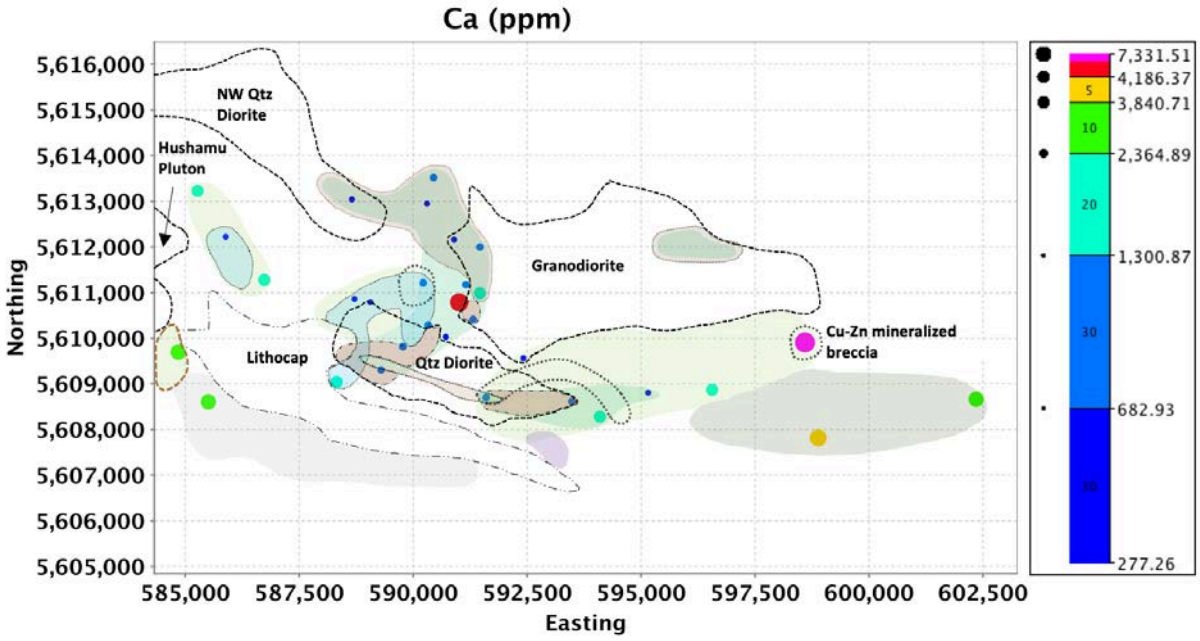


Figure 6.52. Spatial distribution of median chlorite Ca concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

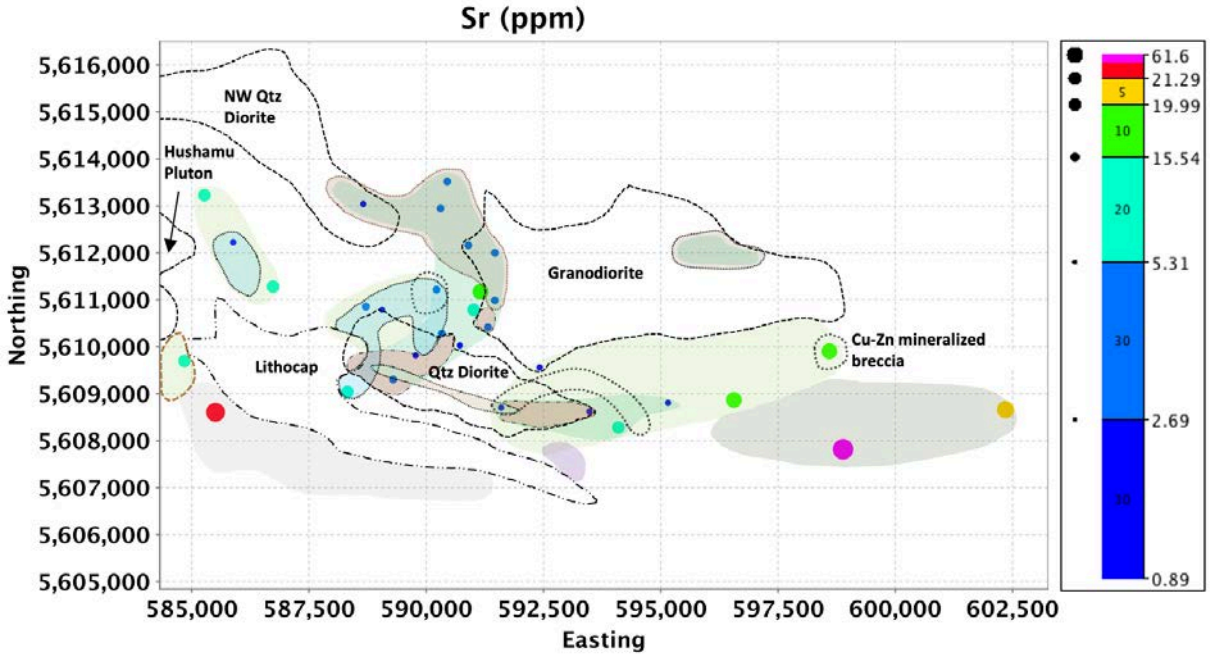


Figure 6.53. Spatial distribution of median chlorite Sr concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Other elements that display similar spatial variation trends to Ca and Sr are V and Y. Vanadium displays higher values with increasing distance from the southeastern margin of the quartz diorite, with the relatively highest values in chlorite from samples within the distal chlorite alteration domain (Fig. 6.54). However, there are anomalously high V values in chlorite from within the quartz diorite itself, and in particular within the QSP shell. Vanadium also displays higher values with increasing distance to the northwest in the three samples proximal to the Hushamu pluton, suggesting a possible influence in chlorite chemistry with proximity to the Hushamu pluton (Fig. 6.54). Similarly, Y also displays elevated values in chlorite from samples within the distal chlorite alteration domain, but does not appear to show any systematic variation elsewhere throughout the study area (Fig. 6.55).

Wilkinson et al. (2015) reported that Co is one of a handful of elements that typically increases in chlorite with distance from porphyry deposit centers. At Pemberton Hills, relatively high Co values in chlorite are observed in the potassic and actinolite alteration centered around the southeastern margin of the quartz diorite pluton, and displays low values with increasing distance to the east (Fig. 6.56). Given that potassic alteration in the quartz diorite pluton is more proximal to a porphyry alteration-related heat source than the distally chlorite altered volcanic rocks to the east, Co appears to behave inversely to what is observed at most other porphyry deposits, at least in this part of the study area. Cobalt does not show any apparent spatial variation patterns elsewhere in the study area, although some higher values are observed in the samples to the southwest of the lithocap, which may be more typical of background rocks in the porphyry environment (Fig. 6.56).

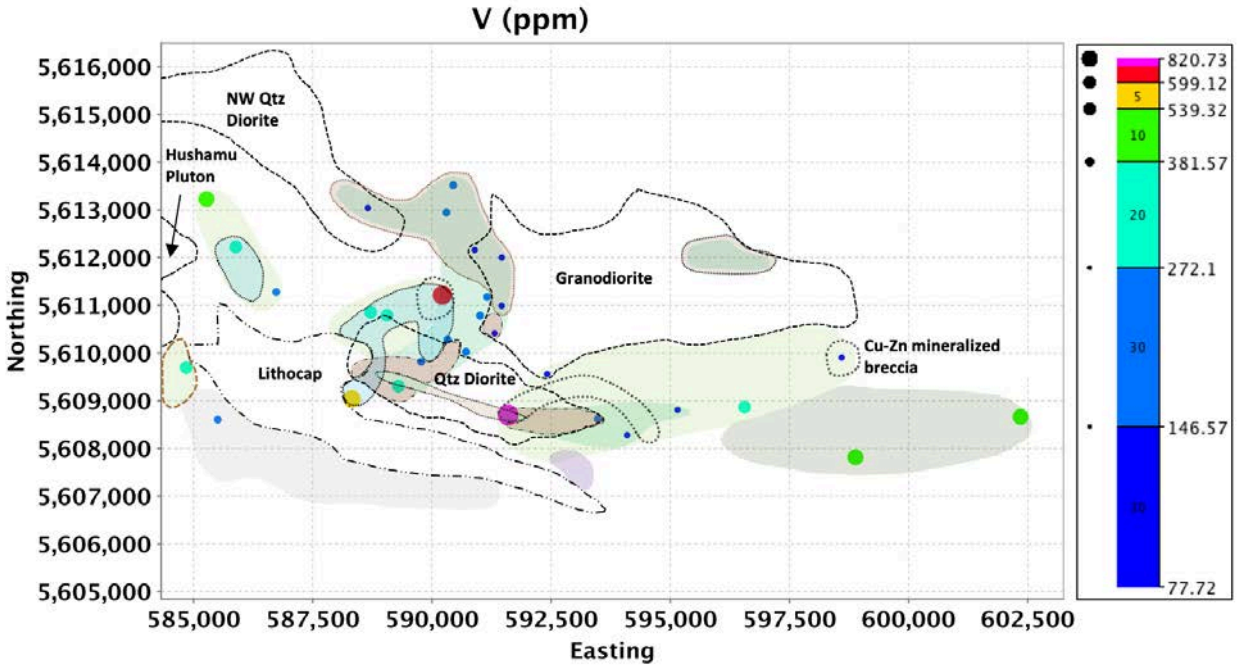


Figure 6.54. Spatial distribution of median chlorite V concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

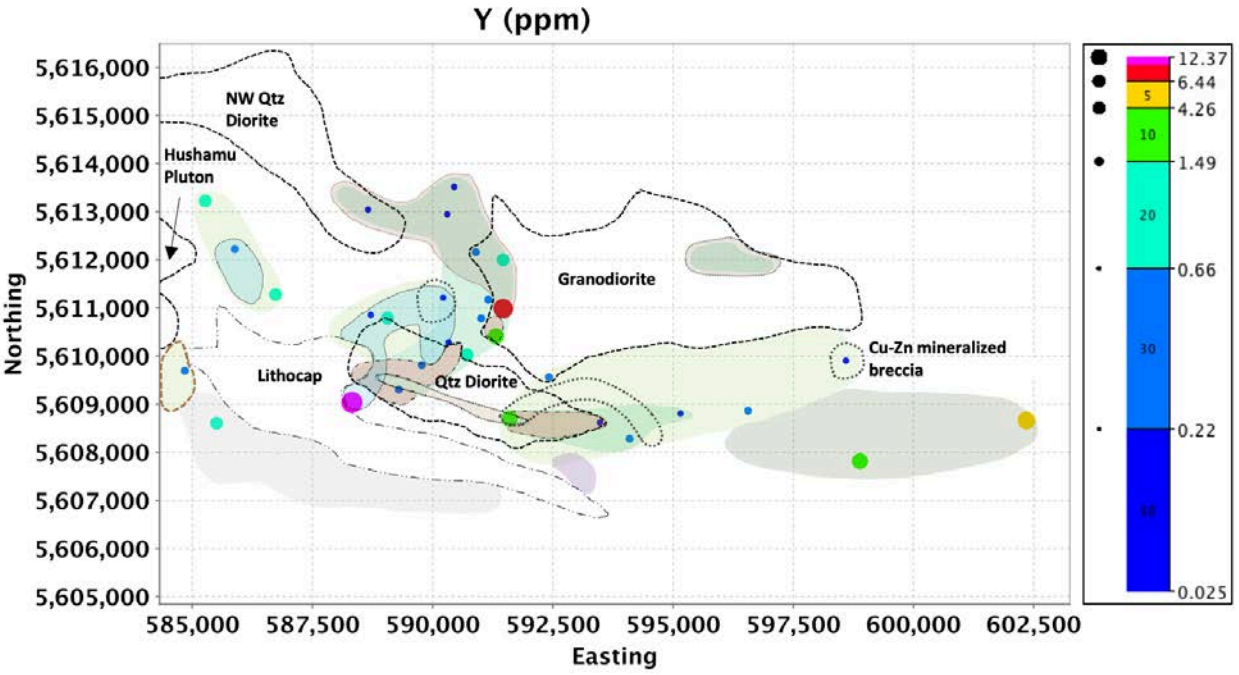


Figure 6.55. Spatial distribution of median chlorite Y concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

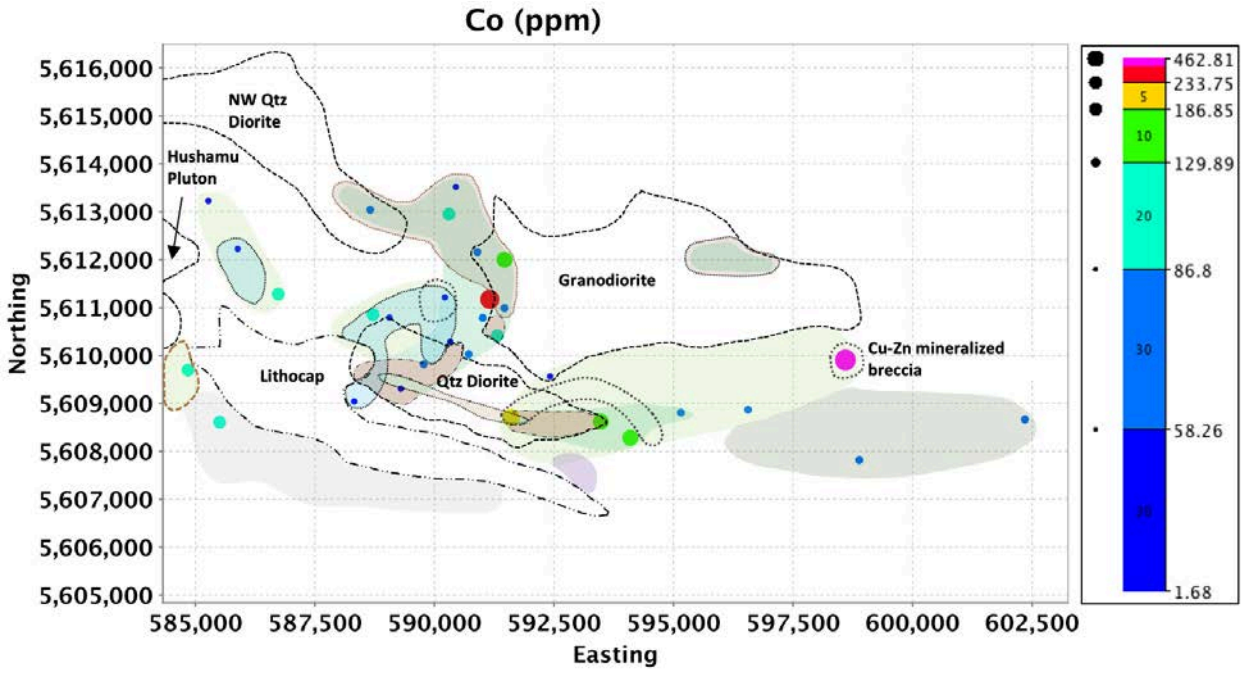


Figure 6.56. Spatial distribution of median chlorite Co concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Wilkinson et al. (2015) reported that metals such as Zn and Mn showed maximums in chlorite at a distance of ~1.3 km away from the center of the Bata Hijau porphyry deposit. At Pemberton Hills, Zn concentrations in chlorite are collectively highest in the center of the study area directly to the northeast of the lithocap (Fig. 6.57). Anomalously high Zn concentrations also occur in chlorite from the northwest quartz diorite sample, as well as the Cu-Zn mineralized hydrothermal breccia sample to the east (Fig. 6.57). Manganese in chlorite demonstrates more spatial variability than Zn and is only enriched in chlorite from select samples in the center of the study site, but also exhibits relatively higher values in chlorite from samples centered around the southeastern margin of the quartz diorite pluton (Fig. 6.58). However, Mn is also enriched in chlorite from the northwest quartz diorite sample and the Cu-Zn mineralized hydrothermal breccia sample (Fig. 6.58). High Zn and Mn values in samples from the center of the study site highlight an area of interest relative to low values in the more distal samples to the south of the

lithocap, proximal to the Hushamu pluton, and to the east of the southern quartz diorite, excluding the Cu-Zn mineralized hydrothermal breccia (Figs. 6.57 and 6.58). Considering that the samples in the center of the study area do not display any strong systematic increase or decrease in Zn and Mn laterally, it is possible that related porphyry mineralization may be at depth in this area (Figs. 6.57 and 6.58). The relatively high Mn values centered around the southeastern margin of the quartz diorite pluton could also suggest proximity to porphyry mineralization or a heat source that is associated with hydrothermal alteration in this area (Fig 6.58).

The anomalously high Zn and Mn values in the sample from the northwest quartz diorite suggest that chlorite from this sample may be genetically related to a discrete porphyry system or reflect a closer proximity to the same porphyry system associated with the main group of samples in the center of the study area, but this is difficult to evaluate given the spatial discontinuity between these sample locations (Figs. 6.57 and 6.58). The enrichment in Mn and in particular Zn in chlorite from the Cu-Zn mineralized hydrothermal breccia most likely has to do with the abundance of these elements in the hydrothermal fluids at the time of chlorite crystallization in this sample (Figs. 6.57 and 6.58).

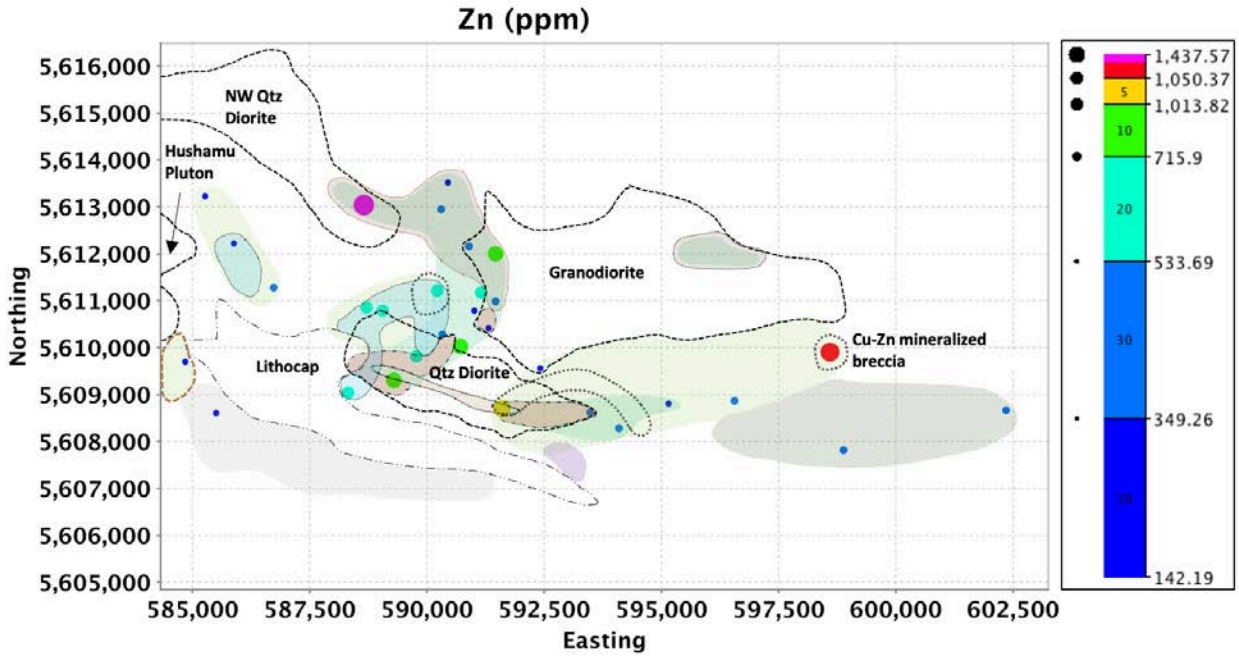


Figure 6.57. Spatial distribution of median chlorite Zn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

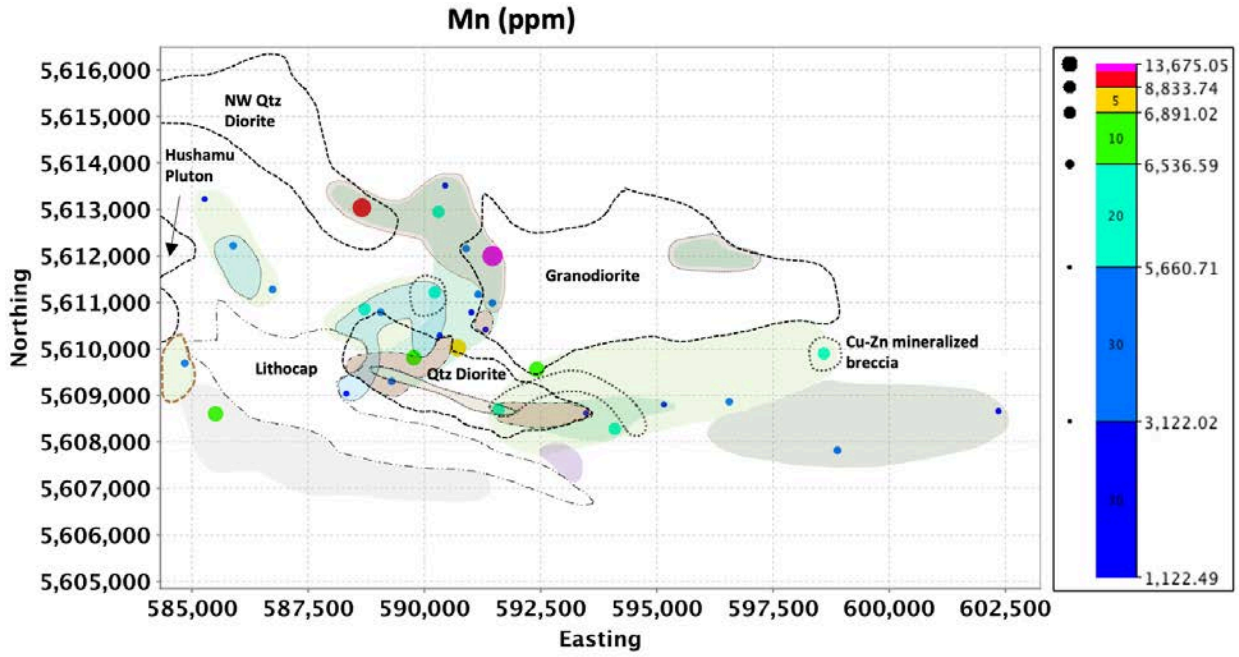


Figure 6.58. Spatial distribution of median chlorite Mn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

To further evaluate the vectoring potential of chlorite, Wilkinson et al. (2015) demonstrated that by ratioing certain elements that increase in chlorite moving away from porphyry deposit centers against elements such as Ti, Mg, and V, it was possible to observe ratios that vary up to four orders of magnitude. Controls on the Ti, Mg, and V concentrations in chlorite at Pemberton Hills such as lithology and alteration, particularly for samples located in the center of the study site limits the usefulness ratios involving these elements in. However, chlorite from the sample group that extends eastwards from the southeastern margin of the quartz diorite pluton shows some systematic spatial trends using element ratios. The plot of Mg/Sr displays higher values in chlorite from most samples within and proximal to the southeastern margin of the quartz diorite relative to chlorite from samples within the distal epidote and chlorite alteration domains (Fig 6.59). In contrast, the plots of V/Li (Fig. 6.60) and V/Co (Fig. 6.61) show increased values in the distal chlorite and epidote alteration domains relative to chlorite from within and around the southeastern margin of the quartz diorite.

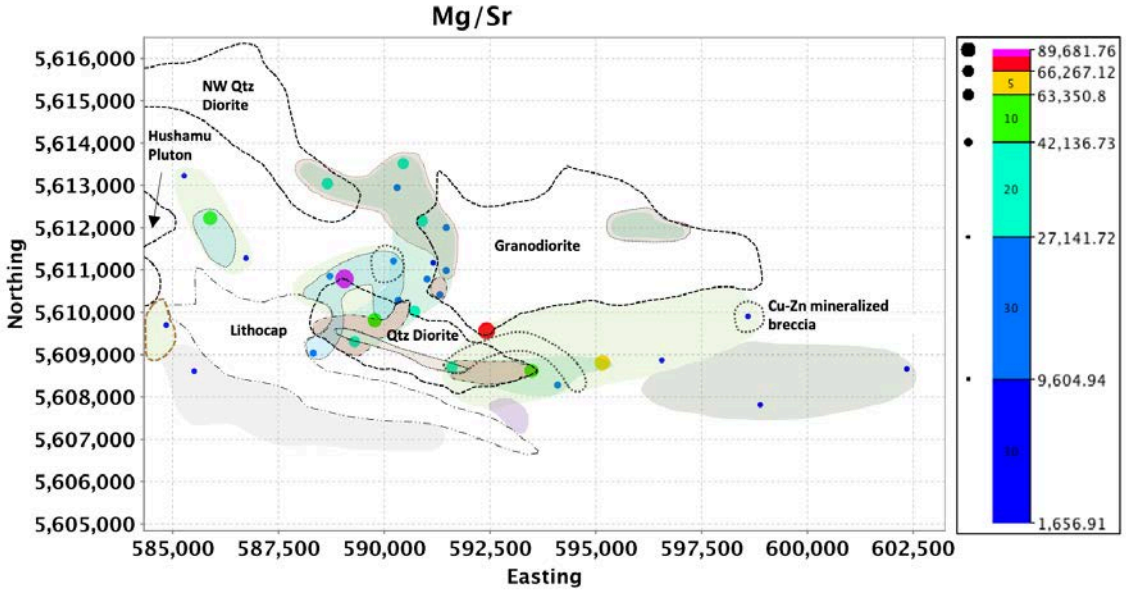


Figure 6.59. Spatial distribution of chlorite Mg/Sr across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

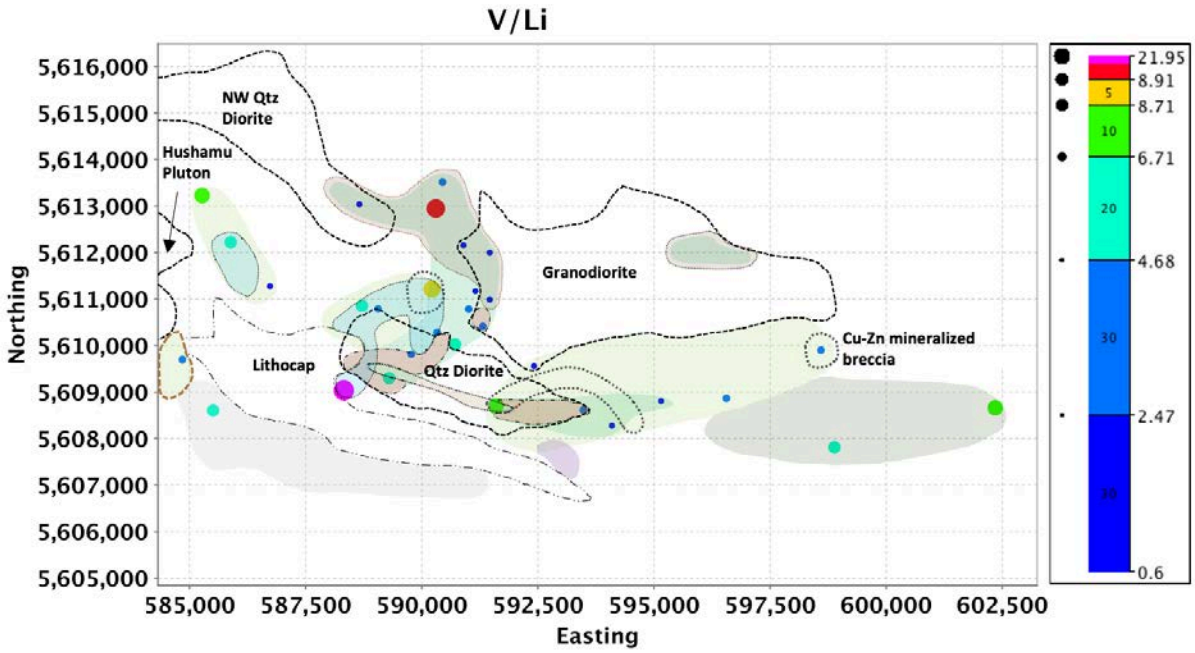


Figure 6.60. Spatial distribution of chlorite V/Li across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

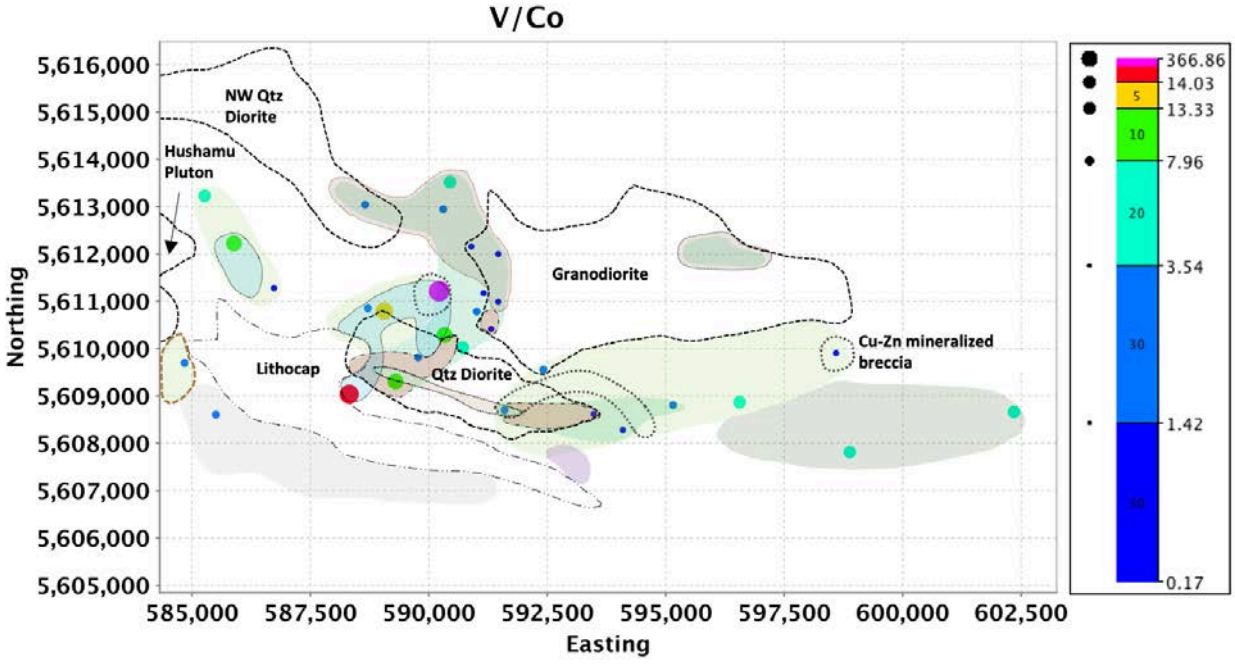


Figure 6.61. Spatial distribution of chlorite V/Co across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

6.3.3.3 Chlorite fertility at Pemberton Hills

Wilkinson et al. (2020) demonstrated that Zn and Mn concentrations in chlorite can be a useful tool for discriminating porphyry deposit-related hydrothermal chlorite from metamorphic chlorite, in addition to assessing overall chlorite fertility using data sets from El Teniente, the Baguio district, Central Chile, and a variety of greenschist facies metamorphic terranes. They showed that chlorite from porphyry deposit centers almost always contains elevated values of Mn above ~4,000 ppm and ~900 ppm for Zn, whereas the majority of metamorphic chlorite have values of around 450 ppm Zn and 2,500 ppm Mn. As a result, these can be used as an effective discrimination tool and fertility indicator for "large" porphyry deposits as well as distinguishing porphyry related from metamorphic chlorite. Chlorite from Pemberton Hills that could be associated with a "large" porphyry deposit based on the criteria of Wilkinson et al. (2020) plots within the boundaries of the dotted pink lines in Figure 6.62. The majority of chlorite analyses at Pemberton Hills plot well above 2,500 ppm Mn, and mostly above 450 ppm Zn, which suggests that the majority of chlorite at Pemberton Hills can be classified as hydrothermal in origin (Fig. 6.62).

Chlorite analyses from Pemberton Hills are classified into "any size" (black circles) and "giant only" (orange and green circles) porphyry deposit groups based on chlorite Zn and Mn data from all of the porphyry deposits in the AMIRA database (Fig. 6.62). The orange and green coloured chlorite analyses that plot within the "giant only" field have Zn and Mn concentrations that are only found in giant porphyry deposits, whereas the black coloured chlorite analyses that plot in the "any size" field represent chlorite that could be found in variably sized porphyry deposits (Fig. 6.62).

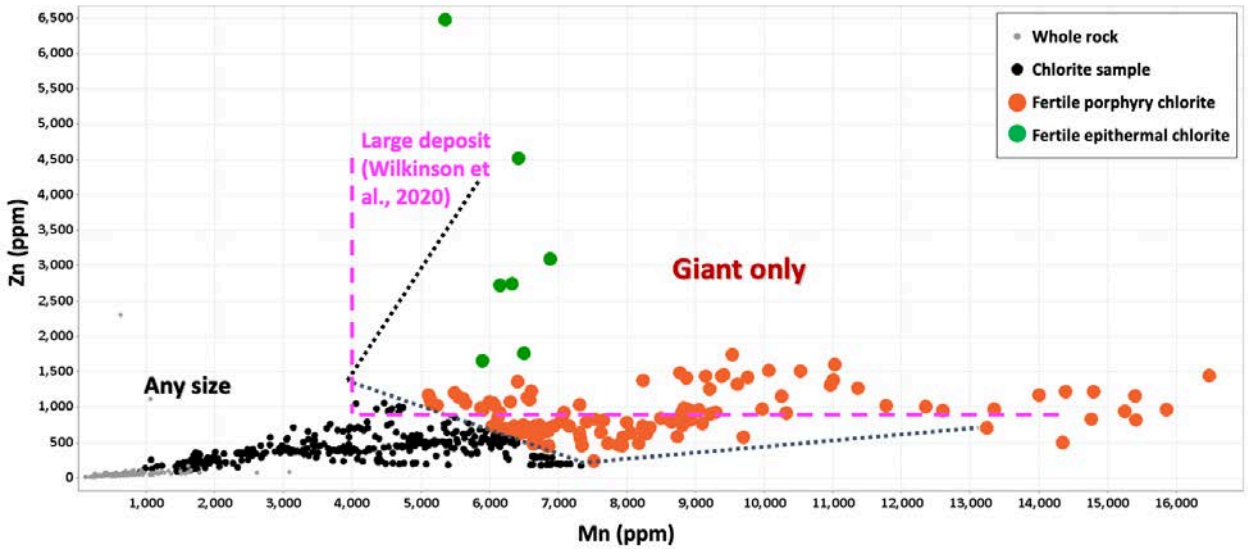


Fig. 6.62. Zn vs. Mn concentrations in chlorite Pemberton Hills. “Any size” and “Giant only” classifications based on porphyry deposits from the AMIRA database while the “Large deposit” classification is from Wilkinson et al. (2020).

Samples used for chlorite analyses in this study have been colour coded to represent their location across the study site (Fig. 6.63). There are five groups that represent samples from the west of the study site including those to the south of the lithocap and proximal to the Hushamu pluton (highlighted in black), the Cu-Zn mineralized hydrothermal breccia sample (highlighted in blue), samples from the central and north-central domains of the study site (highlighted in green), samples within and proximal to the southeast margin of the quartz diorite pluton (highlighted in red), and the one sample located within the southeast of the quartz diorite pluton (highlighted in pink; Fig. 6.63A).

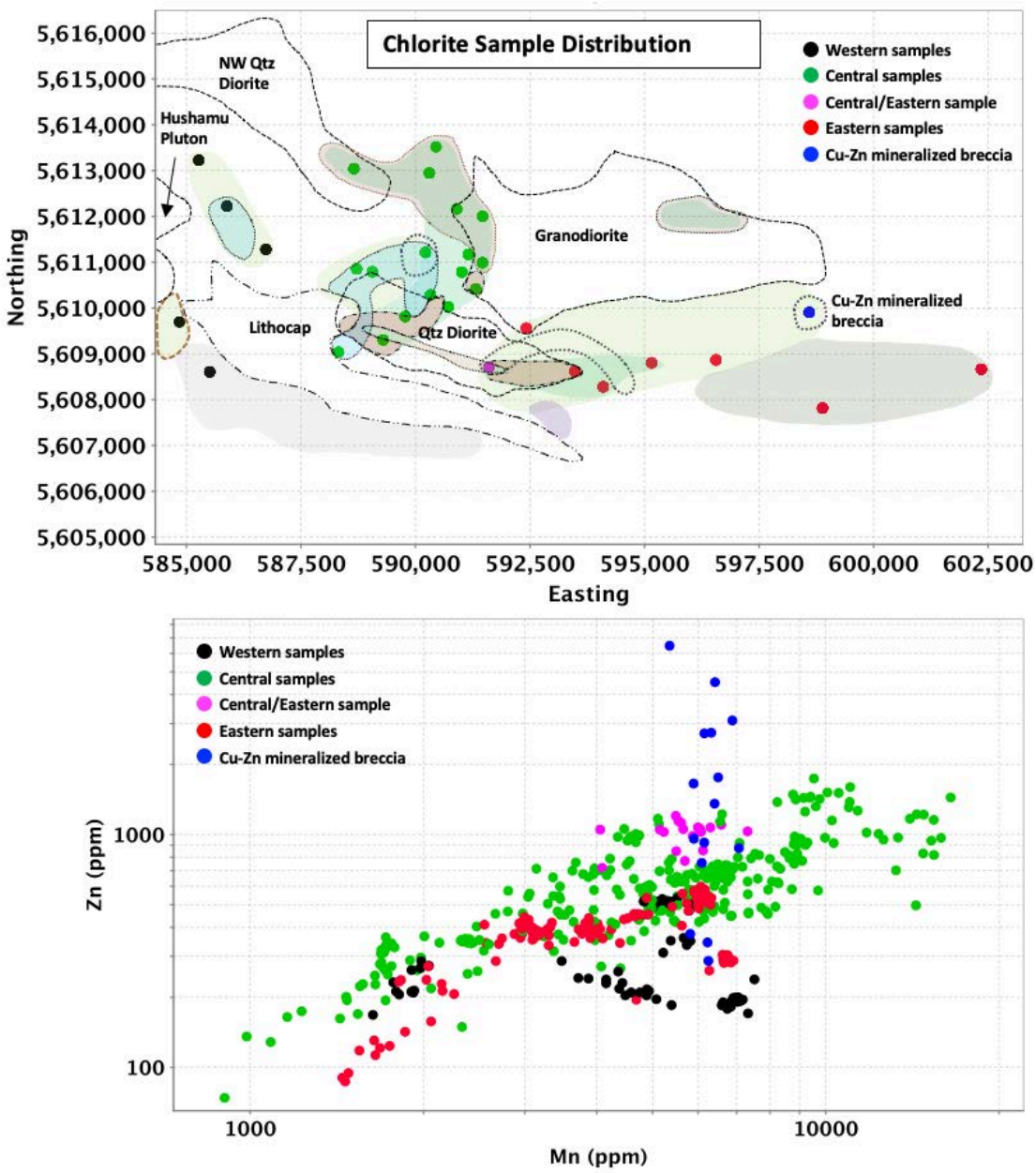


Figure 6.63. (A) Spatial distribution of chlorite LA-ICP-MS samples from the Pemberton Hills study site with different sample groups of interest corresponding to different colours. (B) Plot of Zn vs. Mn concentrations of chlorite from Pemberton Hills with colours corresponding to sample location in Figure 6.63A.

Figure 6.63 shows that Zn and Mn concentrations in chlorite from samples throughout the study site can effectively discriminate samples from discrete porphyry-related hydrothermal events at Pemberton Hills. This is supported by samples from within the center of the study area (green) collectively displaying elevated Zn and Mn values in comparison to the samples that are

along the margin and extend east of the southeast quartz diorite pluton (red), in addition to the western samples (black; Fig. 6.63A, B). This is an important observation given that As and Sb values in epidote were also able to effectively differentiate these same sample groups.

The sample highlighted in pink (PM18AJ275) displays enrichment of Zn and Mn concentrations in chlorite, plotting well above Zn and Mn contents for the chlorite analyses highlighted in red (Fig. 6.63A, B). Epidote showed high As and Sb values in this same sample relative to the sample group highlighted in red. Together, these observations would suggest that either propylitic alteration observed in this sample is spatially and temporally related to the hydrothermal alteration event that is associated with samples from the center of the study area (green), or that this sample is proximal to a causative heat source that produced the propylitic alteration in the samples extending to the east of the quartz diorite (highlighted in red).

Samples that show the most potential to reflect low-grade regional metamorphism based on chlorite mineral chemistry are those located within the distal chlorite altered domain in the far eastern domain of the study site (red coloured samples) and potentially from the western domain of the study area (black coloured samples). Most of these chlorites have high Ca and Sr and corresponding low Mg/Sr, which may represent a background metamorphic signature or their position on the distal edges of the alteration system. Most chlorite from the samples in these locations also display low Zn and Mn values. While most chlorite from the study site displayed textural evidence for a hydrothermal origin (i.e., hydrothermal veins, clots, reaction fronts, association to other hydrothermal minerals) and was targeted during the LA-ICP-MS analyses, chlorite with poikiloblastic textures was observed in one sample from the far distal

chlorite altered domain, reflecting its location on the margin of the hydrothermal system with a greater influence of background metamorphism (Fig. 6.64).

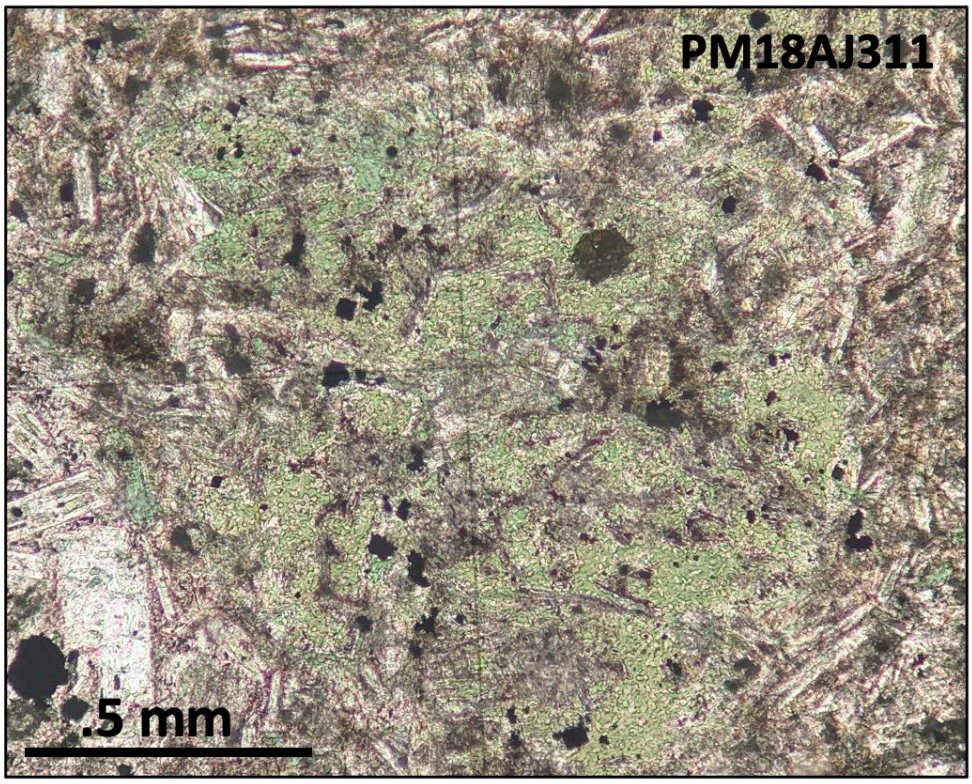


Figure 6.64. Fine-grained poikiloblastic chlorite from the distal chlorite altered domain on the far east side of the Pemberton Hills study site.

6.3.4 Pyrite mineral chemistry

Pyrite is known to occur in a variety of mineral deposit types (i.e., porphyry, epithermal, VHMS, orogenic Au, BIF, SEDEX) and is the most abundant sulphide mineral in the Earth's crust (see Belousov et al., 2016 and references therein). Additionally, pyrite commonly forms by a number of other processes such as metamorphism, diagenesis, and barren hydrothermal activity (Reich et al., 2013). As a result of its distribution in different environments, pyrite geochemistry can be a useful tool for evaluating compositions of fluids at the time of formation (Belousov et al., 2016).

Pyrite has a general formula of FeS_2 and exhibits a cubic and dodecahedral habit (Fig. 6.65). Pyrite has been documented to form in fluids ranging from ~30 to 700 °C, but trace element substitution predominantly occurs at lower temperatures (Reich et al., 2013; Deditius et al., 2011). Pyrite crystallization effects metal partitioning and distribution within ore deposits, and can be useful for vectoring in certain environments where it occurs at different distances to the deposit center (Reich et al., 2013; Belousov et al., 2016). This study and other recent studies have shown a wide range in trace elements to be detectable by LA-ICP-MS analysis in pyrite including As, Ni, Mn, Pb, Co, Ti, Ba, Cu, Zn, Sb, Cr, V, Mo, Se, Sn, W, Ag, Au, Bi, Tl, Te, and Re (Large et al., 2007, 2009; Smyk, 2015; Belousov et al., 2016; Vrzovski, 2018). Belousov et al. (2016) documented four ways that trace elements were occurring in pyrite: 1) as solid solution within the pyrite structure; 2) within invisible nano-inclusions of other minerals; 3) within visible micron-sized inclusions of other sulphides; and 4) within visible micron-sized inclusions of silicate or carbonate minerals.

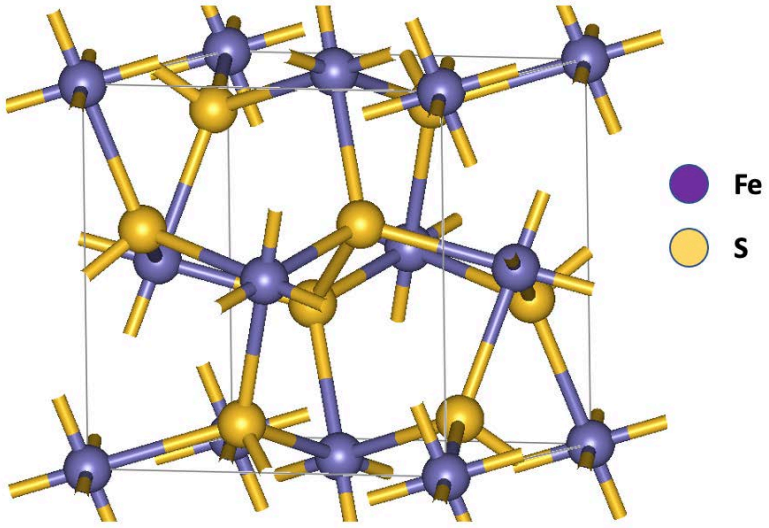


Figure 6.65. Pyrite crystal structure. From Willeke et al. (1992).

Solubility of Au into the pyrite lattice has been proposed by Reich et al. (2013) to be a function of As content in the pyrite. Thus, as the As content of the pyrite increases, a greater proportion of Au can be incorporated into the pyrite lattice. Reich et al. (2013) noted that Au occurring in concentrations of 100 – 1000 ppm likely reflects the presence of nano-sized inclusions or clusters whereas Au occurring in concentrations <10 ppm suggests that the Au is structurally bound within the pyrite lattice. In more reduced environments, As can substitute for S as anionic As, whereas it will occur as As^{3+} in more oxidized conditions (Reich et al., 2013). Reich et al. (2013) identified a decoupling behaviour between As and Cu in porphyry systems that suggests selective partitioning of these metals into pyrite is strongly controlled by compositional changes in the ore forming fluid.

Elements such as Co and Ni substitute for Fe in pyrite, whereas elements such as As, Se, Te, and Ag substitute for S (Gao et al., 2015). Moreover, elements including Se, Te, and Ag are known to behave similarly to Au in pyrite, and should display elevated levels in pyrite with increasing Au content (Gao et al., 2015). Copper may substitute for Fe in pyrite, however most of the Cu that occurs in pyrite is due to the presence of Cu-bearing sulphide nanoparticles. The reason for this is that solid solution of CuS_2 in pyrite is thermodynamically unstable under typical conditions of hydrothermal alteration associated with porphyry deposit formation (Shimazaki and Clark, 1970; Schmidt-Beurmann and Bente, 1995). Elemental substitution in solid solution with pyrite relies on element availability, and is thus a function of the composition of the pyrite-forming fluid (Deditius et al., 2011). Furthermore, substitution of elements in solid solution with pyrite may cause distortion of the pyrite lattice, which may lead to an increase in the number of inclusions or substitutions occurring in the pyrite at the time of crystallization (Reich et al., 2013).

6.3.4.1 Pyrite trace element chemistry and element maps at Pemberton Hills

Pyrite median trace element data is displayed on spatial distribution plots for 18 pyrite-bearing samples using the progressive binning function on the plotting software ioGAS (Figs. 6.66 – 6.76). Median values for two additional samples collected from downhole drilling that are not represented on the plots are provided in each figure. A number of key observations can be made using the mineral chemistry data from the 20 pyrite-bearing samples in conjunction with the eight pyrite element maps created from six samples.

Firstly, there is a clear correlation between elements such as Mn, V, Zn, and Cu illustrated by the spatial distribution plots in Figures 6.66 – 6.69. These elements all display relatively high values in the phyllic altered rocks to the northeast of the lithocap. This is in sharp contrast to the low values observed in these elements in the nearby potassic altered samples within the quartz diorite pluton. Manganese, V, Zn and Cu were all commonly observed elements in relatively high concentrations in the chlorite mineral chemistry data from this study. The abundance of microscopic silicate inclusions in pyrite from the phyllic altered samples (see Figs. 6.9, 6.11, and 6.12) suggests that the high concentrations of these elements in the pyrite are the result of micro-sized chlorite inclusions that are ubiquitous throughout the pyrite grains in these samples. It can thus be inferred that pyrite and chlorite were crystallizing in the same fluids associated with the phyllic alteration; this is further reinforced by the contrasting mineral chemistry signatures observed in the chlorite from phyllic altered samples compared to chlorite from elsewhere in the study site that suggests different generations of chlorite.

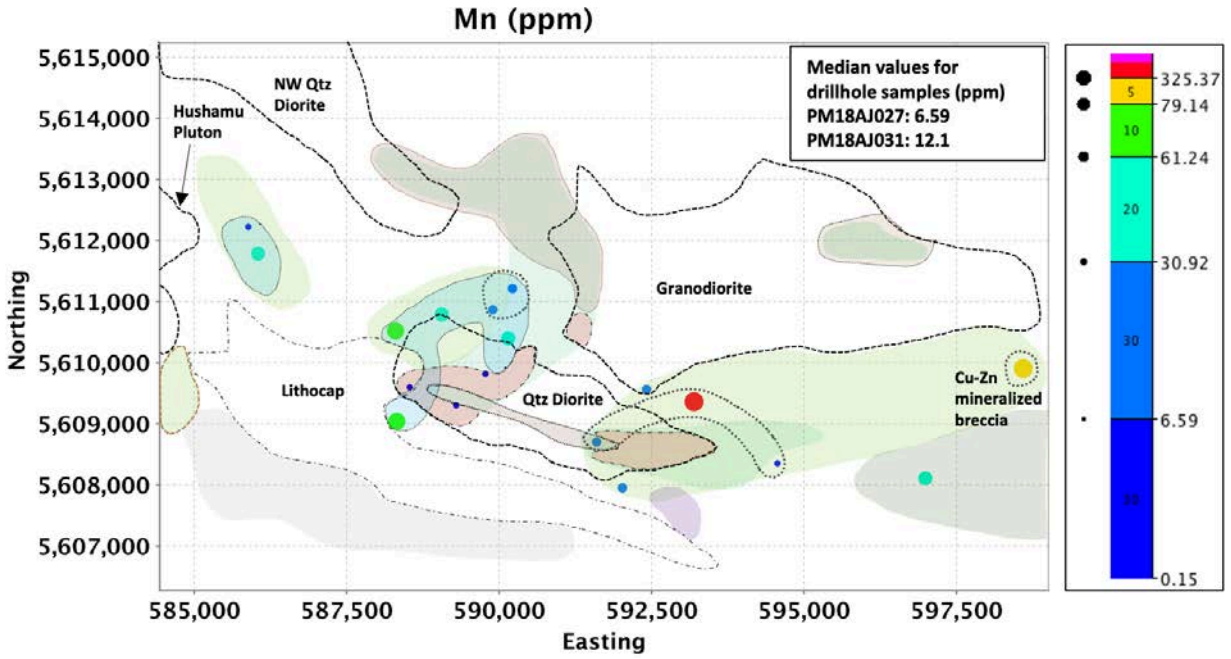


Figure 6.66. Spatial distribution of median pyrite Mn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

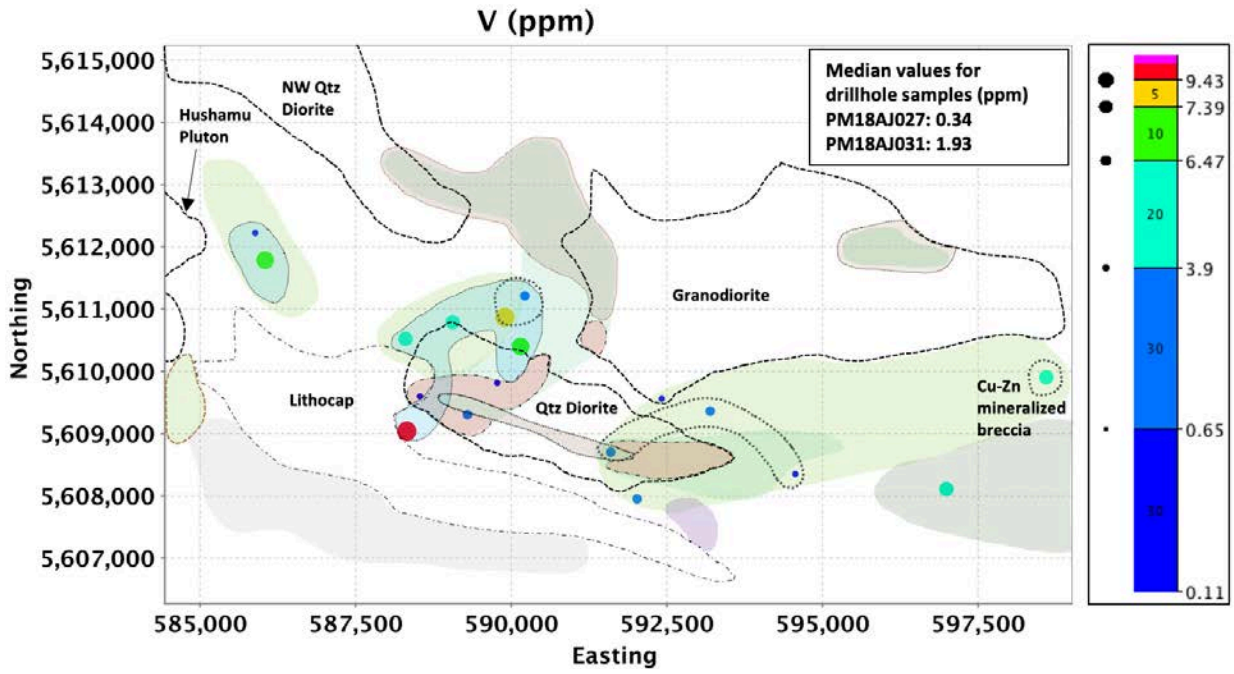


Figure 6.67. Spatial distribution of median pyrite V concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

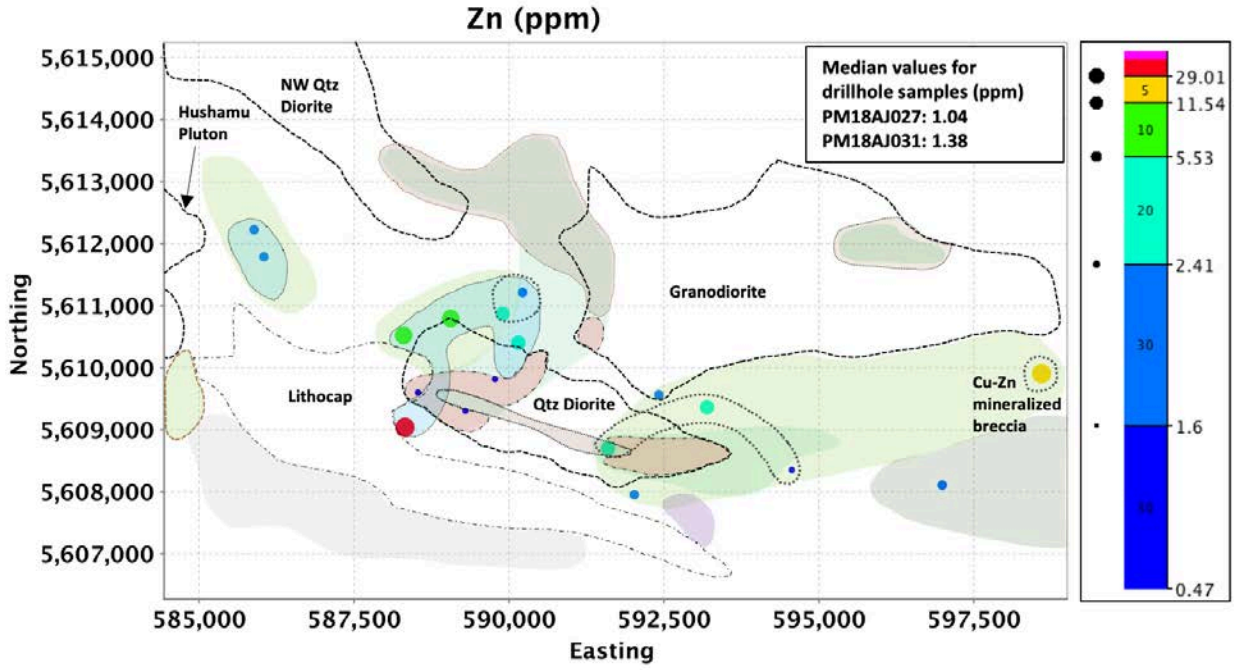


Figure 6.68. Spatial distribution of median pyrite Zn concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

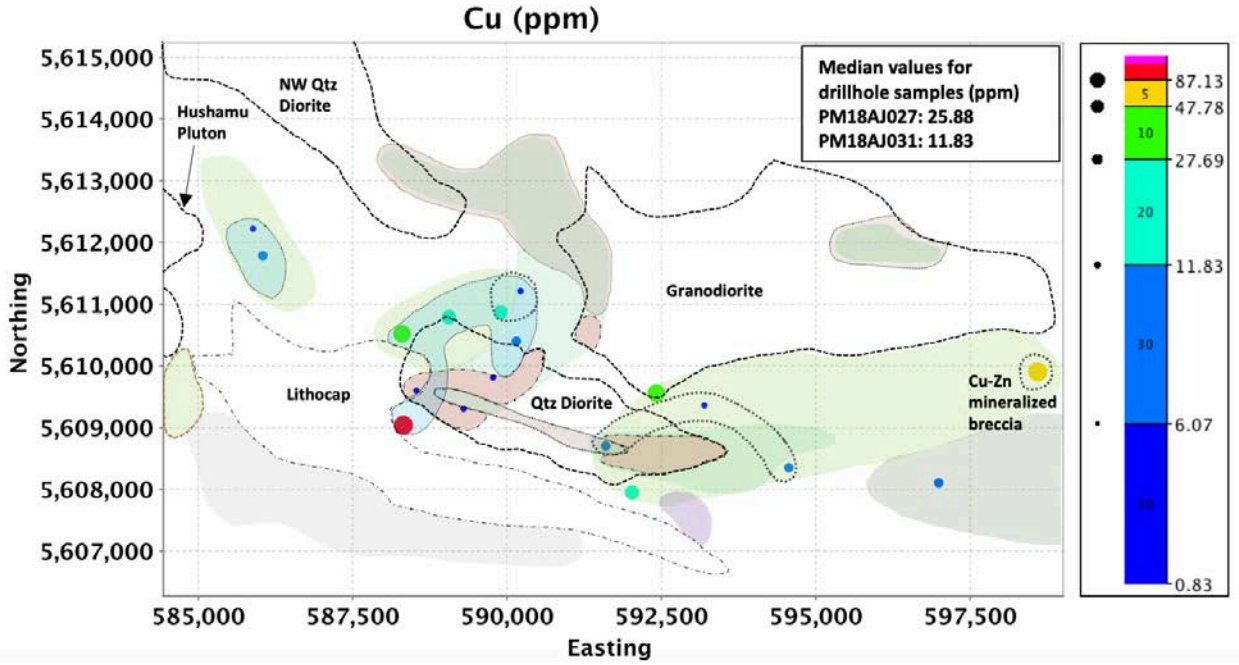


Figure 6.69. Spatial distribution of median pyrite Cu concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Correlation between elements including As, Au, Sb, Ag, and Te can be observed on the spatial distribution plots in Figures 6.70 – 6.74. These elements are collectively enriched and display the highest values in pyrite from samples centered around the southeastern margin of the quartz diorite pluton whereas pyrite from most samples within the phyllic altered and potassic altered rocks to the northeast of the lithocap are low in these elements. This observation further reinforces the interpretation that the alteration surrounding the southeastern margin of the quartz diorite represents a discrete porphyry-related alteration event compared to the alteration from the center, west, and north of the study site.

The element maps of a pyrite grain from sample PM18AJ281 (Fig. 6.6) shows Au distributed homogeneously throughout the core and rim of the pyrite grain, suggesting that Au substitution was occurring in solid solution with pyrite at the time of crystallization and that there was a relative abundance of Au in the pyrite forming fluid; the pyrite is interpreted to have formed mostly interstitial to epidote until the final stage of pyrite crystallization, where parts of the rim are euhedral. An SEM image of a free electrum grain occurring between two epidote crystals in this sample further supports this interpretation (Fig. 4.18E). Arsenic, Au, Sb, and Ag are also enriched in pyrite from the Cu-Zn mineralized hydrothermal breccia occurring to the far east of the study area. It is important to note that none of these elements show enrichment in pyrite from the distal chlorite altered sample to the southeast of the study area, highlighting their effectiveness as mineralization indicators in pyrite closer to the inferred porphyry deposit center (Figs. 6.70 – 6.74).

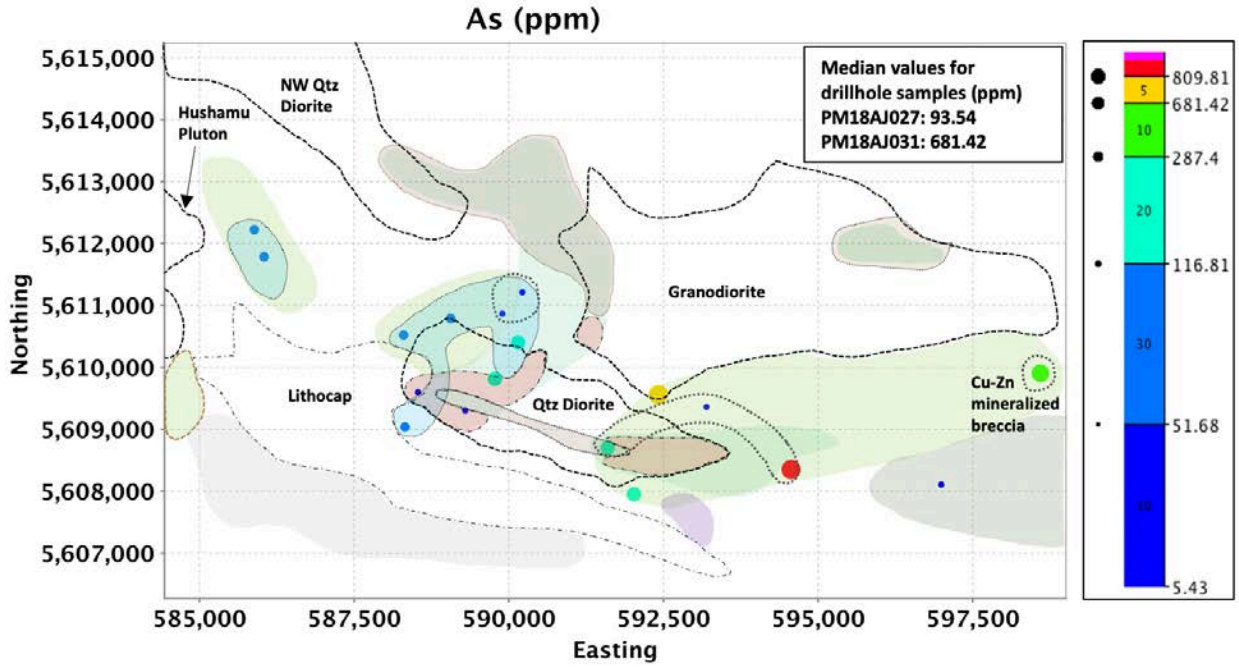


Figure 6.70. Spatial distribution of median pyrite As concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

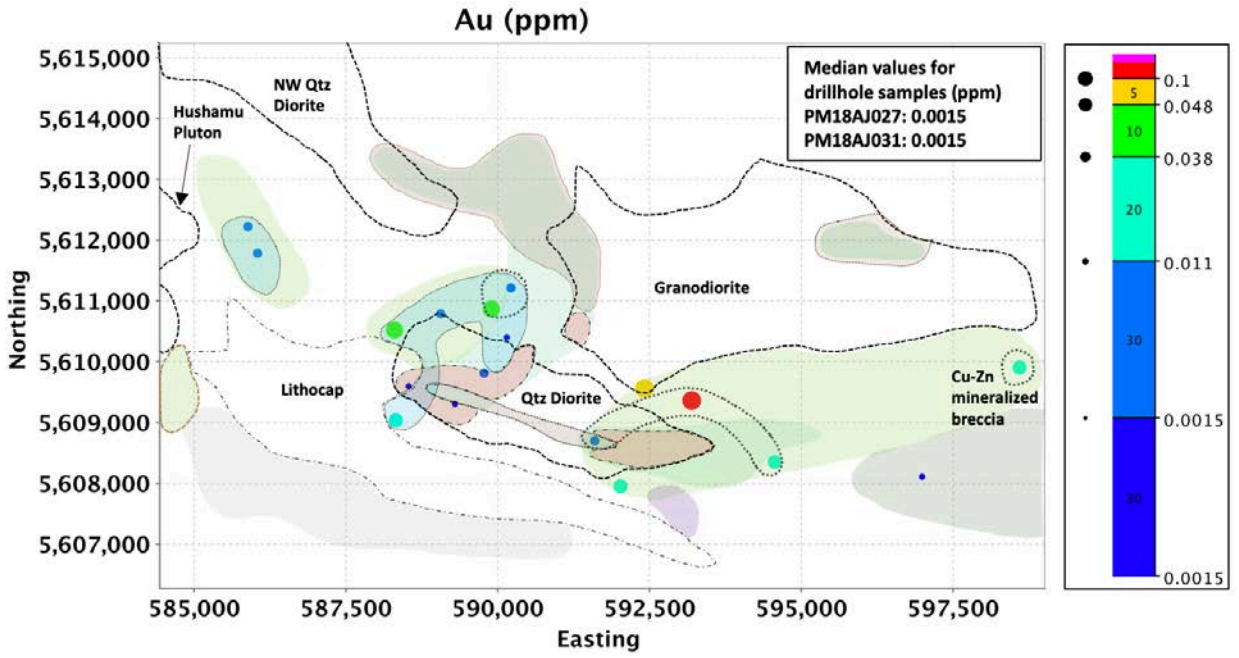


Figure 6.71. Spatial distribution of median pyrite Au concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

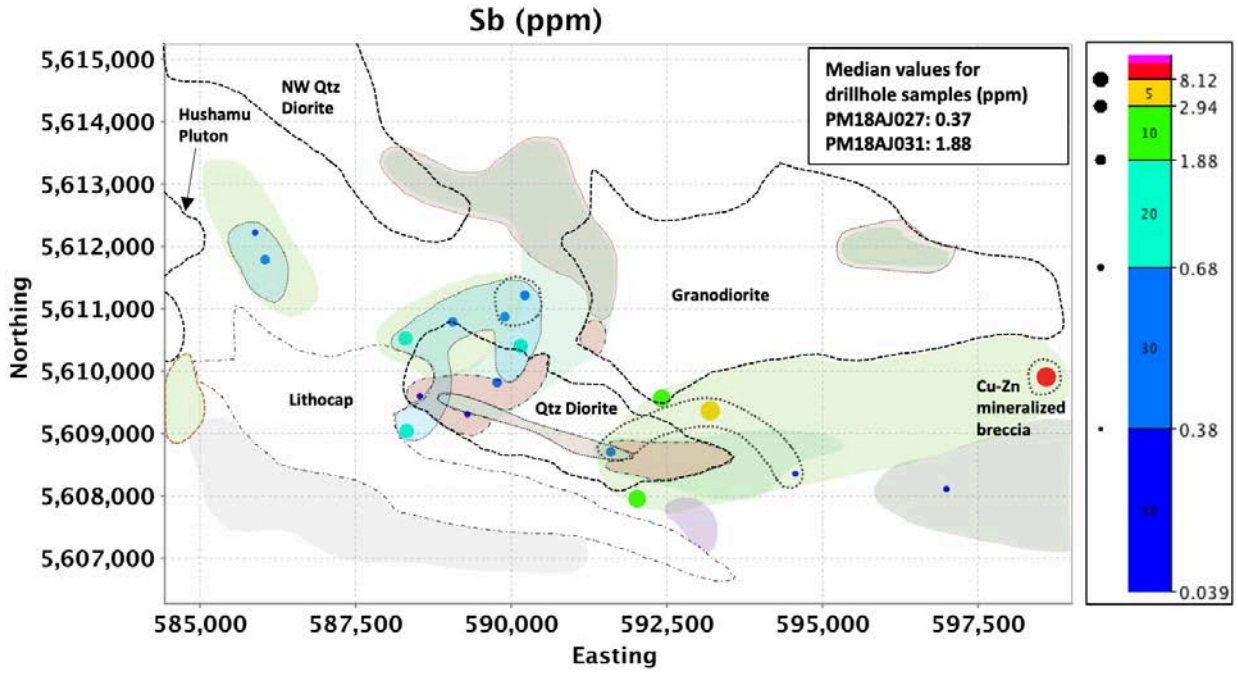


Figure 6.72. Spatial distribution of median pyrite Sb concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

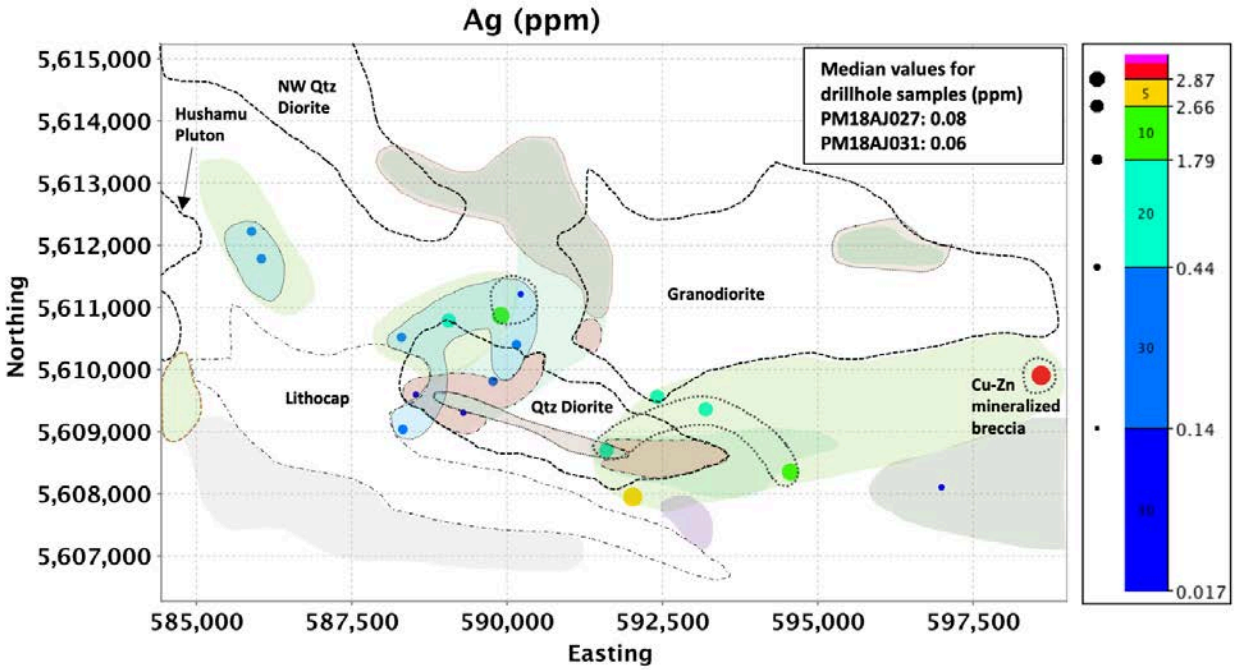


Figure 6.73. Spatial distribution of median pyrite Ag concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

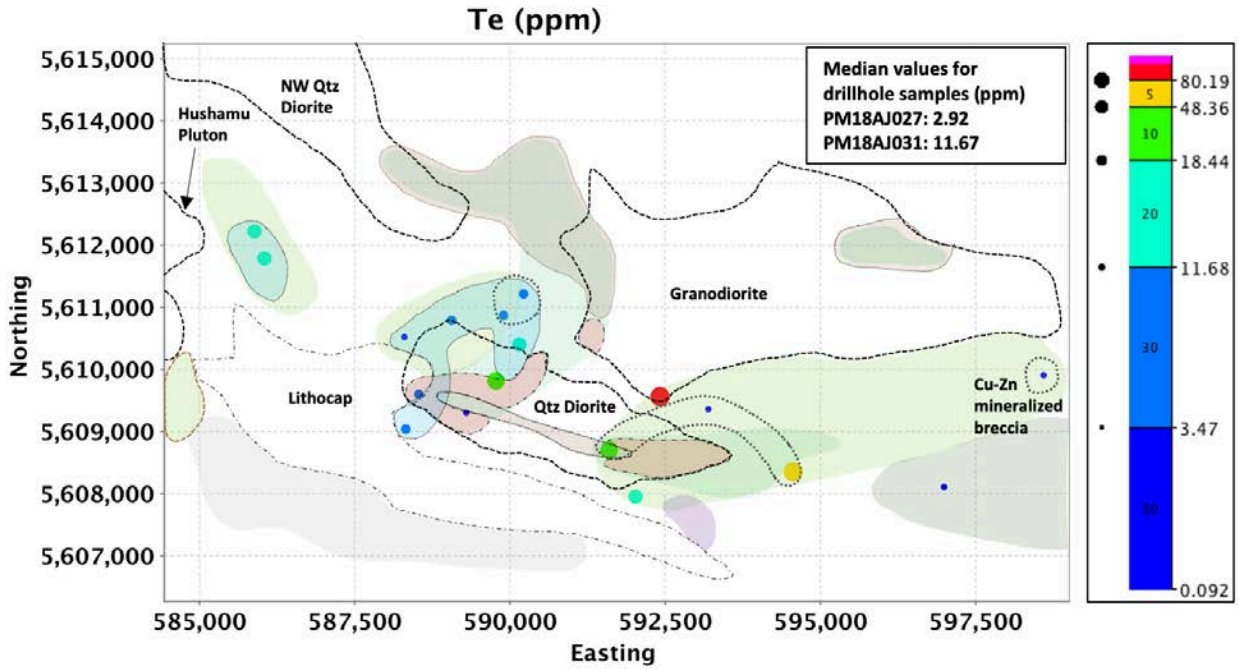


Figure 6.74. Spatial distribution of median pyrite Te concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Elements such as Re, and to a lesser extent Mo display highest values in pyrite in the samples surrounding the northeastern lobe in the lithocap (Figs. 6.75 and 6.76). Whole-rock geochemistry has shown that the lithocap environment is characterized by the highest Re content at Pemberton Hills (Hamilton, in prep). Element maps of two pyrite grains from sample PM18AJ201 show fairly homogenous distribution of Re throughout the grain, suggesting that Re was in solid solution with pyrite at the time of pyrite crystallization (Figs. 6.7 and 6.8). Together, these observations suggest that pyrite from this sample is associated with the advanced argillic alteration that formed the lithocap environment.

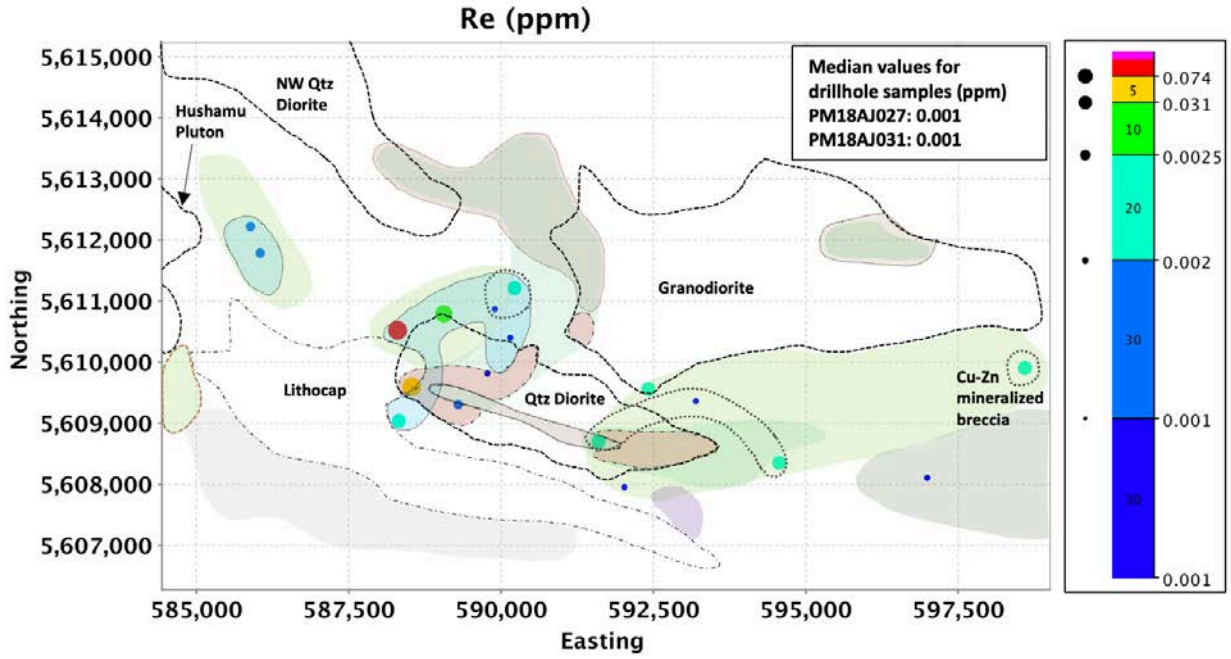


Figure 6.75. Spatial distribution of median pyrite Re concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Observations from the spatial distribution plots above highlight the importance of using pyrite element maps in conjunction with pyrite mineral chemistry data. For example, element maps of pyrite from samples PM18AJ281 and PM18AJ215 display Mo enriched rims on these pyrite grains. Despite efforts to analyze various domains within pyrite grains during the LA-ICP-MS process, both of these samples display relatively low median Mo values (Fig. 6.76), and mineral chemistry data alone does not indicate the presence of any appreciable Mo in these pyrite grains, which is not consistent with the element maps.

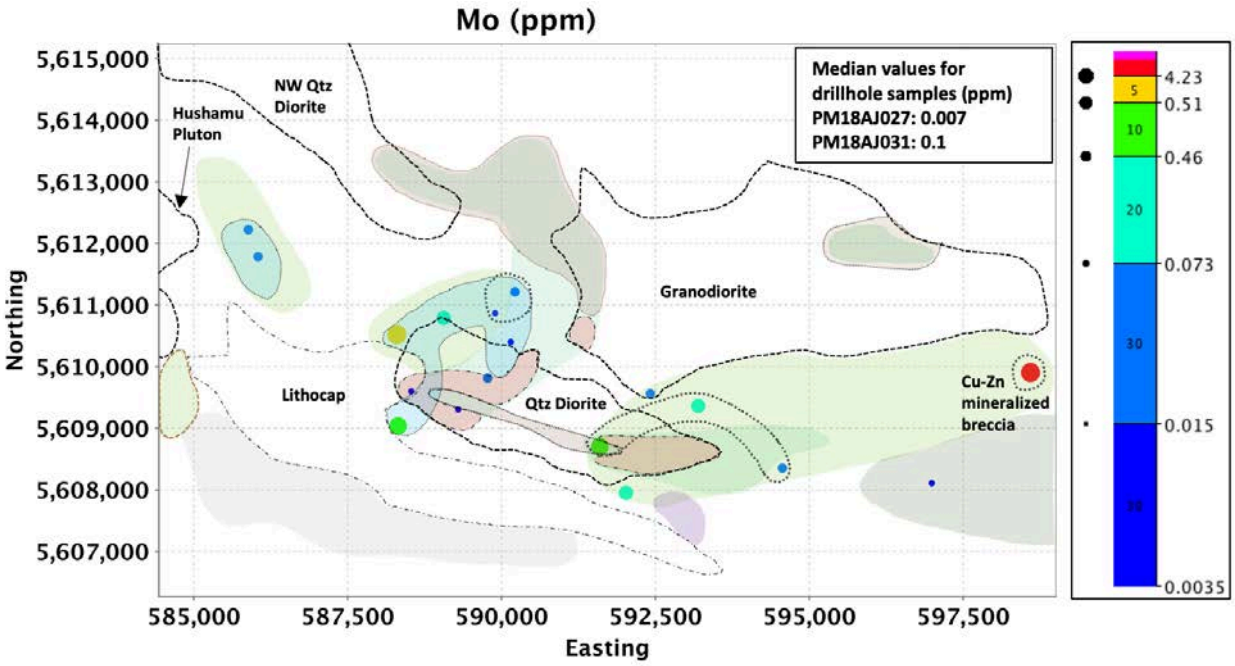


Figure 6.76. Spatial distribution of median pyrite Mo concentrations across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b).

Together, the pyrite mineral chemistry data and pyrite element maps suggest the following: 1) Pyrite in samples centered around the southeastern margin of the quartz diorite are relatively enriched in Au, As, Sb, Te, Ag. Homogenous distribution of Au within the core of the pyrite grain from sample PM18AJ281 suggests Au was in solid solution with the pyrite at the time of formation, which is interpreted to have been from a late-stage propylitic fluid based on the pyrite forming interstitial to euhedral epidote; 2) pyrite from samples located along the margin of the lithocap are characterized by elevated Re, illustrated by the two element maps of pyrite grains from sample PM18AJ201. Enrichment of Co, Ni, Cu, Pb, As, and Bi along the rims of these pyrite grains imply that these metals were the last to crystallize out of the pyrite forming fluid associated with advanced argillic alteration; 3) pyrite from the phyllic altered samples is characterized by high Mn, V, and Zn reflecting an abundance of micro-sized silicate inclusions in the pyrite, illustrated by the pyrite element maps from samples PM18AJ215 and PM18AJ222; 4)

strong variation is observed in Ni and Co in pyrite throughout the study area; in the cores of pyrite grains (i.e., PM18AJ222, PM18AJ031), in the outer cores and outer domains of pyrite grains (i.e., PM18AJ215, PM18AJ281, PM18AJ290), and in the rims of pyrite grains (i.e., PM18AJ201); and 5) the decoupling of As and Au in certain samples such as PM18AJ222, where the core of the grain is enriched in As, and the outer margins are characterized by elevated levels of Au.

6.3.5 Whole-rock carbon and oxygen isotopes

Some of the largest porphyry deposits in the world are hosted in lower greenschist facies regional metamorphic terrains (i.e., Collahuasi district; Ireland, 2010; Djouka-Fonkwé et al., 2012; Baker et al., 2020). Propylitic minerals such as epidote and chlorite are the products of both hydrothermal alteration and regional low-grade metamorphism, which creates challenges for geologists trying to recognize distal propylitic alteration related to porphyry deposit mineralization from these background metamorphic terrains (Djouka-Fonkwé et al., 2012 and references therein).

In addition to epidote and chlorite chemistry, stable isotopes have also proven to be a valuable means of differentiating propylitic alteration from greenschist facies metamorphism in porphyry deposit exploration, and can provide additional insight into the isotopic evolution of porphyry-related hydrothermal fluids. Djouka-Fonkwé et al. (2012) demonstrated that using whole-rock carbon and oxygen isotopes in conjunction with carbon isotopes on carbonate separates and detailed petrography of the rock types affected by different hydrothermal alteration assemblages could effectively discriminate propylitic alteration from lower greenschist facies metamorphism and as well as other alteration assemblages in rocks from the Collahuasi district, Chile.

Djouka-Fonkwé et al. (2012) argued that CO_2 degassing in a magma should result in low $\boldsymbol{\delta}^{13}C$ values and carbon contents in plutonic and volcanic rocks, with the exception of those modified by propylitic alteration. The authors attributed this to the addition of magmatic CO_2 (high $\boldsymbol{\delta}^{13}C$) from porphyry-magma degassing during the main mineralization event typically associated with potassic alteration, into propylitically altered rocks, where it would be precipitated as calcite. Rocks having undergone propylitic alteration should therefore contain the most magmatic CO_2 relative to other hydrothermal alteration assemblages and background metamorphic rocks, and subsequently have higher ^{13}C values (Djouka-Fonkwé et al., 2012). Djouka-Fonkwé et al. (2012) confirmed this by observing a systematic spatial variation in the whole-rock carbon isotope compositions around the porphyry Cu-Mo deposits of the Collahuasi district. The lowest $\boldsymbol{\delta}^{13}C$ values (less than -15‰) were observed in samples from the center of the deposits and in the background metamorphosed rocks compared to propylitic altered rocks, which were characterized by high $\boldsymbol{\delta}^{13}C$ values (mostly above -13‰). Relatively low $\boldsymbol{\delta}^{13}C$ values and carbon contents of the sericitically and argillically altered rocks were attributed to the low pH conditions associated with the formation of these assemblages that would inhibit the stabilization of carbonates (Djouka-Fonkwé et al., 2012). As these alteration assemblages are typically later-stage events, they may overprint previously formed propylitic alteration and become depleted in $\boldsymbol{\delta}^{13}C$ relative to unaffected propylitic altered rocks (Djouka-Fonkwé et al., 2012).

6.3.5.1 Whole-rock carbon and oxygen isotope compositions at Pemberton Hills

Similar to what was observed in rocks from the Collahuasi district, carbon and oxygen isotope compositions display some systematic spatial variation at Pemberton Hills. Sample data

is shown using the 8 equal tails binning function on the plotting software ioGAS. $\delta^{13}C$ values are highest in the distal chlorite, illite-chlorite and epidote altered samples to the southeast of the study site (Fig. 6.77). High $\delta^{13}C$ values also characterize the clay-zeolite altered samples to the south of the lithocap and a relatively high $\delta^{13}C$ value is also observed in a sample from the NW quartz diorite (Fig. 6.77). In contrast, $\delta^{13}C$ values are lowest in samples from the quartz diorite and proximally epidote-actinolite altered samples, as well as in samples from the granodiorite, and in select samples from the clay-zeolite alteration to the south of the lithocap. Moderate to moderately high $\delta^{13}C$ values were observed in samples located within the main QSP shell to the northeast of the lithocap, and in the sample group to the east of the Hushamu pluton (Fig. 6.77).

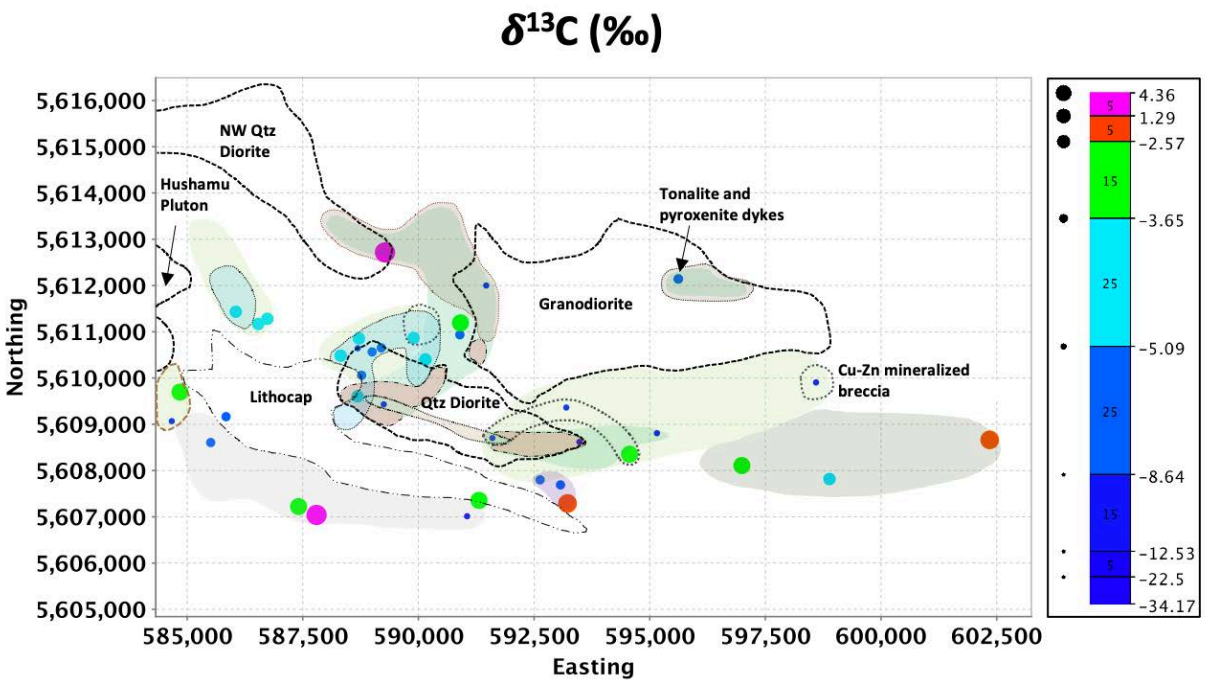


Figure 6.77. Spatial distribution of whole-rock $\delta^{13}C$ values across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b). Sample data is shown using the 8 equal tails binning function on the plotting software ioGAS.

$\delta^{18}O$ values are highest in the clay altered samples to the south of the lithocap, as well as in samples of the granodiorite and in quartz diorite samples that have not been overprinted by

phyllic alteration (Fig. 6.78). High $\delta^{18}O$ values were also observed in actinolite altered samples within the center of the study site in between the granodiorite and quartz diorite plutons, as well as in the sample from the NW quartz diorite (Fig. 6.78). In contrast, $\delta^{18}O$ values are collectively lowest in the phyllic altered samples to the northeast of the lithocap and in the samples directly to the east and south of the Hushamu pluton, as well as in the distal chlorite and illite-chlorite altered samples to the southeast of the study site. Low $\delta^{18}O$ values are also observed in the two samples that are located just inside of the southern boundary of the lithocap (Fig. 6.78).

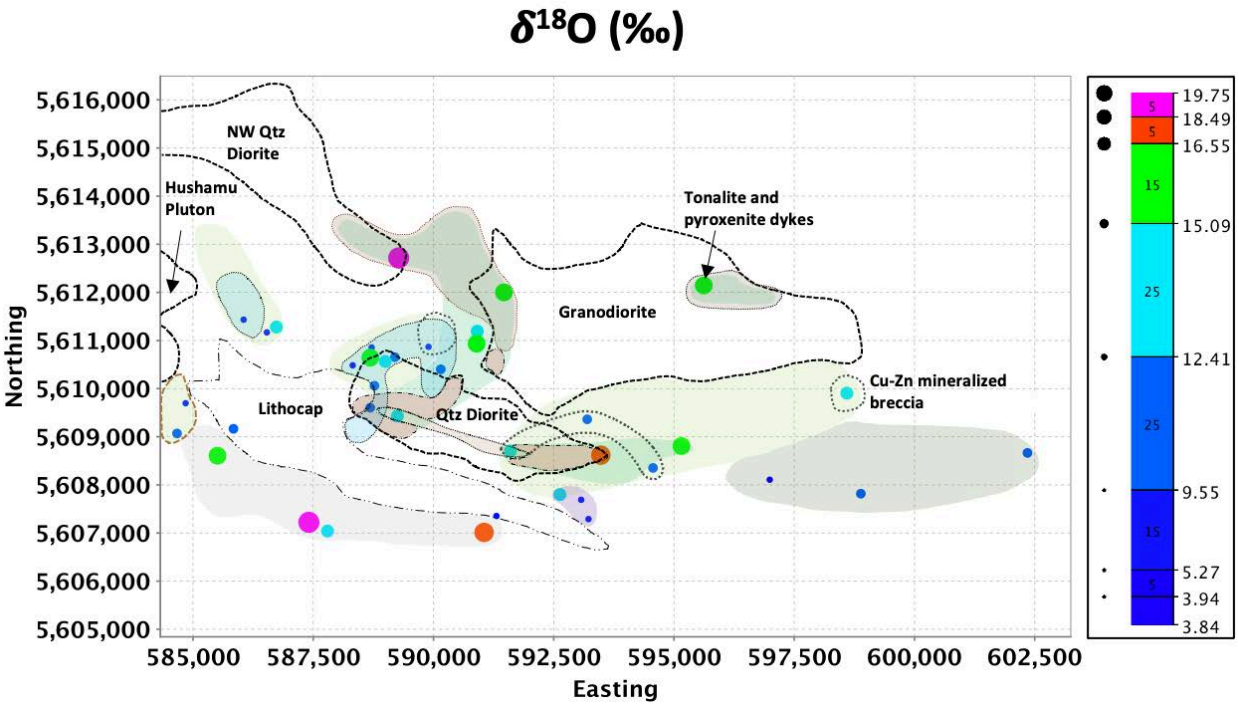


Figure 6.78. Spatial distribution of whole-rock $\delta^{18}O$ values across the Pemberton Hills study site. Outlines of plutonic units modified from Nixon et al. (2011a, b). Sample data is shown using the 8 equal tails binning function on the plotting software ioGAS.

Although taking into consideration temperature corrections and collecting carbon and oxygen isotope compositions for calcite mineral separates in conjunction with the whole-rock isotope data would provide additional insight into the origin of the carbon and oxygen and changes in isotopic compositions, this was not within the scope of this study. However, the

differences observed in the carbon and oxygen isotope compositions between the various alteration types at Pemberton Hills suggests a complex magmatic, meteoric and potential metamorphic fluid history.

The epidote and actinolite altered samples can be differentiated from the potassic altered samples by higher $\boldsymbol{\delta}^{13}$C values, which likely reflects decreasing temperature and the addition of $\boldsymbol{\delta}^{13}$C from magma degassing (Fig. 6.79; Djouka-Fonkwé et al., 2012; Sharp, 2017). The separation between these two groups is not as large as may be expected, given the low $\boldsymbol{\delta}^{13}$C values expected in potassic altered rocks. The majority of potassic altered plutonic rocks at Pemberton Hills contain secondary propylitic alteration, and thus a potential explanation for the relatively close range in $\boldsymbol{\delta}^{13}$C values between these two groups could be the mixing of high $\boldsymbol{\delta}^{13}$C from the propylitic alteration and low $\boldsymbol{\delta}^{13}$C from the degassing of magmatic CO_2 in the plutonic rocks (Fig. 6.79). Phyllic altered samples at Pemberton Hills are characterized by high $\boldsymbol{\delta}^{13}$C values that plot within the range of $\boldsymbol{\delta}^{13}$C values observed for the epidote and actinolite altered samples (Fig. 6.79). However, phyllic altered samples display markedly lower $\boldsymbol{\delta}^{18}$O values that suggest a strong meteoric fluid input relative to epidote and actinolite altered samples, which are interpreted to have a dominantly magmatic fluid origin based on $\boldsymbol{\delta}^{18}$O values (Fig. 6.80).

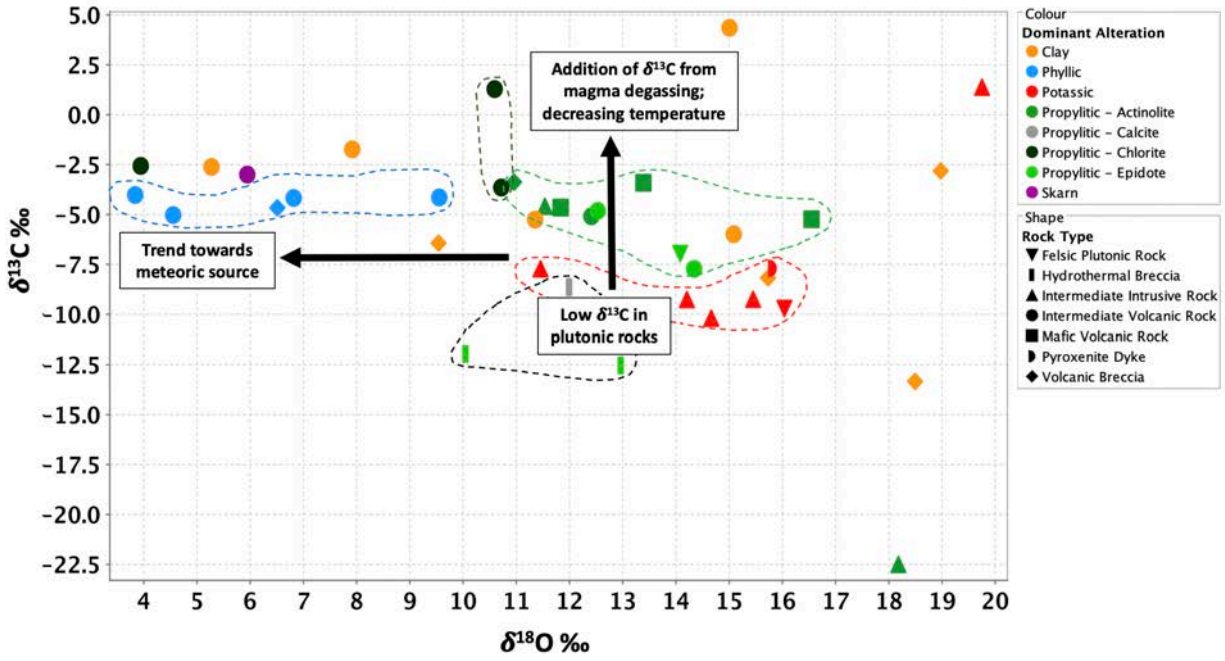


Fig 6.79. Schematic plot of whole-rock $\delta^{18}O$ vs. $\delta^{13}C$ values of samples from Pemberton Hills.

Samples at Pemberton Hills that have the most potential to preserve regional low-grade regional metamorphic signatures include those within the distal chlorite alteration domain extending to the east of the study site, and those within the clay-chlorite-zeolite alteration domain to the south of the lithocap. (Figs. 6.77 and 6.78). Clay-altered samples exhibit the greatest variation in carbon and oxygen isotopes in this study, which makes them difficult to interpret collectively, although many of these samples would plot within the metamorphic water field in Figure 6.80). Samples from the distal chlorite altered domain are characterized by higher $\delta^{13}C$ values relative to the epidote-actinolite and potassic altered rocks (Fig. 6.79). Furthermore, these samples contain a high total carbon content above values typically observed for background metamorphic rocks (Djouka-Fonkwé et al., 2012). This would suggest that calcite, which can be observed as thin veinlets in these rocks, is hydrothermal in origin and can be used

to show an overprint of propylitic alteration in distal porphyry-related environments using carbon isotope compositions.

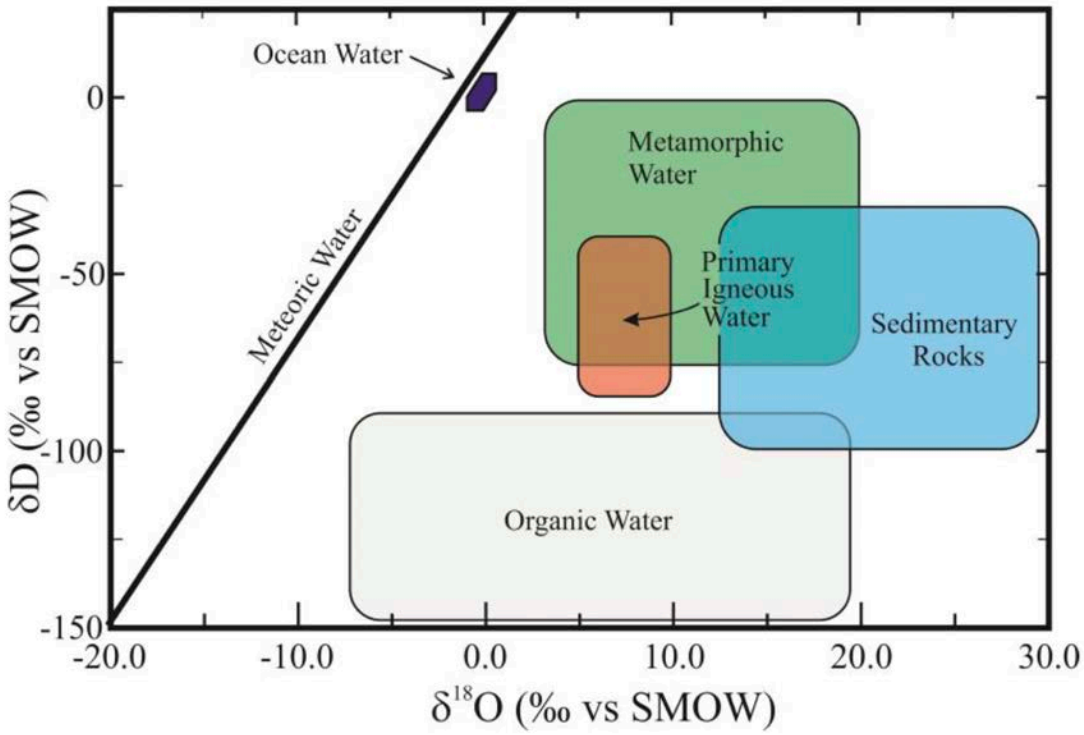


Figure 6.80. Generic water boxes for various geological environments. From Sharp (2017), after Sheppard (1986).

6.4 Summary of key findings

The porphyry environment at Pemberton Hills is characterized by a broad range of alteration mineral assemblages that commonly have complex overprinting relationships. Whole-rock geochemistry worked well to highlight specific features or areas of interest across the study area. Proximal pathfinder elements such as Au and Cu were highest in samples from within the phyllic alteration shell, whereas Mo was highest in samples around the northeast margin of the lithocap. Both whole-rock proximal and distal pathfinder elements were most effective at highlighting samples from within the major hydrothermal breccia domains throughout the study site.

Epidote mineral chemistry was most effective as a fertility assessment and discrimination tool as opposed to a vectoring tool, possibly reflecting the complex overlapping alteration systems. Collectively high As and Sb concentrations in epidote were observed in samples from within the center of the study site as well as in samples adjacent to the southeast margin of the quartz diorite pluton, highlighting these as areas of interest. Most importantly, epidote As and Sb values were able to effectively discriminate samples from the west, center, and east portions of the study site, suggesting multiple porphyry-related alteration events at Pemberton Hills.

Chlorite mineral chemistry was effective as both a vector as well as a fertility assessment and discrimination tool. Chlorite displayed systematic spatial distribution trends shown by increasing Ca and Sr concentrations in samples moving to the east from the southeast margin of the quartz diorite pluton, high Y, V/Co, and V/Li values in the distal chlorite altered samples, and high Co and Mg/Sr values in samples within and adjacent to the southeast margin of the quartz diorite pluton. These observations suggest a weakening of the hydrothermal system towards the eastern margin of the study site. Zinc and Mn concentrations in chlorite were also highest in samples from the center of the study site. Similar to As and Sb in epidote, Zn and Mn concentrations were able to discriminate samples from the west, center, and east of the study site, consistent with the presence of multiple porphyry-related events at Pemberton Hills.

Pyrite was effective in characterizing the hydrothermal fluid flow in the porphyry environment. Elements such as Au, As, Sb, Te, and Ag were elevated in pyrite from samples located around the southeastern margin of the quartz diorite pluton. Most pyrite from within the phyllic altered domain displayed elevated concentrations of Mn, V, and Zn, which is likely a reflection of abundant micro-silicate inclusions in these pyrites. Pyrite from samples around the

northeast margin of the lithocap were enriched in Re, likely reflecting outflow from the lithocap environment.

A small study using whole-rock carbonate carbon and oxygen isotopes was able to show distinct differences between phyllic, propylitic, and potassic zones, as well as hydrothermal breccia samples. The propylitic and potassic samples show stronger primary magmatic signatures whereas the phyllic altered samples reflect a dominantly meteoric fluid source. High $\boldsymbol{\delta}^{13}$C values in the distal chlorite altered samples suggest that the carbonate from these rocks is hydrothermal in origin, implying a hydrothermal signature influence in distal rocks that are weakly altered.

Chapter 7: Conclusions

This study focuses on two main components of the Pemberton Hills study site: 1) the tectonomagmatic evolution of the Bonanza arc volcanic and plutonic rocks with implications for porphyry deposit formation, and 2) characterization of the alteration system and application of propylitic mineral chemistry as vectoring tools at an active porphyry exploration site.

The Pemberton Hills study area comprises a wide range of volcanic and plutonic rocks including granodiorites, quartz diorites, tonalite dykes, pyroxenite dykes, mafic volcanic rocks, intermediate volcanic rocks, volcanic breccias, and hydrothermal breccias. Intense hydrothermal alteration of some samples has affected the more mobile elements (i.e., NaO_2, K_2O), requiring the use of immobile elements to interpret the magmatic evolution and fertility of these units. Samples from Pemberton Hills are mainly medium-K calc-alkaline rocks that follow a typical calc-alkaline magmatic differentiation trend, characteristic of many porphyry-related arc rocks (Cooke et al., 2005, 2014; Sillitoe, 2010).

New high-precision geochronology provides detailed insight into the timing relationships of felsic and intermediate plutonism as well as alteration and mineralization at Pemberton Hills and the association with other nearby porphyry systems (i.e., Island Copper mine). Granodiorite sample PM18AJ273 from the northern Wanakana pluton is the oldest intrusive unit dated at 172.34 ± 0.11 Ma. Following this is the 172.01 ± 0.17 Ma quartz diorite sample PM18AJ248 from the southern Wanakana pluton, which overlaps with tonalite dyke sample PM18AJ289 (171.77 ± 0.13 Ma) from the northern Wanakana pluton. The quartz diorite sample PM18AJ203 yielded the youngest reported age at 171.44 ± 0.25 Ma. These results indicate that felsic plutonism was occurring for a minimum of ~0.33 m.y. to a maximum of ~0.8 m.y. Following the crystallization of

the granodiorite, intermediate plutonism in the southern Wanakana pluton was occurring and proceeded for a minimum of ~0.15 m.y. to a maximum of ~1.0 m.y. that overlapped with the emplacement of the tonalite dyke. Textural differences and ages that do not overlap between the quartz diorite samples suggest that these samples were emplaced as discrete pulses of magma, despite being only ~300m apart.

Zircon trace element geochemistry from the four plutonic samples used for high-precision geochronology reveals contrasting conditions in the felsic and intermediate magmas during emplacement. Relatively high and overlapping Eu/Eu* ratios in the granodiorite and tonalite dyke samples suggest that the felsic plutonic magmas were more oxidized, and that the oxidation state of these magmas remained stable from the emplacement of the granodiorite, through until the emplacement of the tonalite dyke. Relatively low and increasing Eu/Eu* ratios over time observed in the two quartz diorite samples indicates that these magmas were less oxidized during emplacement, and that the controls on the oxidation state of these magmas were changing throughout the crystallization history of these rocks. Similarly, low and overlapping Dy/Yb ratios in zircons from the granodiorite and tonalite dyke samples suggest that the felsic plutonic magmas had effectively fractionated amphibole at depth prior to the emplacement of the granodiorite (Lu et al., 2016). In contrast, relatively high and decreasing Dy/Yb ratios observed in the two quartz diorite samples suggest that amphibole fractionation was an ongoing process throughout the crystallization history of these rocks. Economic porphyry deposits are known to be associated with high zircon Eu/Eu* and low Dy/Yb ratios, suggesting that the felsic plutonic magmas at Pemberton Hills are more fertile, and have the potential to be associated with a larger porphyry system than the intermediate magmas.

Zircon Hf isotope compositions from three of the four samples used for zircon trace element geochemistry yielded positive average ϵHf signatures of +11.4, +11.2, and +9.5 for the granodiorite, tonalite dyke, and quartz diorite sample PM18AJ203, respectively. Despite a more primary composition observed in the sample of quartz diorite, this sample exhibits a slightly less radiogenic ϵHf signature, possibly due to late-stage assimilation of minor amounts of evolved crustal material. This is consistent with the plot of zircon Yb/Gd vs. U/Th, which suggests that the granodiorite and tonalite dyke samples are evolved crustal melts, whereas the quartz diorite samples represent less evolved but contaminated melts. Despite the Bonanza arc volcanic and plutonic rocks forming on thick, non-continental crust, the strongly positive ϵHf signatures of these rocks suggest that they are derived from a juvenile mantle source. A juvenile source is interpreted to be a critical component in the evolution of fertile magmas associated with porphyry Cu ± Au ± Mo mineralization, and would suggest that the plutonic rocks at Pemberton Hills have the potential to be associated with economic porphyry mineralization (Dolgopolova et al., 2013).

The porphyry environment at Pemberton Hills is characterized by a broad range of alteration mineral assemblages that commonly form overprinting relationships (Fig. 4.8). Potassic alteration, characterized by biotite, potassium feldspar, quartz, and magnetite, was mainly observed within and proximal to plutonic rocks across the study site. Locally intense phyllic alteration, characterized by fine-grained quartz, white-mica, and pyrite, was generally constrained to samples located in the center of the study site to the northeast of the lithocap, and overprints previously formed mineral assemblages. As the main focus of this study, propylitic alteration was ubiquitous in most areas sampled. It is characterized by the presence of epidote,

chlorite, and actinolite, as well as a wide range of accessory minerals. Propylitic alteration at Pemberton Hills was subdivided into actinolite, epidote, and chlorite sub-zones based on the works of Holliday and Cooke (2007) and Cooke et al. (2014), who suggested that these sub-zones represent temperature gradients within the propylitic alteration environment.

This study builds on the work of Cooke et al. (2014) and Wilkinson et al. (2015), who demonstrated that epidote and chlorite chemistry could be used to vector towards mineralization around porphyry deposits. However, unlike most other published works on the use of green rock mineral chemistry in the porphyry environment, the Pemberton Hills study site is not known to host any porphyry ore body(s) at surface or at depth despite the presence of a well-developed lithocap in the study area (see Hamilton, in prep), and its proximity to the Island Copper Mine to the southeast as well as other porphyry deposits and prospects to the northwest (i.e., Hushamu deposit, Red Dog property).

Proximal pathfinder elements in epidote such as Sb and As are useful indications of proximity to porphyry deposit centers and porphyry deposit fertility. The strongest systematic spatial distribution in epidote is shown by a relatively tight cluster of high Sb and As concentrations in samples located within the center of the study site to the northeast of the lithocap, which is a potential indication of porphyry-deposit mineralization at depth. Some high As values in epidote were also observed in samples centered around the southeast margin of the quartz diorite pluton, suggesting this may be an area of higher heat flow. Higher Na and K in replacement epidote than vein epidote supports. Overprinting of Na- and K-bearing phyllic alteration on previously formed epidote is consistent with higher Na and K observed in

replacement epidote than vein epidote, suggesting that phyllic overprinting may be complicating some other trace element vectoring signatures in epidote.

Chlorite displays clearer systematic spatial distribution trends than epidote, illustrated by increasing Ca and Sr concentrations from the east to the southeast margin of the quartz diorite pluton, high Y, V/Co, and V/Li values in the distal chlorite altered samples, and high Co and Mg/Sr values in samples within and adjacent to the southeast margin of the quartz diorite pluton (Figs. 6.51 – 6.60). These trends suggest that the samples within and directly adjacent to the southeastern margin of the quartz diorite pluton are more proximal to a heat source than the samples to the east, which display weaker porphyry related trace element signatures. Chlorite trace element chemistry in samples from the center of the study area do not display clear systematic spatial distribution patterns despite containing high concentrations of trace elements such as Zn and Mn. Lithology control on the Fe and Mg distribution in chlorite and the influence of alteration (i.e., high Ti in chlorite replacing biotite, high V in phyllic altered samples) on chlorite from the center of the study site suggest that these factors are complicating the chlorite mineral chemistry in this area.

One of the most important findings of this study was the ability to use porphyry deposit fertility indicators such as Sb and As concentrations in epidote and Mn and Zn concentrations in chlorite to discriminate groups of samples interpreted to represent discrete porphyry-related alteration events at Pemberton Hills. Samples from the center of the study site to the northeast of the lithocap displayed collectively higher As and Sb in epidote as well as Zn and Mn in chlorite relative to samples that extend east from the southeastern margin of the quartz diorite pluton. This is consistent with the systematic outwards zonation of potassic altered rocks in the

southeastern domain of the quartz diorite pluton, through actinolite, epidote, and into chlorite altered rocks in the far eastern area of the study site, which suggests these samples were derived from a separate porphyry related alteration event to the one that caused the alteration assemblages and zonation patterns observed in the samples within the center of the study site (Figs. 6.42 and 6.62).

Pyrite forms in and under a broad range of alteration assemblages and conditions in the porphyry environment, making it a powerful tool for characterizing the composition of hydrothermal fluids at the time of formation. Pyrite mineral chemistry in conjunction with pyrite element maps proved to be effective at characterizing hydrothermal fluid flow in the porphyry environment at Pemberton Hills. The pyrite grains from samples centered around the southeastern margin of the quartz diorite were shown to be enriched in Au, As, Sb, Te, and Ag, suggesting that the pyrite in these samples are related to a porphyry alteration event that contained elevated concentrations of these metals in the pyrite forming fluids. Elevated and homogeneously distributed Re in pyrite grains from samples located along the margin of the lithocap is consistent with an epithermal overprint as pyrite from within the lithocap is characteristically enriched in Re (see Hamilton, in prep). Furthermore, pyrite from the phyllic altered samples is characterized by high Mn, V, and Zn, and reflects an abundance of micro-sized silicate inclusions in the pyrite, as shown in the pyrite element maps.

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Appendix A:
Pemberton Hills Whole-rock Geochemistry

Sample	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Sum	Ba	Sc	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W
PM18AJ200	55.78	16.06	8.33	4.02	2.64	2.91	1.63	0.88	0.18	0.27	0.003	99.85	456	26	1.1	14.7	3.7	6.6	40.1	<1	231.7	0.5	3.2	1.3	222	<0.5
PM18AJ201	55.67	17.02	8.24	4.01	5.71	3.26	2.02	0.87	0.17	0.22	0.002	99.84	799	27	4.1	15.1	3.5	5.6	40.1	1	419.7	0.4	3	1.5	225	<0.5
PM18AJ202	55.32	17.48	8.32	3.23	5.69	3.77	2.24	0.75	0.23	0.19	<0.002	99.85	802	19	4.6	15.3	2.5	4.1	44.5	<1	510.3	0.2	2.2	0.9	164	<0.5
PM18AJ203	57.86	17.03	6.24	2.9	5.36	4.28	2.29	0.75	0.19	0.19	<0.002	99.83	731	19	1.2	14	4.5	7.5	43.7	2	476.5	0.4	5.3	1.9	171	<0.5
PM18AJ204	51.3	16.42	10.66	3.59	5.58	3.15	1.5	0.81	0.15	0.16	0.019	99.84	806	35	3.3	11.3	1.5	2.8	33.6	<1	458.2	0.1	1	0.4	248	<0.5
PM18AJ205	50.63	14.04	12.22	4.41	6.11	2.52	1.18	0.79	0.15	0.18	0.034	99.83	831	35	4.5	10.1	1.5	2.3	28.2	<1	488.9	0.1	1	0.5	270	<0.5
PM18AJ206	47.1	15.71	11.27	7.09	10.99	2.24	0.99	0.89	0.16	0.22	0.051	99.82	483	41	2.5	13.3	1.7	3	19.9	<1	455.3	0.2	1.3	0.4	284	<0.5
PM18AJ207	60.42	15.2	6.56	2.41	3.97	2.11	2.73	0.7	0.14	0.13	0.003	99.85	753	18	1	14.3	4.3	7.6	50.1	<1	196.2	0.5	4.7	2.2	140	0.7
PM18AJ208	55.71	17.38	7.75	3.96	5.11	3.3	3.05	0.72	0.15	0.15	0.002	99.83	1694	25	5.2	14.5	3.1	5.1	72.2	<1	437.9	0.4	3.2	1.4	187	<0.5
PM18AJ209	48.09	18.25	8.73	5.22	6.38	3.62	0.81	1.04	0.23	0.17	0.003	99.78	700	31	3.9	13.4	1.8	3.6	20.8	<1	837.6	0.2	1	0.3	267	0.8
PM18AJ210	53.65	16.3	10.71	3.64	1.51	3.9	1.62	0.89	0.2	0.13	0.005	99.84	619	26	1.3	11.8	2.7	4.5	42.9	<1	405	0.3	2.3	0.9	208	0.9
PM18AJ211	54.76	17.34	7.32	3.43	6.76	3.09	1.38	0.71	0.18	0.2	0.003	99.82	868	22	2.2	14.4	2.6	4.4	14.8	<1	585.6	0.2	3.1	1.4	191	<0.5
PM18AJ212	56.95	17.17	7.36	3.18	5.59	3.5	1.28	0.69	0.2	0.21	0.003	99.82	838	17	0.7	14.9	2.9	5.9	17.9	<1	573.1	0.4	3.6	1.4	170	0.6
PM18AJ213	55.76	17.7	7.9	4.16	4.02	3.6	0.19	0.75	0.15	0.16	0.002	99.8	290	24	2.2	14.5	3.1	4.6	4.3	<1	667.1	0.3	2.5	1	199	<0.5
PM18AJ214	47.16	14.84	8.97	8.67	11.34	2.42	0.37	0.74	0.18	0.22	0.078	99.82	235	33	1.1	11.1	1.5	2.1	6.7	<1	557.8	0.1	0.9	2.7	238	<0.5
PM18AJ215	53.63	20	7.37	2.48	3.56	6.63	1.08	0.83	0.28	0.1	<0.002	99.81	622	19	2.4	14.2	2.5	6.6	21.9	<1	724.1	0.3	1.7	0.6	159	<0.5
PM18AJ216	57.76	19.59	5.29	1.78	2.97	7.28	2.24	0.69	0.22	0.16	<0.002	99.87	582	12	<0.1	20.7	5.2	9.4	29.4	2	224.6	0.6	4.5	2	81	0.9
PM18AJ217	52.21	16.53	9.07	1.89	10.18	0.84	0.09	0.35	0.2	0.31	0.006	99.62	26	13	0.7	27.6	1.1	2.6	2.2	<1	763.7	0.1	0.9	0.5	203	<0.5
PM18AJ218	46.77	19.12	10.1	6	9.09	2.65	0.51	1	0.23	0.29	0.008	99.81	774	32	1.8	17.7	1.8	3.9	12.4	<1	625.3	0.2	0.9	0.5	300	<0.5
PM18AJ219	48.14	17.68	9.64	4.48	5.55	3.3	1.32	0.98	0.23	0.28	0.01	99.79	542	36	1.4	13.1	1.6	4	36.7	<1	605.9	0.2	0.8	0.3	323	0.7
PM18AJ220	49.11	17.01	9.87	5.84	10.85	2.97	0.55	0.91	0.17	0.18	0.029	99.81	304	41	1.1	15.6	1.7	3.8	9.3	<1	608.3	0.3	1	0.4	313	<0.5
PM18AJ221	50.45	18.44	8.23	5.4	9.13	3.11	1.29	0.97	0.23	0.17	0.006	99.82	603	29	1.8	15.8	2	4.6	22.3	<1	626.5	0.2	1.5	0.4	268	<0.5
PM18AJ222	45.13	17.23	10.16	7.2	11.82	1.46	0.83	0.9	0.17	0.22	0.033	99.83	365	43	4.9	15	1.6	3.4	24.2	<1	536.1	0.2	1	0.4	293	<0.5
PM18AJ223	54.75	17.85	7.44	2.48	3.15	4.55	1.48	0.82	0.17	0.09	0.004	99.86	554	21	2	15.3	2.8	4.9	30.3	<1	414.3	0.3	2.3	1	217	0.7
PM18AJ224	48.45	18.87	10.58	3.12	4.39	2.76	2.58	0.93	0.14	0.24	0.01	99.82	1061	34	3.3	14.5	1.7	3.2	63.4	<1	547.9	0.2	1.1	0.6	310	<0.5
PM18AJ225	46.64	16.95	10.55	8.05	7.77	3.25	0.78	0.86	0.12	0.15	0.029	99.82	203	40	9.4	12.9	1.3	2.6	25.4	<1	645.7	0.2	0.5	0.3	287	<0.5
PM18AJ226	49.61	17.45	7.94	5.01	5.84	2.92	1.41	0.86	0.15	0.17	0.029	99.85	709	38	4.5	14.3	1.5	2.8	24.7	<1	345.7	0.1	0.6	0.2	303	0.7
PM18AJ227	55.83	17.28	7.36	2.71	6.88	3.9	1.28	0.77	0.19	0.15	0.004	99.84	396	23	<0.1	17.8	3.9	6.7	20.8	<1	353.6	0.4	4	1.7	200	0.7
PM18AJ228	68.31	15.29	1.98	1.08	3.41	3.95	0.71	0.44	0.09	0.07	0.002	99.88	282	12	0.7	14.1	6.1	9.4	17.3	<1	187.9	0.6	6.6	3.1	55	1.1
PM18AJ229	45.13	13.93	10.02	14.1	7	2.24	0.36	0.69	0.12	0.19	0.083	99.86	129	39	0.3	11	1.3	1.5	8.4	<1	221.7	<0.1	0.5	0.3	255	<0.5
PM18AJ230	68.74	14.24	3.77	1.12	1.48	3.87	4.42	0.48	0.09	0.05	<0.002	99.86	1382	10	1	12.9	7	12.6	97.9	<1	244.1	0.8	9.8	5.1	57	<0.5
PM18AJ231	67.42	14.59	4.15	1.44	1.88	4.81	3.48	0.56	0.12	0.04	<0.002	99.87	1044	12	0.4	12.8	6.6	11.1	72.6	<1	178.7	0.7	8.6	3.1	86	0.5
PM18AJ232	65.23	15.34	4.19	1.7	2.88	4.84	3.34	0.59	0.13	0.04	0.004	99.86	1100	13	1.2	13.2	6.3	11.2	59	<1	331.5	0.7	7.6	2.7	98	0.6
PM18AJ233	51.19	16.62	9.13	5.91	8.24	4.1	0.63	0.83	0.26	0.19	0.039	99.8	202	29	2.6	13.7	2.1	3	12.9	<1	647.5	0.2	1.2	1	251	0.6
PM18AJ234	47.39	15.45	10.25	9.57	11.43	2.33	0.23	0.84	0.19	0.2	0.074	99.79	109	33	0.6	14.5	1.7	2.4	4.5	<1	672.6	0.2	0.8	0.5	280	<0.5
PM18AJ235	45.26	14.47	10.01	12.27	9.9	1.92	1.19	0.94	0.2	0.24	0.084	99.83	777	32	2.3	14.3	1.6	4.2	28	<1	481.6	0.3	0.8	0.3	268	<0.5
PM18AJ236	45.72	14.59	9.57	8.45	15.2	1.8	0.02	0.64	0.12	0.31	0.077	99.83	26	37	<0.1	13.7	1.1	1.2	0.3	<1	511.7	<0.1	0.5	0.4	273	0.7
PM18AJ237	50.62	15.03	10.22	6.52	8.85	3.85	0.84	0.76	0.18	0.26	0.053	99.83	180	33	5.8	10.8	1.9	2.2	21	<1	545.3	0.2	0.9	0.9	260	0.5
PM18AJ238	50.22	17.09	9.12	5.77	9.11	3.61	0.71	0.93	0.18	0.19	0.01	99.8	397	35	1.8	15.5	2.1	4.3	19.6	<1	757	0.2	1.5	0.6	285	0.8
PM18AJ239	67.5	15.11	3.92	1.8	1.84	3.71	2.52	0.57	0.17	0.12	0.003	99.86	968	10	0.7	13.8	4.2	7.3	58.6	<1	435.4	0.5	3.6	1.7	61	0.7
PM18AJ240	55.1	16.49	8.18	2.92	5.6	2.69	2.81	0.78	0.26	0.16	0.011	99.83	1111	23	0.5	15.7	3.7	7.7	53.9	<1	360.7	0.5	3.6	1.2	200	0.9
PM18AJ241	51.9	18.19	8.57	3.44	6.79	3.8	1.08	0.75	0.26	0.19	<0.002	99.84	249	18	3.9	18.2	3.2	6.5	25.1	<1	479.9	0.3	2.1	0.7	162	<0.5
PM18AJ242	49.92	17.7	9.3	4.68	8.2	3.01	1.62	0.85	0.23	0.22	0.01	99.83	584	27	1.8	17.7	2.4	4.9	34	<1	557	0.2	1.9	0.7	214	<0.5
PM18AJ243	59.32	15.91	6	1.7	5.46	3.14	0.67	0.66	0.17	0.1	0.002	99.89	271	17	0.2	15.6	3.2	4.8	8.9	<1	196.6	0.3	2	1	90	<0.5
PM18AJ244	52.38	17.78	8.3	2.24	6.43	3.44	0.04	0.91	0.3	0.21	<0.002	99.87	127	22	0.8	18.3	3.1	6.3	1.2	<1	265.8	0.4	2.2	0.9	167	0.8
PM18AJ245	58.41	16.62	7.33	3.27	4.74	2.5	1.52	0.83	0.17	0.19	0.006	99.83	754	23	1.8	16.2	4.5	8.4	30.4	1	362.9	0.4	4.4	1.9	184	1
PM18AJ246	54.1	16.5	6.36	2.75	7.77	0.93	0.99	0.68	0.15	0.13	0.004	99.87	292	19	0.5	15.8	3.7	6.6	22.4	<1	214.2	0.4	4.7	1.9	149	<0.5
PM18AJ247	54.72	17.43	8.31	3.62	5.02	3.85	2.5	0.78	0.23	0.18	0.003	99.82	820	20	2.4	12.6	3.2	6.2	55.5	<1	465.6	0.4	3.4	1.4	180	0.6
PM18AJ248	58.63	16.22	6.89	2.76	4.22	3.44	3.09	0.75	0.15	0.15	0.004	99.83	927	21	2.2	12.3	4.5	7.7	71.6	<1	385.2	0.4	5.4	2.5	148	0.9
PM18AJ249	54.65	17.35	8.6	3.96	6.56	3.16	2.2	0.78	0.23	0.2	0.004	99.8	885	23	3	12.3	2.4	4.8	51.3	<1	535.7	0.3	2.8	1.2	182	<0.5
PM18AJ250	49.48	19.14	7.23	6.27	4.12	3.44	1.06	0.87	0.19	0.2	0.006	99.82	346	24	0.1	14.8	3.8	6.1	21.6	<1	392.8	0.3	3.7	1.7	194	<0.5
PM18AJ251	57.44	17.12	7.61	3.18	5.2	3.47	1.12	0.8	0.22	0.14	0.004	99.85	274	18	0.6	18.6	2.8	6.3	30.4	<1	378.7	0.4	2.3	0.7	160	1.3
PM18AJ252	56.17	18.79	6.61	3.54	2.23	4.7	1.56	0.8	0.19	0.06	0.005	99.85	439	20	0.6	18.6	3.8	7.1	39.4	1	302.6	0.4	3.3	1.6	156	1.5
PM18AJ253	58.32	18.19	5.82	2.55	5.42	4.13	1.13	0.78	0.18	0.12	0.007	99.84	760	24	<0.1	18.2	3.7	6.6	15.6	<1	426.3	0.4	3.4	1.5	181	0.6
PM18AJ254	48.99	18.21	10.67	3.12	5.77	5.74	0.03	1.02	0.25	0.19	0.004	99.87	98	27	<0.1	17.3	2.8	5.6	<0.1	1	139.1	0.3	1.5	0.7	232	<0.5
PM18AJ255	52.82	17.7	9.9	3.04	4.03	6.3	0.13	0.93	0.28	0.18	0.004	99.85	137	20	0.2	14.2	2.4	5	1	<1	428.5	0.3	1.2	0.3	178	0.5
PM18AJ256	53.95	19.28	6.98	2.47	4.51	6.39	0.15	0.8	0.28	0.09	<0.002	99.87	229	15	0.1	15.3	3	6	0.8	<1	355.2	0.3	1.8	0.3	93	<0.5

***All major oxides, C, and S are in wt. %; all other elements are in ppm except Au, Ag, Hg, Re, Pt, and Pd, which are in ppb.**

Appendix A:
Pemberton Hills Whole-rock Geochemistry

Sample	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Sum	Ba	Sc	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W
PM18AJ257	57.43	17.95	6.45	1.19	4.54	5.52	0.61	0.69	0.27	0.09	0.004	99.87	322	14	0.6	12.4	2.6	5.3	11.5	<1	356.3	0.4	1.6	0.6	94	1.9
PM18AJ258	51.84	18.55	8.77	2.8	5.52	5.17	0.13	0.8	0.32	0.15	0.003	99.86	115	18	0.1	14.5	3	6.1	0.8	<1	374.3	0.3	1.7	0.3	136	<0.5
PM18AJ259	54.6	19.42	7.66	1.62	4.19	6.85	1.22	0.87	0.32	0.13	0.004	99.85	424	19	0.2	14.2	3.2	6.3	17.8	<1	472.5	0.4	1.9	0.7	133	<0.5
PM18AJ260	51.28	19.16	8.67	3.44	5.89	2.75	1.47	0.84	0.23	0.26	0.003	99.85	645	21	1	16.5	2.6	4.3	30.4	1	424.5	0.3	2.1	0.9	194	1.1
PM18AJ261	60.35	16.09	6.55	2.76	6.46	2.64	1.14	0.6	0.19	0.14	0.005	99.85	446	14	0.5	14.6	3.2	6.3	25	<1	368	0.4	3.8	1.8	116	1
PM18AJ262	57.95	17.58	7.78	2.44	4.61	2.97	0.73	0.75	0.16	0.14	0.005	99.85	458	20	0.9	15.7	2.8	4.9	16.3	<1	368.5	0.3	2.8	1.1	180	1.5
PM18AJ263	53.79	16.88	7.29	2.27	7.5	2.15	0.46	0.74	0.19	0.11	0.004	99.86	199	17	2.7	13.5	2.5	4.7	9.6	<1	477.9	0.3	2.3	0.7	138	<0.5
PM18AJ264	58.96	17.18	6.64	2.82	4.13	4.56	0.64	0.68	0.19	0.12	0.003	99.83	742	16	2.7	11.4	4.1	6.3	11.1	<1	613.4	0.4	3.6	1	116	0.5
PM18AJ265	58.33	16.84	6.86	2.68	5.33	3.95	2.44	0.72	0.22	0.15	0.006	99.84	862	17	1.3	15.1	3.7	6.3	44.4	<1	508.3	0.5	3.1	1.5	145	0.8
PM18AJ266	60.62	17.04	6.11	2.51	3.04	3.82	2.24	0.74	0.22	0.14	0.007	99.86	586	16	0.8	15.5	3.7	6.4	65	<1	343.2	0.4	3.3	1.4	158	1
PM18AJ267	62.36	16.43	5.17	1.71	5.25	5.22	1.23	0.58	0.18	0.11	0.003	99.87	222	12	0.1	16.3	2.7	4.6	19.9	<1	268.9	0.4	3.8	1.6	152	0.6
PM18AJ268	50.64	14.51	9.15	9.58	6.63	2.72	2.31	0.74	0.18	0.12	0.061	99.84	362	31	0.6	12	1.5	2.5	79.6	<1	577.2	0.1	0.9	0.6	232	<0.5
PM18AJ269	62.56	13.64	4.79	1.71	13.05	0.03	<0.01	0.2	0.05	0.09	0.007	99.94	23	7	<0.1	37	0.5	0.8	0.2	<1	84.7	<0.1	0.3	0.2	65	0.9
PM18AJ270	59.27	15.97	7.2	2.64	6.85	3.01	1.68	0.67	0.21	0.17	0.003	99.83	729	14	0.8	15.3	3.6	5.7	37.3	<1	587.3	0.3	2.9	1.3	133	1.5
PM18AJ271	52.54	16.11	7	7.53	8.07	3.79	1.21	0.71	0.19	0.11	0.038	99.83	262	24	1.1	14.7	2	3	34.2	<1	631.3	0.2	1.2	0.9	181	<0.5
PM18AJ272	66.2	15.18	3.64	0.98	3.84	3.23	2.52	0.36	0.1	0.11	<0.002	99.88	796	8	0.7	14.5	4.1	7.3	47.4	7	311.4	0.5	6.8	2.7	59	1.4
PM18AJ273	68.74	14.88	3.79	1.07	2.71	3.8	3.18	0.35	0.1	0.08	0.003	99.89	965	8	1	12.6	4.2	7.1	75.8	<1	276.6	0.6	7	2.9	54	<0.5
PM18AJ274	61.9	14.61	4.6	1.07	9.14	1.75	0.39	0.41	0.13	0.23	0.002	99.85	66	10	0.7	19.3	3	6.1	11.9	5	543.9	0.4	3.2	6.1	95	3.3
PM18AJ275	45.81	16.62	12.23	2.29	11.24	2.88	1.59	0.86	0.17	0.18	0.007	99.77	291	27	0.3	19.6	2	2.9	28.1	4	697.3	0.2	1.5	0.8	282	1.3
PM18AJ276	50.77	17.9	8.59	2.2	7.82	3.7	0.48	0.93	0.22	0.33	0.003	99.84	486	26	0.6	16.5	3	4.2	7.9	<1	440.8	0.2	2.3	0.9	232	<0.5
PM18AJ277	59.8	15.74	7.38	2.49	3.92	4.1	1.33	0.62	0.16	0.15	0.005	99.87	320	15	0.5	12.9	3.5	5.4	44.2	<1	289.9	0.3	4.1	1.6	129	0.8
PM18AJ278	53.66	14.93	6.83	3.14	8.36	2.95	1.56	0.72	0.17	0.16	0.008	99.83	1035	20	1	11.9	3.5	5.5	25.3	<1	510.2	0.4	3.5	1.6	171	0.7
PM18AJ279	55.14	17.13	8.5	3.49	5.86	3.94	2.17	0.86	0.23	0.15	0.003	99.82	939	22	1.4	14.7	3.2	5.7	42.3	<1	581.9	0.4	3	1.4	203	<0.5
PM18AJ280	54.59	18.25	8	3.55	7.43	3.5	0.22	0.76	0.25	0.22	0.005	99.83	360	21	<0.1	15.6	2.6	4.8	1.7	<1	561.2	0.3	2	1	184	18.4
PM18AJ281	68.47	14.95	3.68	0.88	2.43	4.74	2.76	0.37	0.12	0.09	0.002	99.89	1105	6	0.2	13	4.5	7.1	43.2	<1	271.8	0.5	5	1.9	47	3.1
PM18AJ282	42.57	17.65	10.1	3.21	16.72	2.09	0.61	0.74	0.3	0.2	0.003	99.81	251	16	0.8	18.5	2.3	6.7	13.9	<1	889.2	0.4	2.2	0.8	193	<0.5
PM18AJ283	49.2	16.71	8.69	5.27	9.58	1.98	0.46	0.88	0.18	0.17	0.013	99.85	122	33	1.7	18.4	2.9	4.8	9.3	<1	335.2	0.3	2.8	1.2	226	0.6
PM18AJ284	57.11	15.56	7.86	2.79	7.19	2.5	1.88	0.82	0.25	0.19	0.003	99.84	706	21	1.5	15.4	2.5	4.4	39.7	<1	364.4	0.3	2.4	0.8	170	0.6
PM18AJ285	48.66	16.23	9.47	7.92	8.52	3.59	0.95	0.78	0.19	0.17	0.053	99.87	129	31	<0.1	13.1	1.5	2.2	16	<1	259.6	0.2	1	0.5	234	<0.5
PM18AJ286	54.4	17.25	10.09	3.93	4.12	4.07	0.73	0.96	0.27	0.2	0.007	99.78	502	30	0.4	14.9	2.9	4.9	16.5	<1	481.4	0.3	2.2	1	266	0.8
PM18AJ287	68.84	14.6	3.66	1.29	1.98	4.24	3.02	0.34	0.1	0.1	<0.002	99.88	1100	7	1	12.4	3.4	6.5	69.1	<1	292.2	0.5	5.3	1.6	55	<0.5
PM18AJ288	48.52	0.81	20.05	6.38	22.54	0.1	<0.01	0.09	0.12	1.77	<0.002	99.81	6	7	<0.1	3.4	1.4	0.3	<0.1	<1	26.7	<0.1	0.7	1.4	37	<0.5
PM18AJ289	73.99	11.88	1.66	0.5	3.93	2.49	3.92	0.13	0.04	0.1	<0.002	99.89	1444	3	0.4	10.1	3.3	8.5	74.4	1	234.1	0.9	11.5	4.8	14	0.6
PM18AJ290	55.81	17.08	7.79	3.39	7.1	2.89	1.6	0.75	0.24	0.16	<0.002	99.82	572	18	3.2	15.9	3.3	6.2	35.6	<1	618.7	0.4	2.5	1.2	159	<0.5
PM18AJ291	53.33	14.64	7.32	1.89	8.44	1.19	1.35	0.55	0.22	0.11	<0.002	99.89	261	14	3.5	13.5	2.2	4.4	44.5	<1	155.1	0.3	1.8	0.7	141	<0.5
PM18AJ292	41.85	20.2	9.32	2.16	16.78	2.41	<0.01	0.83	0.32	0.13	<0.002	99.9	26	21	<0.1	33	2.5	5.3	<0.1	<1	40.6	0.3	1.5	0.7	143	<0.5
PM18AJ293	51.34	18.62	7.35	2.97	7.1	2.7	0.21	0.86	0.24	0.15	0.002	99.84	73	20	1.2	17.9	2.9	5.9	2.4	<1	361.8	0.3	1.9	0.9	173	<0.5
PM18AJ294	54.8	17.18	7.85	4.06	5.74	3.37	2.48	0.7	0.14	0.15	<0.002	99.83	1030	26	5.4	14.5	3.2	5.1	66.8	<1	498.7	0.4	3.1	1.4	195	<0.5
PM18AJ295	54.14	17.8	8.74	3.76	3.62	3.96	0.87	0.84	0.26	0.24	<0.002	99.82	785	20	1.5	16.6	2.6	5.8	13.7	<1	655.2	0.3	2.4	1.1	199	<0.5
PM18AJ296	56.22	16.9	7.92	4.17	4.87	3.11	2.12	0.72	0.16	0.15	0.003	99.83	801	25	2.2	14.7	3.7	5.9	43.3	<1	414.3	0.4	3.6	1.6	179	<0.5
PM18AJ297	69.27	14.15	3.91	1.24	1.24	3.36	3.59	0.39	0.09	0.05	<0.002	99.86	1288	11	0.7	12.6	6.8	10.5	76.9	1	162.5	0.7	7.4	3.4	39	0.6
PM18AJ298	56.62	17.11	8	3.27	5.63	3.78	2.34	0.84	0.22	0.11	<0.002	99.83	1110	19	2.2	16	3.5	6.9	39.7	<1	528.4	0.4	3.4	1.4	173	<0.5
PM18AJ299	55.95	16.47	8.51	3.12	8	2.36	1.4	0.76	0.19	0.22	<0.002	99.8	604	17	1.2	17.5	3	6.1	24	1	719.5	0.4	2.9	1.4	196	1.1
PM18AJ300	58.8	17.05	7.19	2.58	4.18	4.39	2.93	0.73	0.23	0.07	<0.002	99.84	1277	15	0.6	16.3	3.9	7.1	57.4	1	480.8	0.4	3.9	2	133	1.1
PM18AJ301	56.02	17.9	6.74	3.07	6.74	5.67	0.9	0.77	0.25	0.09	<0.002	99.79	348	18	0.3	15.4	3.8	6.8	19.5	<1	707.4	0.4	3.6	1.5	184	<0.5
PM18AJ302	68.13	15.39	3.52	0.92	1.43	4.68	4.02	0.47	0.1	0.06	<0.002	99.86	1330	8	1.5	12.9	7	10.7	83.4	1	341.4	0.6	7.4	3	38	<0.5
PM18AJ303	59.77	15.28	9.36	3.3	0.73	1.26	2.88	0.65	0.2	0.08	0.003	99.86	1094	17	1.5	13.8	3.2	5.7	70	<1	224.4	0.4	2.9	1	195	0.9
PM18AJ304	67.72	14.16	4.31	1.91	1.54	3.13	3.98	0.51	0.11	0.11	<0.002	99.87	1218	10	0.6	11.9	6.2	10.4	80.4	<1	219.1	0.7	8.1	3.4	77	0.6
PM18AJ305	52.84	17.79	7.72	3.72	7.44	3.29	0.82	0.87	0.22	0.16	0.004	99.85	558	25	0.4	15.2	2.7	4.7	14	<1	470.8	0.3	2.3	0.9	221	0.5
PM18AJ306	66.02	17.13	3.73	1.17	1.04	7.35	0.62	0.54	0.11	0.06	<0.002	99.86	318	11	0.2	12.8	4.1	5.1	11	<1	462.1	0.4	3.9	1.9	80	0.7
PM18AJ307	49.01	18.38	9.72	2.49	7.64	3.67	0.69	0.93	0.21	0.39	<0.002	99.83	343	24	1	16.5	2.9	5.1	20.6	<1	489.1	0.2	2.1	1	230	0.6
PM18AJ308	49.86	17.63	10.3	4.92	7.14	3.24	1.96	0.9	0.19	0.19	<0.002	99.8	4121	30	1.6	14.4	2	3.4	41.5	<1	786.3	0.2	0.9	0.4	274	<0.5
PM18AJ309	56.12	15.14	8.38	1.33	14.88	<0.01	<0.01	0.48	0.19	0.18	0.004	99.47	30	15	<0.1	16.6	0.9	2.5	<0.1	<1	1208.5	0.1	1.5	0.7	191	0.7
PM18AJ310	64.88	15.44	4.22	1.31	2.08	4.27	3.12	0.51	0.12	0.03	<0.002	99.88	1144	11	0.9	12	5.5	9.1	64.6	3	244.3	0.7	6.4	2.8	64	<0.5
PM18AJ311	58.18	16.38	6.7	2.91	5.15	3.74	1.8	0.62	0.19	0.12	0.021	99.84	961	21	1.6	14.2	2.8	5.9	30.7	<1	448.1	0.3	3.1	1.2	169	<0.5
PM18AJ312	48.19	13.76	12.78	7.08	10.47	3.09	0.53	1.45	0.12	0.17	0.026	99.84	80	42	0.6	14.6	2	5.6	10.1	<1	267.7	0.4	0.5	0.1	336	<0.5

***All major oxides, C, and S are in wt. %; all other elements are in ppm except Au, Ag, Hg, Re, Pt, and Pd, which are in ppb.**

Appendix A:
Pemberton Hills Whole-rock Geochemistry

Sample	Zr	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Ni	LOI	TOT/C	TOT/S	Mo	Cu	Pb	Zn	Ag	Ni	Co
PM18AJ200	133.1	21.5	15.9	30.8	3.93	16.8	3.87	0.98	3.77	0.59	3.64	0.85	2.44	0.35	2.49	0.36	<10	7.1	0.05	3.11	1.22	44.15	5.5	91.4	44	8.8	17.4
PM18AJ201	116	23.8	13.7	28.4	3.83	16.3	4.09	1.09	4.43	0.7	4.36	0.92	2.81	0.39	2.63	0.42	<10	2.6	0.02	0.27	1.17	11.61	1.67	33.5	14	7.5	5.9
PM18AJ202	90.5	23	12.2	25.9	3.55	16.5	3.75	1.23	4.09	0.63	4	0.85	2.64	0.37	2.54	0.38	<10	2.5	0.05	0.06	0.36	10.05	2.3	29.9	13	1.3	8.4
PM18AJ203	160.5	29.2	16.9	34.4	4.61	20.7	4.77	1.06	5.25	0.84	5.25	1.08	3.45	0.49	3.27	0.5	<10	2.6	0.02	0.13	5.19	32.9	4.16	32.8	25	5.5	5
PM18AJ204	50	15	10.1	18.9	2.55	11.2	2.41	0.97	2.88	0.46	2.85	0.57	1.73	0.24	1.54	0.26	55	6.4	0.02	6.24	0.66	109.51	11.34	33.9	95	57.1	46.4
PM18AJ205	50.4	14.6	7.4	17.4	2.46	10.7	2.59	0.94	2.78	0.43	2.72	0.55	1.71	0.24	1.46	0.24	107	7.5	0.03	6.07	2.75	72.55	8.91	32.5	135	94.8	55.2
PM18AJ206	58.6	18.4	7.9	17.9	2.46	11.6	2.91	1.02	3.29	0.54	3.31	0.66	2.01	0.27	1.57	0.27	129	3	0.05	1.15	0.56	104.93	4.08	34.6	93	103.7	47.6
PM18AJ207	158.9	35.3	22	46.8	5.61	23.2	5.77	1.34	6.26	0.98	5.95	1.29	4.06	0.55	3.57	0.55	15	5.4	0.04	0.04	1.05	40.43	2.74	64.7	33	14.3	40.3
PM18AJ208	111	22.3	14.4	28.6	3.67	15.5	3.71	0.99	4.04	0.63	3.84	0.84	2.49	0.35	2.42	0.38	16	2.4	0.02	0.03	1.01	64.43	2.92	47	70	11.3	16.5
PM18AJ209	67.7	21.2	12.3	25.1	3.4	15.3	3.79	1.36	4.09	0.62	3.77	0.78	2.38	0.33	2.11	0.31	17	7.2	0.04	4.98	0.38	106.79	9.09	47.6	190	17.1	21.4
PM18AJ210	101.9	17.5	11.8	23.9	3.21	14.2	3.3	0.94	3.37	0.53	3.21	0.66	2.03	0.31	2.01	0.32	24	7.2	0.08	5.19	0.74	72.54	10.62	52.6	82	27.8	25.8
PM18AJ211	98.9	18.6	15.4	28	3.45	15.3	3.19	1	3.28	0.52	3.36	0.66	2.04	0.29	1.97	0.3	<10	4.5	0.03	2.7	1	49.93	2.22	63.4	36	9.7	20
PM18AJ212	114	20.3	18.3	34	4.05	17.1	3.7	1.07	3.62	0.59	3.43	0.73	2.28	0.33	2.18	0.34	<10	3.6	0.13	1.12	0.79	34.65	2.43	75.4	30	6.2	15.3
PM18AJ213	104.4	21	13	26.8	3.37	15.1	3.53	1.01	3.95	0.62	3.76	0.82	2.37	0.36	2.3	0.36	15	5.4	0.06	1.98	1.66	145.56	5.51	67.2	81	17.5	24.5
PM18AJ214	54.1	18.1	8.4	16.5	2.29	10.9	2.71	0.96	3.25	0.51	3.25	0.67	1.98	0.27	1.86	0.3	200	4.8	0.02	0.02	0.11	52.25	2.2	51.3	54	134.5	28.7
PM18AJ215	89.2	19.7	20.1	40	4.88	19.7	4.19	1.3	4	0.62	3.64	0.75	2.24	0.32	2.12	0.32	12	3.8	0.02	2.72	0.33	18.81	3.95	75.8	144	11.7	19.7
PM18AJ216	211	28.6	24.2	47.4	5.4	20.8	4.63	1.4	4.69	0.77	4.71	1.04	3.05	0.46	3.32	0.52	<10	1.8	0.03	0.02	0.15	16.11	1.27	69.3	15	1.8	8.6
PM18AJ217	41.7	9.6	9.4	17.8	2.29	9.4	2.04	0.91	2.26	0.35	1.69	0.34	1.05	0.16	0.96	0.15	13	7.9	0.08	3.7	1.79	118.02	502.15	1115.9	2370	11.4	8.7
PM18AJ218	62.2	19.1	10.9	21	2.93	13.5	3.07	1.03	3.68	0.56	3.61	0.73	2.18	0.32	2.04	0.3	20	3.9	0.02	2.78	0.27	78.53	3.76	45.8	79	19.3	30.6
PM18AJ219	53.2	18.8	10.3	20.1	2.75	11.8	3.18	1.1	3.58	0.55	3.37	0.73	2.08	0.29	1.95	0.28	30	8.1	0.19	4.75	0.93	169.71	34.63	109.1	766	30.8	37.3
PM18AJ220	60.1	17.9	8.8	18.5	2.55	11.1	2.75	1.02	3.39	0.52	3.32	0.72	2.11	0.28	1.75	0.29	69	2.3	0.02	0.46	0.5	99.79	1.09	39.4	40	46.2	26.8
PM18AJ221	76.4	21.3	13.5	26.1	3.51	15.9	3.88	1.16	3.98	0.63	3.88	0.83	2.32	0.34	2.16	0.32	18	2.3	0.03	0.17	0.72	66.82	1.03	35.1	30	14.5	17.5
PM18AJ222	58.4	17.9	9.4	19.3	2.57	11.6	2.82	0.97	3.34	0.53	3.09	0.7	2.06	0.29	1.76	0.3	68	4.6	0.05	2.33	0.17	61.61	2.79	35	135	47.8	36.9
PM18AJ223	99.8	20.3	12	22.9	2.99	13	3.09	0.95	3.34	0.55	3.62	0.77	2.31	0.35	2.35	0.38	15	7	0.01	3.97	0.83	13.12	12.06	54.4	117	17.7	10
PM18AJ224	60.4	17.9	9.8	21	2.86	12.4	3.21	1.13	3.46	0.52	3.29	0.7	1.98	0.27	1.91	0.3	35	7.6	0.04	6.24	1.14	14.53	26.13	86	186	36.6	47.3
PM18AJ225	42.9	16.1	7.2	14.3	1.92	9.7	2.43	0.85	2.93	0.47	2.92	0.62	1.78	0.24	1.6	0.27	72	4.6	0.04	1.4	0.2	72.4	1.9	62	63	59	37.2
PM18AJ226	45.2	15.9	10.9	17.7	2.46	11	2.67	0.96	2.93	0.47	2.79	0.62	1.73	0.23	1.6	0.23	45	8.4	0.04	1.81	0.48	50.15	14.93	73.9	233	40.5	21.2
PM18AJ227	138.8	25.1	16.7	33.2	4.28	18.1	4.3	1.22	4.68	0.73	4.64	0.93	2.83	0.42	2.78	0.43	<10	3.4	0.02	0.77	2.05	47.23	2.55	65.9	56	9.6	15.9
PM18AJ228	225	33.5	28.7	54.4	6.58	25.7	5.43	1.07	5.21	0.84	5.48	1.16	3.65	0.55	3.77	0.56	<10	4.5	0.03	0.01	0.15	8.46	3.06	47.6	10	3.6	4.6
PM18AJ229	44.3	15.9	5.8	11.3	1.69	7.9	2.36	0.77	2.82	0.43	2.76	0.62	1.78	0.28	1.54	0.26	210	6	0.09	0.02	0.36	60.03	3.79	108.5	54	182.5	39.9
PM18AJ230	246.1	34.4	29.2	59.3	6.88	26.9	5.78	0.97	5.51	0.89	5.67	1.15	3.75	0.56	3.75	0.58	<10	1.4	0.06	0.02	2.65	7.66	2.43	17.8	8	2.6	5.2
PM18AJ231	239.1	31.6	21.9	44.4	5.45	22.3	5.01	1.04	5.09	0.84	5.25	1.13	3.47	0.52	3.37	0.54	<10	1.3	0.03	0.02	0.59	3.06	1.3	13.1	16	3.3	6.4
PM18AJ232	220.4	31.1	18.7	44.4	5.88	24.3	5.76	1.15	5.57	0.87	5.21	1.15	3.47	0.51	3.39	0.52	<10	1.4	0.02	0.01	1.01	3.25	1.61	8.2	19	2.2	3.1
PM18AJ233	73.6	22.5	11.4	22.5	3.21	14.5	3.76	1.01	4.02	0.62	3.94	0.87	2.58	0.37	2.39	0.37	96	2.6	0.02	0.37	1.18	83.1	4.59	40	216	77	21.6
PM18AJ234	56.8	17.5	9.5	21.4	2.88	12.6	3.28	1.07	3.5	0.54	3.29	0.68	1.89	0.26	1.75	0.2	221	1.8	0.01	0.23	0.85	130.4	6.49	60.2	109	132	26.2
PM18AJ235	56.1	16.8	8.5	18.3	2.41	11.2	2.96	1.02	3.34	0.51	3.2	0.63	1.87	0.25	1.59	0.22	205	3.2	0.02	0.01	0.21	7.25	2.56	67.9	15	95	20.2
PM18AJ236	38.4	15.2	4.8	10.8	1.53	7.7	2.2	0.76	2.62	0.43	2.66	0.56	1.75	0.23	1.52	0.25	163	3.3	0.1	0.03	1.01	35.59	3.41	102.9	61	119.7	32.1
PM18AJ237	62.3	14.9	8.6	15.9	2.21	10	2.14	0.77	2.45	0.37	2.69	0.54	1.58	0.23	1.51	0.23	104	2.6	0.06	0.05	3.52	7.93	1.52	32.9	40	60	12.8
PM18AJ238	76	21.4	10.9	22	2.92	13.5	3.14	1.01	3.8	0.6	3.91	0.8	2.23	0.32	2.16	0.33	25	2.8	0.01	0.4	1.03	77.19	1.9	25.3	58	19.3	20.5
PM18AJ239	168.6	20.5	17.7	33.8	3.82	15.1	3.62	0.99	3.43	0.58	3.64	0.81	2.5	0.38	2.75	0.42	<10	2.5	0.04	0.02	1.73	13.11	1.87	62.1	58	1	5
PM18AJ240	139	25.1	20.7	40.9	4.98	20.1	4.59	1.25	4.54	0.72	4.36	0.96	2.65	0.38	2.65	0.41	24	4.7	0.03	2.78	1.6	89.05	4.09	95.2	156	20.9	20.5
PM18AJ241	108.7	23.4	16.2	31.4	4.18	18.9	4.22	1.29	4.38	0.66	4.16	0.86	2.4	0.37	2.52	0.39	<10	4.8	0.04	0.03	0.32	20.44	2.66	78.2	34	2.4	14
PM18AJ242	89	24.1	15.2	30.3	3.9	17.7	4.13	1.3	4.49	0.67	4.27	0.83	2.41	0.37	2.39	0.39	26	4	0.46	0.2	1.14	52.22	1.32	61	52	21.7	23.1
PM18AJ243	106.7	24.8	15.2	31.6	3.88	16.9	4.31	1.06	4.49	0.68	4.56	0.91	2.92	0.39	2.91	0.43	<10	6.7	0.04	<0.01	0.06	21.69	2.83	28.8	35	1.8	6.4
PM18AJ244	121.9	28.4	17.1	35.5	4.66	21.2	5.27	1.66	5.36	0.81	4.87	1.11	3.11	0.45	3.08	0.47	<10	7.8	0.05	0.01	0.16	28.25	3.36	54.3	46	1.5	12.6
PM18AJ245	159.6	29.4	18.3	36.7	4.76	21.4	4.72	1.28	5.13	0.81	4.95	1.07	3.27	0.45	3.07	0.49	11	4.2	0.03	2.21	6.73	83.5	3.5	87.5	56	10.4	19.1
PM18AJ246	130.9	25.8	17.8	36.2	4.42	19.1	4.29	1.15	4.53	0.7	4.37	0.93	2.92	0.41	2.72	0.43	<10	9.5	0.26	1.51	2.07	48.4	3.48	41.9	62	6.5	14.8
PM18AJ247	122.2	20.6	16.4	31.3	3.91	17.6	3.57	1.02	3.81	0.58	3.74	0.8	2.43	0.34	2.09	0.36	11	3.1	0.02	0.1	0.79	53.72	3.48	38.7	46	5.9	11.6
PM18AJ248	166	26.1	20	37.9	4.77	20.2	4.13	1.01	4.76	0.72	4.63	1.05	3.07	0.43	3	0.42	10	3.4	0.1	0.2	1.9	68.13	5.27	62.2	57	7.7	13.9
PM18AJ249	87.3	20.2	15.4	27.9	3.6	15.3	3.41	1.14	3.57	0.58	3.44	0.77	2.33	0.31	1.99	0.31	<10	2	0.02	0.26	2.91	130.78	8.44	76.6	180	6.8	14.4
PM18AJ250	151.4	25	16.8	32.9	4.16	18.3	3.86	0.92	4.28	0.64	4.04	0.86	2.64	0.41	2.52	0.42	13	7.7	0.88	0.75	0.19	37.3	4.01	173.1	31	10.8	14.3
PM18AJ251	104.2	18.8	16	30.9	3.99	16.8	3.8	1.22	3.63	0.57	3.38	0.71	2.02	0.3	1.98	0.32	14	3.5	0.02	0.92	0.27	61.1	2.16	76.8	122	3.6	18.4
PM18AJ252	145.9	23.7	15.3	30.7	4.1	18.3	4.16	1.24	4.35	0.68	4.33	0.89	2.66	0.39	2.63	0.42	<10	5.2	0.04	3.01	1.13	95.61	6.87	76.2	69	5.4	12.3
PM18AJ253	130.8	22.8	16	31.2	4.06	17.5	3.85	1.18	3.98	0.65	4.19	0.84	2.43	0.38	2.45	0.39	10	3.1	0.06	0.82	1.19	40.72	2.74	72.7	40	9.8	11.1
PM18AJ254	98	26.8	13.5	27.7	3.82	17.7	4.23	1.31	4.52	0.71	4.4	0.98	2.99	0.43	2.73	0.44	10	5.9	1.23	0.05	1.22	54.91	2.6	65.2	12	8.7	22.1
PM18AJ255	88.2	23.8	12.8	28.2	3.8	17	4.19	1.28	4.35	0.69	4.12	0.88	2.64	0.37	2.43	0.36	<10	4.5	0.09	0.02	0.21	13.26	1.97	44.7	34	2.3	15.9
PM18AJ256	113	28.8	16.2	32.6	4.31	18.9	4.4	1.39	4.67	0.73	4.7	0.99	3.02	0.43	2.9	0.45	<10	4.9	0.02	0.01	0.32	28.29	2.07	43.8	54	1.5	11.7

***All major oxides, C, and S are in wt. %; all other elements are in ppm except Au, Ag, Hg, Re, Pt, and Pd, which are in ppb.**

Appendix A:
Pemberton Hills Whole-rock Geochemistry

Sample	Zr	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Ni	LOI	TOT/C	TOT/S	Mo	Cu	Pb	Zn	Ag	Ni	Co
PM18AJ257	98	21.8	15	30	3.89	16.7	3.92	1.23	3.86	0.63	3.66	0.81	2.42	0.35	2.38	0.39	<10	5.1	0.21	0.03	0.41	21.54	1.99	31.3	28	1.4	11
PM18AJ258	115.8	30.1	18.8	40.1	5.34	23.1	4.91	1.43	5.02	0.77	5.04	1.09	3.27	0.47	3.24	0.51	<10	5.8	0.05	0.01	0.19	11.95	2.08	48.2	13	3.5	18.9
PM18AJ259	118.3	31.1	18.9	34.5	5.02	22.8	5.23	1.64	5.47	0.85	5.09	1.1	3.29	0.47	3.17	0.49	<10	2.9	0.05	<0.01	0.22	35.08	3.23	49.7	14	3.2	12.3
PM18AJ260	91.5	24.8	14.4	29.6	3.88	17.3	4.05	1.3	4.31	0.69	4.24	0.87	2.57	0.37	2.42	0.38	<10	5.8	0.11	2.89	7.32	13.21	6.15	68	169	6	28.6
PM18AJ261	130.7	19.8	19.2	36.6	4.42	17.1	3.58	1.06	3.51	0.57	3.31	0.72	2.15	0.32	2.09	0.35	<10	2.9	0.17	0.67	0.58	38.38	2.3	72.8	26	7.1	14.1
PM18AJ262	99.1	17.2	14.4	29.7	3.47	14.4	3.3	1	3.25	0.5	3.17	0.68	2.07	0.29	2	0.33	13	4.7	0.11	0.02	0.16	30.01	1.91	59.8	14	12.6	16.9
PM18AJ263	92.1	17.7	15.1	26.8	3.5	15	3.33	1.08	3.29	0.51	3.22	0.69	1.95	0.3	2.07	0.31	<10	8.5	0.35	0.01	0.38	3.94	3.27	47.7	11	3.9	12.4
PM18AJ264	156.1	26.9	20	39	4.92	20.2	4.57	1.2	4.67	0.75	4.41	1	2.96	0.44	2.98	0.46	<10	3.8	0.11	0.02	0.3	5.67	3.03	56.3	19	7.6	15.9
PM18AJ265	134.3	24.7	18.3	35.1	4.46	18	4.14	1.18	4.51	0.7	4.28	0.89	2.7	0.39	2.66	0.41	13	2.2	0.03	0.05	0.95	41.88	1.47	44.9	48	12.8	15.2
PM18AJ266	133.6	23.3	20.1	36.5	4.86	20.3	4.42	1.23	4.52	0.7	4.23	0.84	2.57	0.37	2.41	0.37	12	3.3	0.03	1.36	1.2	33.94	4.17	66.6	52	13.9	19.2
PM18AJ267	107.1	16.8	18.3	32.8	3.79	15	3.03	1.05	2.99	0.47	2.98	0.59	1.81	0.27	1.9	0.31	<10	1.6	0.05	0.04	5.02	19.27	33.95	31.5	235	5.6	9.5
PM18AJ268	53.1	18.4	6.1	12.9	1.91	9.8	2.68	0.98	3.27	0.53	3.38	0.65	2.11	0.29	1.9	0.28	131	3.1	0.02	0.02	0.17	0.83	2.89	35.6	24	103.7	35.1
PM18AJ269	18.1	5.4	2.4	4.9	0.72	3.6	0.89	0.37	0.99	0.16	0.92	0.2	0.58	0.08	0.51	0.08	47	3.8	0.03	<0.01	0.66	2.17	0.69	34	8	44.2	15.8
PM18AJ270	130.6	23.1	17.7	33.1	4.28	18.7	4.04	1.14	4.03	0.67	3.95	0.87	2.41	0.39	2.6	0.39	<10	2.1	0.03	0.03	0.62	12.46	3.31	42	29	4.1	10.8
PM18AJ271	72.4	18.7	4.8	12.4	2.14	11	3.04	1.04	3.31	0.52	3.35	0.7	1.99	0.3	1.9	0.29	82	2.5	0.03	0.2	1.22	44.55	1.67	23.2	32	75.6	25.3
PM18AJ272	136.1	17.9	21	36.1	4.06	15.8	2.78	0.76	2.76	0.46	2.63	0.63	1.88	0.29	2.19	0.34	<10	3.6	0.05	0.01	0.38	5.33	2.6	30.6	15	1.4	3.9
PM18AJ273	140.4	17.2	21.6	37.8	4.28	15.6	2.86	0.67	2.78	0.47	2.75	0.58	1.83	0.29	2.18	0.34	<10	1.1	0.01	<0.01	1.59	11.88	3.3	21.8	28	1.8	4.5
PM18AJ274	112.2	15.3	26.9	40.8	4.35	15.6	3.22	1.01	2.94	0.44	2.7	0.52	1.59	0.24	1.67	0.26	<10	5.6	0.45	0.09	1	1.99	1.83	73	25	4.4	11.2
PM18AJ275	70.4	19.8	20	36.4	4.8	21.7	4.81	1.64	4.72	0.66	3.94	0.76	2.17	0.3	2.01	0.3	27	5.8	0.86	1.56	5.2	261.67	3.95	89.8	406	26.4	33.6
PM18AJ276	104.7	23	13.2	28.4	3.7	16.8	3.99	1.11	4.2	0.66	4.27	0.89	2.65	0.37	2.58	0.4	<10	6.8	1.01	0.01	0.27	34.09	3.07	69.2	40	4.1	21.5
PM18AJ277	128.6	18.4	16.8	32.6	3.98	16.1	3.53	1	3.48	0.56	3.44	0.78	2.16	0.33	2.33	0.39	<10	4.1	0.47	0.04	0.22	9.18	3.25	60.5	30	7.3	14
PM18AJ278	130.3	22.3	17.7	33.9	4.27	17.5	3.88	1.12	4.04	0.64	4.1	0.86	2.62	0.36	2.49	0.38	11	7.2	0.94	0.22	0.7	38.66	1.8	42.5	26	9.2	14
PM18AJ279	116.9	23.9	16.7	32.9	4.32	18.6	4.18	1.19	4.29	0.69	4.3	0.87	2.59	0.36	2.44	0.41	<10	2.2	0.02	0.01	1	34.77	2.12	49.6	30	7	15.9
PM18AJ280	100.3	20.6	16.2	31.2	4.06	17	3.5	1.22	3.79	0.6	3.76	0.78	2.33	0.32	2.25	0.36	10	3	0.22	<0.01	0.36	25.64	1.21	60.6	22	10	17.4
PM18AJ281	179.4	16.7	22.8	39.8	4.34	16.3	3.02	0.76	2.73	0.44	2.75	0.59	1.88	0.31	2.15	0.35	<10	1.3	0.06	0.04	0.6	1.66	2.8	24.5	6	1.8	2.8
PM18AJ282	76.3	18.7	20.3	38.9	4.66	19.2	3.79	1.2	3.8	0.56	3.32	0.68	2.01	0.29	1.96	0.31	<10	5.6	0.86	0.41	0.41	1.59	4.31	39.6	12	3.8	10
PM18AJ283	100.4	21.7	14	26.8	3.47	15.8	3.58	1.09	4	0.62	3.77	0.8	2.55	0.33	2.27	0.35	20	6.7	0.1	0.23	1.26	66.98	1.12	51.1	34	16.2	17.1
PM18AJ284	87.9	20.9	15.5	28.4	3.71	16.8	3.49	1.1	3.73	0.59	3.75	0.8	2.38	0.33	2.19	0.35	<10	3.6	0.3	0.56	0.37	28.33	69.14	96.3	204	7.6	17.7
PM18AJ285	53.4	17.6	10.1	17.8	2.54	11.8	2.88	1.07	3.33	0.53	3.35	0.69	1.97	0.29	1.87	0.27	117	3.3	0.06	0.06	0.54	63.8	1.34	37.2	78	105.3	27.6
PM18AJ286	103.7	23.3	14.7	29.6	3.95	17.3	3.88	1.13	4.2	0.68	3.93	0.88	2.5	0.4	2.44	0.39	15	3.7	0.04	0.02	0.46	357.3	2.16	90	510	17.5	33
PM18AJ287	126.6	12.9	15.7	26.1	2.94	10.9	2.08	0.71	2.17	0.32	2	0.47	1.37	0.22	1.63	0.26	<10	1.6	0.02	0.01	0.85	3.14	7.11	28.7	28	2.1	5
PM18AJ288	51.4	5.4	6.7	6.1	1.22	4.9	0.68	0.07	0.79	0.13	0.63	0.16	0.59	0.07	0.58	0.12	67	-0.6	0.03	0.55	2.04	175.94	0.82	60.5	151	45.2	28.8
PM18AJ289	91.7	14.4	13.8	28.1	3.41	12.4	2.24	0.45	2.08	0.34	2.07	0.47	1.56	0.24	1.81	0.3	<10	1.1	0.08	0.02	2.62	4.04	2.77	57	22	1.1	0.9
PM18AJ290	120.6	23.4	16.9	33.7	4.32	18.5	3.99	1.3	4.28	0.67	3.81	0.85	2.58	0.39	2.48	0.42	11	3	0.04	0.15	0.79	49.06	1.62	36.9	218	10.8	15.3
PM18AJ291	84.1	16.2	10.4	24.1	3.12	13.3	3	0.81	2.93	0.46	2.8	0.59	1.8	0.27	1.75	0.27	<10	10.8	1.68	3.57	2.84	20.47	5.03	40.9	98	6.8	13.5
PM18AJ292	92.7	23.9	14.6	29	3.98	18.1	3.96	1.32	4.43	0.69	4.14	0.91	2.56	0.37	2.48	0.39	<10	5.9	0.26	0.01	0.61	33.79	2.17	59.6	12	8.1	25.5
PM18AJ293	111	23.9	16.2	32.1	4.26	18.8	4.26	1.31	4.39	0.68	4.08	0.89	2.57	0.37	2.52	0.4	<10	8.3	0.05	0.43	0.58	41.01	4.19	74.6	49	7.7	22.4
PM18AJ294	112.3	22.5	13.2	26.4	3.46	15.2	3.54	1	3.88	0.62	3.84	0.86	2.52	0.41	2.44	0.37	13	3.2	0.03	0.02	1.53	58.7	1.5	42.5	32	11.6	18.3
PM18AJ295	100.1	22.4	17.4	35	4.36	18.6	4.04	1.3	4.29	0.66	3.9	0.78	2.42	0.34	2.28	0.35	<10	5.5	0.07	2.66	1.22	24.48	6.4	87.6	43	7	16.7
PM18AJ296	131.8	25.4	16.3	32	4.13	17.7	4.08	1.08	4.46	0.7	4.33	0.95	2.79	0.39	2.72	0.41	16	3.4	0.17	0.12	2.37	61.97	2.18	46.7	40	15.6	16.2
PM18AJ297	241.4	36	25.3	50.7	6.25	26	5.85	1.15	6.11	0.98	5.99	1.36	4.23	0.63	4.01	0.64	<10	2.4	0.03	1.18	13.37	36.59	11.67	25.6	52	1.7	4.5
PM18AJ298	129.1	25.5	18.9	36.6	4.68	20.4	4.39	1.36	4.67	0.72	4.43	0.9	2.78	0.4	2.81	0.41	<10	1.8	0.02	0.02	1.47	23.52	3.39	36.8	37	3.6	8.1
PM18AJ299	112.2	23.4	18.5	32.8	4.08	16.8	3.84	1.2	4.3	0.65	4.01	0.87	2.7	0.38	2.29	0.39	<10	2.8	0.04	0.02	0.5	5.95	10.98	63.6	23	3.9	8.9
PM18AJ300	149.5	24.4	21	42	5.2	21.6	4.75	1.38	4.74	0.74	4.3	0.91	2.73	0.41	2.68	0.43	<10	1.6	0.06	0.17	2.02	14.24	4.04	35.4	37	4.3	7.8
PM18AJ301	141.3	25.7	21	38.5	4.86	21.1	4.53	1.23	4.78	0.72	4.51	0.93	2.82	0.42	2.8	0.44	<10	1.6	0.03	1.14	2.25	170.03	1.96	12.1	72	9.5	28.5
PM18AJ302	256.9	32.7	26.8	51.2	6.36	26.1	5.55	1.06	5.54	0.9	5.46	1.2	3.64	0.52	3.72	0.6	<10	1	0.02	0.01	1.7	4.35	3.35	16.3	17	1.4	3.4
PM18AJ303	119.8	22.7	18	34.8	4.12	17.6	3.76	1.21	4.09	0.63	3.84	0.85	2.68	0.37	2.53	0.4	16	6.2	0.02	4.43	1.06	43.41	5.89	34.1	45	16.3	19.3
PM18AJ304	220	28	25.3	47	5.68	22.3	4.69	0.87	4.79	0.75	4.74	1.04	3.19	0.46	3.1	0.49	37	2.3	0.09	0.84	3.88	27.13	3.04	51.9	27	3.1	7.5
PM18AJ305	102.9	20.4	14.2	28.1	3.58	15.3	3.57	1.15	3.92	0.6	3.74	0.76	2.29	0.33	2.23	0.36	23	4.9	0.63	0.28	0.49	32.42	1.62	53.7	15	14.5	18.3
PM18AJ306	153.2	20.7	16.4	31.1	3.74	15.3	3	0.95	3.33	0.52	3.34	0.73	2.29	0.33	2.2	0.37	<10	2.1	0.09	0.02	0.15	19.25	6.1	53	34	2.1	7.9
PM18AJ307	102.7	22.8	15.3	30.1	3.86	16.9	3.84	1.17	4.13	0.64	3.85	0.85	2.5	0.35	2.3	0.37	<10	6.7	1.08	0.2	0.38	57.83	0.84	84.3	7	8.5	21.8
PM18AJ308	66.1	19.1	9.9	20.2	2.75	13.5	2.98	1.11	3.48	0.53	3.31	0.7	2.07	0.29	1.85	0.3	12	3	0.03	0.05	0.98	2.01	1	54.2	5	11.2	20.5
PM18AJ309	28.8	10.4	12.4	22.8	2.75	12.2	2.59	1.06	2.49	0.33	1.91	0.37	1.2	0.15	1.04	0.16	10	2.8	0.47	0.32	2.55	271.52	2.81	2306.2	254	10.8	28.8
PM18AJ310	192.2	24.7	20.9	41.5	4.95	19.2	4.02	0.94	4.31	0.67	4.31	0.91	2.89	0.42	2.83	0.46	<10	3.8	0.03	2.11	1.49	5.3	3.61	12.8	19	2.6	4.4
PM18AJ311	104.8	18.3	17.8	33.5	3.85	15.8	3.07	0.93	3.2	0.53	3.23	0.66	2.11	0.3	1.95	0.3	35	3.9	0.56	0.04	0.56	16.94	2.12	50.5	18	31.7	14.6
PM18AJ312	75.7	20.6	6.1	14.8	2.06	10.7	3	1.11	3.91	0.61	3.88	0.82	2.41	0.32	1.99	0.29	102	2.1	0.03	0.01	0.37	45.33	0.6	47.4	22	46.9	25.3

***All major oxides, C, and S are in wt. %; all other elements are in ppm except Au, Ag, Hg, Re, Pt, and Pd, which are in ppb.**

Appendix A:
Pemberton Hills Whole-rock Geochemistry

Sample	Mn	As	Au	Cd	Sb	Bi	Cr	B	Tl	Hg	Se	Te	Ge	In	Re	Be	Li	Pd	Pt	F
PM18AJ200	1326	7.2	1.5	0.04	0.25	0.11	15	<1	0.06	128	7.3	0.86	0.1	0.09	<1	0.2	7.5	<10	2	311
PM18AJ201	533	1.3	1.7	0.07	0.05	0.06	16.4	2	0.03	12	0.6	0.05	<0.1	<0.02	5	<0.1	4.4	<10	<2	617
PM18AJ202	517	1.1	2.8	0.12	0.05	<0.02	2.3	1	0.05	13	<0.1	0.05	0.1	<0.02	1	0.2	3.7	<10	<2	188
PM18AJ203	431	1.3	2.9	0.12	0.09	<0.02	12.1	3	0.03	13	<0.1	0.04	0.2	<0.02	4	0.7	3.2	<10	<2	1078
PM18AJ204	477	6.4	2.9	0.12	0.11	0.29	57.4	1	0.02	667	15.5	1.2	<0.1	<0.02	<1	0.3	6.6	<10	<2	169
PM18AJ205	390	3.6	3.7	0.07	0.15	0.14	59.6	<1	0.04	761	7.3	1.53	0.1	<0.02	1	<0.1	9.4	<10	<2	270
PM18AJ206	391	14.3	1.7	0.08	0.47	0.07	202	2	0.02	65	2.8	1.14	<0.1	<0.02	<1	0.2	11.3	<10	<2	168
PM18AJ207	673	2.2	1.8	0.11	0.08	<0.02	8.8	1	0.02	63	<0.1	0.05	<0.1	0.04	<1	0.5	11.7	<10	<2	411
PM18AJ208	493	0.6	1.6	0.05	0.05	<0.02	14	3	0.02	251	<0.1	<0.02	<0.1	<0.02	<1	<0.1	7.7	<10	<2	385
PM18AJ209	632	<0.1	2.9	0.12	0.16	1.1	15.7	2	0.03	26	11.1	0.46	0.1	0.06	1	0.3	10.1	<10	<2	202
PM18AJ210	1048	0.2	2.5	0.09	0.11	0.38	25.4	<1	0.05	45	7.7	0.34	0.1	0.03	<1	<0.1	15.9	<10	<2	327
PM18AJ211	851	10.7	1.8	0.01	0.26	0.05	12.8	<1	0.02	<5	1.8	3.46	0.1	<0.02	<1	0.4	5.6	<10	<2	233
PM18AJ212	1267	2.5	1.8	0.02	0.13	0.02	5.5	2	0.04	<5	0.3	0.26	0.1	0.03	<1	0.2	10.9	<10	<2	161
PM18AJ213	1213	0.3	1.6	0.03	0.12	0.08	14.9	1	0.12	<5	1.8	0.05	0.2	0.06	1	0.2	11.1	<10	3	719
PM18AJ214	633	4.4	1.5	<0.01	0.16	<0.02	200.6	5	0.02	11	0.1	0.04	0.1	<0.02	<1	<0.1	12.9	<10	2	350
PM18AJ215	746	5.5	5	0.02	0.09	0.1	14.4	1	<0.02	27	5	3.17	0.1	<0.02	<1	0.2	9.9	<10	<2	219
PM18AJ216	1081	0.5	1.8	<0.01	0.1	0.03	1.5	2	<0.02	<5	<0.1	0.02	0.2	<0.02	<1	0.2	7	<10	<2	215
PM18AJ217	1061	2.7	7	14.4	0.26	2.96	17.8	1	<0.02	88	20.9	1.15	0.2	<0.02	1	0.5	6.9	<10	<2	217
PM18AJ218	471	3.5	1.3	0.12	0.06	0.06	19.1	2	<0.02	154	0.9	0.6	<0.1	<0.02	1	0.2	8.4	<10	<2	192
PM18AJ219	1648	2.2	6.3	0.2	0.21	0.26	41.4	2	0.02	135	3.6	1.76	<0.1	0.04	<1	0.2	27	<10	<2	243
PM18AJ220	285	6.8	<0.2	0.1	0.05	<0.02	37.6	5	<0.02	5	0.4	<0.02	<0.1	<0.02	<1	<0.1	5.6	<10	<2	81
PM18AJ221	535	<0.1	4.2	0.02	0.12	<0.02	13.3	2	<0.02	21	<0.1	<0.02	<0.1	<0.02	<1	0.1	9.5	<10	<2	147
PM18AJ222	478	8.8	4.2	0.03	0.21	0.54	69	4	0.03	464	2.5	2.09	<0.1	<0.02	<1	0.4	17.9	<10	<2	387
PM18AJ223	657	0.8	2.8	0.03	0.07	0.35	13.4	2	0.06	<5	6.9	0.47	<0.1	0.02	<1	0.3	9.8	<10	<2	262
PM18AJ224	1617	21.3	2.9	0.1	0.22	0.96	45.2	2	0.05	1700	5.7	2.15	0.1	0.03	<1	0.2	13.1	<10	<2	242
PM18AJ225	589	1.2	3.2	0.02	0.1	<0.02	37.6	3	0.03	74	<0.1	<0.02	<0.1	<0.02	<1	0.1	18	12	<2	127
PM18AJ226	556	1.9	1.4	0.29	0.12	0.28	117.7	2	0.04	343	10	0.64	0.2	<0.02	<1	0.2	15.3	<10	<2	110
PM18AJ227	788	4.7	1.5	0.07	0.33	<0.02	16.2	3	0.06	14	0.3	0.16	0.3	0.03	<1	0.7	7.8	<10	<2	329
PM18AJ228	439	0.4	1.6	0.03	0.05	0.02	4.1	<1	0.03	15	<0.1	<0.02	<0.1	<0.02	<1	0.3	4.8	<10	<2	392
PM18AJ229	816	7.8	0.6	0.07	0.05	<0.02	294.2	2	0.02	25	<0.1	<0.02	0.1	<0.02	<1	0.1	32.8	10	3	98
PM18AJ230	213	2.8	1.1	<0.01	0.11	<0.02	5.2	2	<0.02	16	<0.1	<0.02	0.2	<0.02	<1	0.5	3.3	<10	<2	467
PM18AJ231	186	3.7	2.7	<0.01	0.16	<0.02	6	2	0.02	9	<0.1	<0.02	0.1	<0.02	<1	0.1	4.1	<10	<2	440
PM18AJ232	128	2.2	0.6	0.03	0.13	<0.02	5.8	2	<0.02	10	<0.1	<0.02	0.1	<0.02	<1	0.3	2.7	<10	<2	519
PM18AJ233	312	5.5	1.7	0.17	0.22	0.04	67.6	3	0.04	15	<0.1	0.16	0.1	<0.02	<1	0.3	7	<10	<2	316
PM18AJ234	404	5.3	1.2	0.38	0.1	0.06	141.6	3	0.09	7	0.1	<0.02	<0.1	0.02	2	0.3	3.8	<10	<2	213
PM18AJ235	566	1	1.4	0.15	0.09	<0.02	208.1	4	0.13	<5	<0.1	0.04	0.1	0.02	<1	0.3	15.3	<10	<2	194
PM18AJ236	923	0.9	1.5	0.03	0.18	0.03	248.9	4	<0.02	8	0.1	0.14	0.1	<0.02	1	<0.1	8.2	<10	5	237
PM18AJ237	623	1.8	2.2	0.04	0.24	0.08	151.3	7	0.03	28	<0.1	0.7	0.1	0.03	9	0.2	9.5	<10	<2	299
PM18AJ238	337	6.3	1.1	0.08	0.11	0.09	12.6	5	0.05	18	<0.1	<0.02	<0.1	<0.02	<1	0.2	16.2	<10	<2	231
PM18AJ239	836	1.1	1	0.08	0.08	0.02	1.3	2	0.06	5	<0.1	<0.02	<0.1	<0.02	<1	0.2	9.5	<10	<2	237
PM18AJ240	933	11	2	0.17	0.31	0.25	54.3	2	0.04	47	2.2	0.9	0.1	<0.02	1	0.5	13	<10	<2	346
PM18AJ241	684	2.3	0.7	0.36	0.08	<0.02	1.7	2	0.03	12	<0.1	<0.02	0.1	<0.02	<1	0.4	7.9	<10	<2	218
PM18AJ242	1179	5.4	4	0.16	0.09	<0.02	41.6	1	0.02	9	<0.1	0.02	<0.1	0.03	<1	0.3	14.1	<10	<2	224
PM18AJ243	358	2	1.1	0.02	0.03	<0.02	0.9	1	<0.02	<5	<0.1	<0.02	<0.1	0.02	<1	0.5	1.1	<10	<2	242
PM18AJ244	1366	0.2	0.4	0.05	0.03	<0.02	0.9	4	<0.02	<5	<0.1	<0.02	0.1	0.04	<1	0.7	5.8	<10	<2	493
PM18AJ245	769	2.6	1.8	0.27	0.09	0.07	15.4	1	0.05	8	4.2	0.16	0.2	0.06	51	0.2	5	<10	<2	620
PM18AJ246	636	41.8	4.8	0.06	0.19	0.12	12.1	1	0.04	8	2.6	0.43	<0.1	0.04	2	0.3	12.3	<10	<2	312
PM18AJ247	347	3	0.9	0.12	0.09	0.04	9.2	2	0.03	19	0.4	0.21	<0.1	<0.02	2	0.3	6.4	<10	<2	382
PM18AJ248	523	2.4	<0.2	0.07	0.12	0.03	15	2	0.04	<5	<0.1	<0.02	<0.1	0.02	<1	0.3	6.8	<10	<2	358
PM18AJ249	421	1.5	<0.2	0.24	0.06	0.06	17.4	2	0.03	39	0.1	0.22	<0.1	<0.02	5	0.2	5.3	<10	<2	234
PM18AJ250	1612	1.9	0.4	0.12	<0.02	0.04	24.9	<1	<0.02	25	0.7	<0.02	<0.1	0.04	<1	0.5	11.3	<10	<2	274
PM18AJ251	746	6.7	<0.2	0.03	0.24	<0.02	2.4	<1	0.03	5	<0.1	0.26	<0.1	<0.02	<1	0.2	12.5	<10	<2	214
PM18AJ252	400	6.6	4.8	0.15	0.14	0.12	7.9	<1	0.05	<5	4.2	2.41	<0.1	0.04	17	0.1	3.6	<10	<2	652
PM18AJ253	759	1.8	<0.2	0.03	0.09	<0.02	22	2	0.13	<5	<0.1	<0.02	0.2	0.05	<1	0.2	5.1	<10	<2	219
PM18AJ254	1570	1.5	<0.2	0.08	0.04	<0.02	14.6	26	<0.02	8	<0.1	<0.02	0.5	0.09	<1	0.6	7	<10	3	195
PM18AJ255	1094	0.2	<0.2	0.01	0.02	<0.02	0.9	2	<0.02	<5	<0.1	<0.02	0.1	0.04	<1	0.7	5.9	<10	<2	212
PM18AJ256	581	0.5	<0.2	0.19	<0.02	<0.02	0.7	10	<0.02	26	<0.1	<0.02	0.1	0.03	<1	0.5	4.4	<10	<2	184

***All major oxides, C, and S are in wt. %; all other elements are in ppm except Au, Ag, Hg, Re, Pt, and Pd, which are in ppb.**

Appendix A:
Pemberton Hills Whole-rock Geochemistry

Sample	Mn	As	Au	Cd	Sb	Bi	Cr	B	Tl	Hg	Se	Te	Ge	In	Re	Be	Li	Pd	Pt	F
PM18AJ257	601	0.3	<0.2	<0.01	0.03	<0.02	0.8	2	<0.02	<5	<0.1	<0.02	<0.1	0.03	<1	0.3	1.8	<10	<2	255
PM18AJ258	950	<0.1	<0.2	0.05	<0.02	<0.02	1.8	3	<0.02	<5	<0.1	<0.02	0.2	0.04	<1	0.5	5.6	<10	<2	281
PM18AJ259	903	<0.1	<0.2	0.11	0.03	<0.02	2.8	16	<0.02	<5	<0.1	<0.02	<0.1	0.04	<1	0.8	3.2	<10	<2	361
PM18AJ260	1773	7.6	5.8	0.03	0.17	0.58	3.4	1	0.1	75	0.7	1.6	<0.1	<0.02	2	0.2	14.6	<10	<2	405
PM18AJ261	663	1.5	1.1	0.09	0.05	<0.02	11.6	1	0.02	<5	<0.1	0.08	<0.1	<0.02	1	0.4	6.8	<10	<2	186
PM18AJ262	738	0.5	<0.2	0.05	0.04	<0.02	11.3	<1	0.02	<5	<0.1	<0.02	<0.1	0.02	<1	0.1	11.1	<10	<2	244
PM18AJ263	729	0.7	1.6	0.03	0.06	0.07	5.7	<1	0.02	<5	<0.1	0.05	<0.1	0.04	<1	0.3	8.6	<10	<2	208
PM18AJ264	859	0.9	0.4	0.03	0.04	<0.02	6.9	2	<0.02	<5	<0.1	<0.02	<0.1	<0.02	<1	0.3	10.5	<10	<2	234
PM18AJ265	851	0.7	<0.2	0.05	0.13	<0.02	26.8	2	0.02	25	<0.1	<0.02	0.2	0.02	<1	0.3	8.8	<10	<2	316
PM18AJ266	894	2.9	0.5	0.03	0.14	<0.02	18.3	<1	0.07	64	0.3	0.08	<0.1	<0.02	<1	0.2	12	<10	<2	386
PM18AJ267	341	7.1	0.9	0.08	0.41	0.1	5.7	4	0.03	41	<0.1	0.14	0.2	0.04	<1	0.6	7.4	13	<2	227
PM18AJ268	304	80.2	<0.2	0.02	0.06	0.07	223.2	<1	0.04	18	<0.1	<0.02	0.1	<0.02	<1	0.3	16.7	<10	<2	169
PM18AJ269	525	6.8	<0.2	0.23	0.07	0.07	22.5	2	<0.02	<5	<0.1	<0.02	0.5	<0.02	<1	1.2	5.8	<10	<2	143
PM18AJ270	562	0.6	<0.2	0.06	0.12	0.11	3.3	4	0.03	<5	<0.1	<0.02	0.2	0.02	<1	0.2	5.2	11	<2	308
PM18AJ271	210	6.8	0.2	0.13	0.07	0.05	133.7	6	0.13	8	0.3	<0.02	<0.1	<0.02	5	0.4	9.3	<10	3	383
PM18AJ272	388	1	<0.2	0.02	0.13	0.03	2.3	1	<0.02	8	<0.1	<0.02	<0.1	<0.02	<1	0.4	3.5	<10	<2	262
PM18AJ273	320	0.8	<0.2	0.03	0.05	0.03	3.9	1	<0.02	11	<0.1	<0.02	0.1	<0.02	<1	0.2	5.4	<10	<2	288
PM18AJ274	1143	3.2	0.6	0.02	0.29	0.37	3	<1	0.03	21	<0.1	<0.02	0.2	0.04	<1	0.3	4.5	<10	<2	268
PM18AJ275	704	12.4	4.4	0.16	0.71	0.05	26.2	<1	0.08	29	0.1	0.16	0.3	0.04	6	0.4	8	<10	<2	448
PM18AJ276	2615	0.3	1	0.09	0.03	<0.02	5.8	1	<0.02	7	<0.1	<0.02	0.1	0.05	<1	0.5	13.1	<10	<2	230
PM18AJ277	1078	0.7	0.6	<0.01	0.25	<0.02	11.5	<1	0.08	14	<0.1	<0.02	0.1	0.02	<1	0.4	16.8	<10	<2	233
PM18AJ278	1061	9.3	<0.2	0.04	0.16	<0.02	15	<1	<0.02	<5	<0.1	0.03	0.2	0.04	<1	0.2	12.3	<10	3	370
PM18AJ279	768	1.3	1.5	0.04	0.04	0.02	7.1	3	0.03	8	<0.1	<0.02	0.1	<0.02	<1	0.1	9.8	<10	<2	460
PM18AJ280	1505	0.4	0.6	<0.01	0.13	<0.02	13.2	1	<0.02	<5	<0.1	<0.02	<0.1	0.04	<1	0.2	8.5	<10	<2	272
PM18AJ281	552	2	0.3	0.05	0.16	0.03	3.2	<1	0.02	5	<0.1	<0.02	0.1	<0.02	<1	0.2	4	<10	<2	194
PM18AJ282	653	4.1	0.9	<0.01	0.51	<0.02	3.7	7	0.08	43	<0.1	<0.02	0.1	<0.02	<1	0.4	7.2	<10	<2	329
PM18AJ283	510	4.2	<0.2	0.03	0.17	<0.02	39.8	1	0.02	9	<0.1	<0.02	0.2	<0.02	<1	0.4	6.3	<10	<2	390
PM18AJ284	1227	5.4	4.5	0.17	0.48	<0.02	5.5	5	0.06	10	0.6	0.07	0.1	0.02	<1	0.2	16.5	<10	<2	339
PM18AJ285	680	11.5	<0.2	0.05	0.2	0.12	211.9	6	0.04	14	0.3	0.12	0.2	0.03	<1	0.1	28.1	<10	3	214
PM18AJ286	1500	0.5	<0.2	0.09	0.07	<0.02	50.9	1	<0.02	<5	<0.1	<0.02	0.1	<0.02	<1	0.2	28.7	<10	<2	290
PM18AJ287	496	2.5	<0.2	<0.01	0.06	0.03	3.4	1	<0.02	134	<0.1	<0.02	0.1	<0.02	<1	0.4	9.1	<10	<2	203
PM18AJ288	928	58.6	1.7	0.08	0.09	0.09	1.3	<1	0.03	<5	16.4	0.28	<0.1	<0.02	12	<0.1	2.1	<10	<2	37
PM18AJ289	253	2.1	27.7	0.25	0.11	0.48	2.5	<1	0.02	13	0.2	0.03	0.1	0.03	2	0.5	0.7	<10	<2	50
PM18AJ290	648	3.5	0.6	0.04	0.19	<0.02	12.8	2	0.05	13	<0.1	0.09	0.1	<0.02	<1	0.2	9.2	<10	<2	258
PM18AJ291	733	43.6	1.1	0.13	0.34	<0.02	4.8	<1	0.1	307	0.5	0.43	<0.1	<0.02	<1	0.4	8	<10	<2	309
PM18AJ292	1087	1.4	<0.2	0.08	<0.02	<0.02	4	38	<0.02	<5	<0.1	<0.02	0.4	0.08	<1	0.8	1.8	15	2	238
PM18AJ293	971	2.4	0.4	0.09	0.06	<0.02	9.7	4	0.04	152	<0.1	<0.02	0.1	0.05	<1	0.5	9.4	57	<2	208
PM18AJ294	537	2.1	1.2	0.09	0.14	<0.02	13	3	0.06	12	<0.1	<0.02	0.1	<0.02	<1	0.3	8.1	<10	3	197
PM18AJ295	1498	5.2	2.8	0.07	0.37	0.19	6.5	<1	0.13	53	2	0.2	0.2	0.06	<1	0.1	9.9	<10	<2	401
PM18AJ296	818	4.7	3.8	0.07	0.2	<0.02	25.3	<1	0.03	<5	<0.1	0.07	0.2	0.05	<1	0.3	5.9	<10	3	509
PM18AJ297	340	0.9	3.1	0.02	0.15	0.08	2.9	<1	0.17	18	5.5	0.17	<0.1	0.03	42	0.4	2.8	<10	2	529
PM18AJ298	239	0.9	1.9	0.33	0.07	0.04	5.4	<1	0.02	79	<0.1	<0.02	<0.1	<0.02	<1	0.1	4.1	<10	<2	295
PM18AJ299	670	0.6	<0.2	0.13	0.29	0.06	3.9	<1	0.03	21	<0.1	<0.02	0.2	<0.02	<1	0.3	5.6	<10	<2	280
PM18AJ300	345	4.4	0.3	0.16	0.17	0.07	5.1	1	0.03	7	<0.1	<0.02	0.1	0.03	2	0.4	6.8	<10	<2	399
PM18AJ301	109	0.6	<0.2	0.08	0.11	0.14	4	3	0.04	<5	1.7	<0.02	<0.1	<0.02	<1	0.3	1.5	<10	<2	170
PM18AJ302	267	1	0.4	0.02	0.07	<0.02	3.7	2	0.03	13	<0.1	<0.02	0.1	0.04	<1	0.5	5.8	<10	<2	362
PM18AJ303	615	<0.1	1.1	0.06	0.05	0.21	8.2	<1	0.13	19	3.9	0.04	<0.1	0.03	2	0.4	11.3	<10	<2	279
PM18AJ304	654	2.5	<0.2	0.04	0.12	0.06	5	<1	0.04	6	0.7	0.2	<0.1	<0.02	<1	0.3	7.1	<10	<2	447
PM18AJ305	1171	1.2	<0.2	0.05	0.09	<0.02	31	2	<0.02	<5	<0.1	<0.02	0.2	0.06	<1	0.3	20.8	<10	3	255
PM18AJ306	442	0.3	<0.2	0.1	0.07	<0.02	3.8	1	0.03	<5	<0.1	<0.02	0.2	0.04	<1	0.4	3.6	<10	<2	138
PM18AJ307	3083	0.5	<0.2	0.02	0.11	<0.02	6.4	<1	0.04	45	<0.1	<0.02	0.1	0.03	<1	0.4	27	<10	<2	156
PM18AJ308	717	8.1	<0.2	<0.01	0.06	<0.02	10.5	381	<0.02	<5	<0.1	<0.02	0.1	<0.02	1	<0.1	11.8	<10	<2	156
PM18AJ309	625	18.6	<0.2	25.85	0.44	<0.02	15	<1	<0.02	71	0.6	0.14	0.2	0.03	<1	0.3	4.5	<10	<2	191
PM18AJ310	221	3.6	<0.2	0.06	0.04	0.31	3.8	2	0.04	37	0.7	0.1	<0.1	<0.02	<1	0.5	4.5	<10	<2	396
PM18AJ311	787	2.5	<0.2	0.08	0.06	<0.02	99	4	<0.02	8	<0.1	<0.02	0.2	0.04	<1	0.1	10	<10	<2	178
PM18AJ312	446	0.9	1.8	0.03	<0.02	<0.02	12	6	<0.02	<5	<0.1	<0.02	0.1	<0.02	<1	0.3	5.1	15	3	99

***All major oxides, C, and S are in wt. %; all other elements are in ppm except Au, Ag, Hg, Re, Pt, and Pd, which are in ppb.**

Appendix B:
Pemberton Hills Zircon Geochronology Data (CA-TIMS)

Sample	Wt.	U	Pb	Th/U	$^{206}Pb^*$ x10^{-13} mol	mol % $^{206}Pb^*$	Pb^*/Pb_c	Pb_c (pg)	$^{206}Pb/^{204}Pb$	$^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	% err	$^{207}Pb/^{235}U$	% err	$^{206}Pb/^{238}U$	% err	corr. coef.	$^{207}Pb/^{206}Pb$	±	$^{207}Pb/^{235}U$	±	$^{206}Pb/^{238}U$	±
(a)	(b)	(c)	(c)	(d)	(e)	(e)	(e)	(e)	(f)	(g)	(g)	(h)	(g)	(h)	(g)	(h)		(i)	(h)	(i)	(h)	(i)	(h)
PM18AJ203																							
B	0.0129	247	7.4	0.720	3.598	99.92%	415	0.23	23922	0.229	0.04951	0.108	0.1847	0.234	0.02706	0.171	0.904	172.0	2.5	172.09	0.37	172.09	0.29
D	0.0053	199	6.0	0.767	1.191	99.72%	116	0.28	6601	0.244	0.04954	0.225	0.1847	0.284	0.02704	0.101	0.702	173.6	5.2	172.13	0.45	172.02	0.17
F	0.0058	453	13.8	0.805	2.958	99.84%	203	0.39	11494	0.256	0.04951	0.131	0.1844	0.229	0.02701	0.143	0.852	172.1	3.1	171.81	0.36	171.79	0.24
G	0.0147	241	7.1	0.697	3.975	99.87%	248	0.42	14418	0.222	0.04955	0.216	0.1841	0.294	0.02695	0.146	0.711	173.8	5.1	171.60	0.46	171.43	0.25
H	0.0069	73	2.2	0.472	0.571	98.49%	20	0.72	1229	0.150	0.04947	0.709	0.1850	0.775	0.02712	0.134	0.557	170	17	172.4	1.2	172.51	0.23
I	0.0054	299	9.1	0.767	1.828	99.71%	111	0.44	6320	0.244	0.04950	0.144	0.1851	0.221	0.02712	0.110	0.828	171.8	3.4	172.45	0.35	172.50	0.19
J	0.0035	246	7.5	0.726	0.976	99.58%	76	0.34	4389	0.231	0.04951	0.247	0.1853	0.305	0.02715	0.102	0.684	171.9	5.8	172.62	0.48	172.67	0.17
PM18AJ289																							
A	0.0063	96	2.8	0.455	0.678	98.72%	23	0.72	1445	0.145	0.04966	0.525	0.1849	0.585	0.02700	0.125	0.564	179	12	172.23	0.93	171.72	0.21
B	0.0028	234	6.8	0.538	0.736	99.17%	37	0.51	2226	0.171	0.04948	0.369	0.1843	0.423	0.02701	0.100	0.625	170.6	8.6	171.73	0.67	171.80	0.17
C	0.0030	143	4.1	0.445	0.484	98.93%	28	0.43	1730	0.142	0.04952	0.633	0.1848	0.694	0.02706	0.122	0.566	173	15	172.2	1.1	172.12	0.21
D	0.0015	77	2.6	0.173	0.156	97.24%	10	0.36	671	0.055	0.05031	1.992	0.2243	2.126	0.03233	0.186	0.739	209	46	205.5	4.0	205.14	0.38
E	0.0034	138	3.9	0.428	0.528	99.26%	40	0.32	2515	0.136	0.04944	0.352	0.1847	0.408	0.02710	0.107	0.617	168.6	8.2	172.12	0.65	172.38	0.18
PM18AJ248																							
A	0.0050	446	14.0	0.859	2.523	99.59%	80	0.86	4471	0.273	0.04949	0.180	0.1851	0.248	0.02712	0.107	0.770	171.0	4.2	172.42	0.39	172.52	0.18
B	0.0062	424	12.7	0.728	2.972	99.91%	370	0.21	21302	0.232	0.04955	0.093	0.1851	0.197	0.02710	0.129	0.920	173.7	2.2	172.47	0.31	172.38	0.22
C	0.0460	49	1.5	0.901	2.533	99.86%	232	0.30	12801	0.287	0.04953	0.106	0.1847	0.189	0.02704	0.103	0.907	173.1	2.5	172.09	0.30	172.01	0.17
D	0.0073	239	7.2	0.705	1.978	99.87%	247	0.21	14299	0.224	0.04955	0.110	0.1858	0.189	0.02719	0.096	0.901	174.1	2.6	173.00	0.30	172.92	0.16
E	0.0016	390	12.1	0.770	0.705	99.15%	38	0.50	2178	0.245	0.04955	0.340	0.1850	0.397	0.02708	0.106	0.628	173.8	7.9	172.36	0.63	172.26	0.18
PM18AJ273																							
A	0.0048	58	1.7	0.502	0.315	99.08%	33	0.24	2016	0.160	0.04975	0.417	0.1856	0.485	0.02706	0.160	0.565	183.3	9.7	172.87	0.77	172.11	0.27
B	0.0041	97	2.8	0.478	0.447	99.24%	40	0.28	2444	0.152	0.04969	0.382	0.1857	0.438	0.02711	0.110	0.605	180.5	8.9	172.98	0.70	172.43	0.19
C	0.0039	144	4.2	0.604	0.633	99.40%	51	0.32	3060	0.193	0.04931	0.579	0.1844	0.649	0.02712	0.170	0.517	163	14	171.8	1.0	172.47	0.29
D	0.0020	130	3.8	0.536	0.294	99.20%	38	0.19	2317	0.171	0.04963	0.569	0.1853	0.641	0.02708	0.175	0.522	178	13	172.6	1.0	172.25	0.30
E	0.0061	84	2.4	0.523	0.576	99.50%	60	0.24	3684	0.166	0.04940	0.255	0.1845	0.344	0.02709	0.175	0.697	166.7	6.0	171.96	0.54	172.34	0.30

(a) A, B, 1, 2 etc. are labels for fractions composed of single zircon grains or fragments; all fractions annealed and chemically abraded after Mattinson (2005) and Scoates and Friedman (2008).

(b) Nominal fraction weights estimated from photomicrographic grain dimensions, adjusted for partial dissolution during chemical abrasion.

(c) Nominal U and total Pb concentrations subject to uncertainty in photomicrographic estimation of weight and partial dissolution during chemical abrasion.

(d) Model Th/U ratio calculated from radiogenic 208Pb/206Pb ratio and 207Pb/235U age.

(e) Pb* and Pbc represent radiogenic and common Pb, respectively; mol % 206Pb* with respect to radiogenic, blank and initial common Pb.

(f) Measured ratio corrected for spike and fractionation only. Mass discrimination of 0.25 ± 0.04%/amu based on analysis of NBS-982; all Daly analyses.

(g) Corrected for fractionation, spike, and common Pb; all common Pb was assumed to be procedural blank: 206Pb/204Pb = 18.50±1.0%; 207Pb/204Pb = 15.50±1.0%;

(h) Errors are 2-sigma, propagated using the algorithms of Schmitz and Schoene (2007) and Crowley et al. (2007).

(i) Calculations are based on the decay constants of Jaffey et al. (1971). 206Pb/238U and 207Pb/206Pb ages corrected for initial disequilibrium in 230Th/238U using Th/U [magma] = 3.

Appendix C:
Pemberton Hills Zircon Trace Element Geochemistry (LA-ICP-MS)

Sample / spot	Na23	*2 Std Err*	Mg24	*2 Std Err*	Al27	*2 Std Err*	P31	*2 Std Err*	K39	*2 Std Err*	Ca43	*2 Std Err*	Sc45	*2 Std Err*	Ti47	*2 Std Err*	Mn55	*2 Std Err*	Fe57	*2 Std Err*	Ga69	*2 Std Err*	Rb85	*2 Std Err*	Sr88	*2 Std Err*
PM18AJ248-01	14.54	4.42	23.25	6.27	216.61	46.93	1131.37	33.81	216.96	41.32	-25.09	61.41	387.00	7.44	987.81	25.75	1.88	0.64	38.22	11.63	0.21	0.09	2.92	0.33	0.98	0.12
PM18AJ248-02	16.39	7.98	0.21	0.12	2.39	0.59	897.63	65.04	10.51	7.21	44.16	80.12	360.86	6.70	1048.76	28.14	2.53	0.80	15.70	8.78	0.02	0.02	1.69	0.24	0.88	0.14
PM18AJ248-03	20.58	5.81	0.32	0.14	19.72	2.03	1147.20	34.91	3.54	6.44	-7.42	67.20	449.90	7.10	1012.20	26.52	4.14	0.64	27.58	9.01	0.08	0.04	1.47	0.20	1.01	0.12
PM18AJ248-04	609.05	98.72	411.00	71.49	1934.00	242.24	977.67	32.50	1375.68	231.11	81.41	84.93	414.45	7.29	986.93	26.63	23.15	2.95	343.32	64.02	0.47	0.14	6.11	0.85	1.28	0.16
PM18AJ248-05	-11.45	5.77	0.13	0.11	2.31	0.65	1540.44	45.59	-5.45	6.29	-24.17	67.45	542.12	10.81	1012.61	28.38	0.47	0.50	10.71	7.92	0.03	0.03	2.02	0.21	1.31	0.16
PM18AJ248-06	-4.25	5.00	0.11	0.10	0.52	0.44	831.03	32.56	2.10	4.41	-32.59	68.28	350.43	7.49	1041.87	31.70	0.04	0.50	2.71	7.90	0.00	0.00	1.29	0.16	0.72	0.10
PM18AJ248-07	-2.22	6.59	12.17	3.86	104.05	31.58	870.89	45.38	-3.57	7.39	27.67	86.33	367.00	6.70	1009.04	30.69	0.93	0.73	116.51	38.32	0.13	0.07	1.26	0.18	0.73	0.12
PM18AJ248-08	-1.27	5.27	-0.05	0.04	2.33	0.66	1119.42	38.20	-6.09	4.87	-22.74	66.06	457.55	8.04	1019.08	31.62	-0.18	0.41	3.35	7.61	0.00	0.00	1.74	0.18	0.97	0.11
PM18AJ248-09	-1.81	4.76	0.00	0.04	1.30	0.43	1187.40	34.16	-1.47	3.42	-50.21	44.41	504.27	8.53	1041.66	24.48	-0.20	0.40	3.09	6.00	0.00	0.00	1.72	0.21	1.10	0.12
PM18AJ248-10	6.49	5.21	0.52	0.27	22.06	12.86	1529.23	35.87	-1.81	4.30	36.00	71.74	516.43	11.36	1021.15	26.36	3.73	1.63	23.15	12.17	0.09	0.06	2.44	0.23	1.83	0.38
PM18AJ248-11	-0.90	3.93	-0.01	0.05	8.86	2.52	1220.55	40.24	-3.50	3.77	-26.27	50.74	452.51	12.56	990.94	28.92	0.19	0.43	6.39	7.37	0.00	0.00	1.81	0.20	1.18	0.14
PM18AJ248-12	37.11	14.14	85.38	20.34	897.73	212.81	1111.89	35.49	36.20	14.31	1242.16	317.80	459.80	11.77	953.96	25.87	14.59	3.16	719.57	162.04	0.88	0.25	2.01	0.24	1.40	0.15
PM18AJ248-13	4.49	6.47	112.51	21.09	137.05	23.06	1378.87	40.28	-0.39	5.20	65.67	87.64	499.73	8.31	987.32	26.78	7.47	1.49	264.03	51.25	0.20	0.09	2.33	0.26	1.43	0.17
PM18AJ248-14	12.83	7.96	0.44	0.23	24.09	4.75	1300.77	66.36	11.34	5.14	354.08	144.04	461.26	11.02	1108.98	41.86	3.30	1.02	19.69	12.02	0.00	0.00	1.74	0.29	1.25	0.19
PM18AJ248-15	-2.63	4.68	-0.03	0.00	0.19	0.30	798.89	38.28	-5.20	4.32	-32.17	65.70	355.09	6.15	978.18	24.03	-0.28	0.39	-0.08	6.68	0.00	0.00	1.20	0.19	0.69	0.09
PM18AJ248-16	0.92	5.41	9.10	3.23	7.17	2.74	1050.92	35.74	2.88	4.72	15.15	68.51	417.59	8.90	1030.86	31.75	0.68	0.44	14.47	7.97	0.00	0.00	1.42	0.17	0.96	0.11
PM18AJ248-17	-4.53	4.29	-0.04	0.05	0.30	0.30	712.91	30.54	-4.93	4.72	-39.67	55.19	336.40	6.18	997.89	30.13	0.29	0.44	1.05	6.33	0.00	0.00	0.97	0.12	0.69	0.10
PM18AJ248-18	6.80	4.73	16.76	3.42	187.49	38.44	633.67	28.10	4.28	4.86	176.39	105.53	353.26	9.95	998.08	27.72	2.43	0.51	87.32	17.36	0.06	0.04	1.11	0.18	0.77	0.12
PM18AJ248-19	7.12	6.06	3200.52	730.22	3151.43	654.77	736.08	36.17	7.73	6.19	1346.52	497.18	391.14	16.44	2166.34	367.07	138.53	26.76	3606.47	712.84	1.37	0.36	0.95	0.18	0.87	0.17
PM18AJ248-20	7.44	4.53	6.04	3.39	46.17	10.94	709.49	39.78	90.51	11.31	-42.26	56.37	344.39	11.55	1016.80	31.49	0.78	0.52	23.55	12.63	0.05	0.04	1.13	0.16	0.76	0.09
PM18AJ248-21	18.46	5.65	7.26	1.42	98.05	13.19	654.26	27.52	29.47	8.58	52.96	82.43	332.48	7.22	979.33	27.50	2.75	0.55	74.75	15.00	0.06	0.04	1.07	0.14	0.82	0.10
PM18AJ248-22	-0.21	6.67	0.26	0.14	4.97	1.24	545.08	38.61	-1.38	5.64	-6.84	83.63	317.20	8.46	1021.29	30.18	-0.31	0.53	-2.05	9.29	0.04	0.04	0.92	0.16	0.64	0.13
PM18AJ248-23	100.33	43.61	1.29	0.42	4.74	1.25	1053.36	32.93	77.31	33.57	-3.69	71.25	421.85	8.08	983.31	28.10	8.68	3.64	88.98	37.66	0.00	0.00	2.87	0.50	1.15	0.11
PM18AJ248-24	5.54	4.70	0.04	0.06	0.07	0.28	611.70	28.35	-6.24	3.90	-21.35	65.22	306.39	7.21	956.92	21.83	-0.17	0.42	-4.83	6.64	0.00	0.00	0.81	0.13	0.58	0.09
PM18AJ289-01	35.62	12.06	2.73	0.57	91.01	30.39	1121.70	148.63	46.92	14.59	3378.15	584.92	214.53	7.41	909.89	33.08	11.43	1.86	13.16	11.66	0.03	0.03	0.22	0.07	4.15	0.67
PM18AJ289-02	-1.67	4.75	0.69	0.29	0.00	0.33	655.63	136.12	-9.89	4.32	1299.67	420.32	225.96	6.79	908.59	28.70	5.52	1.69	-1.45	8.45	0.00	0.00	0.17	0.07	1.86	0.51
PM18AJ289-03	-5.27	4.38	-0.04	0.00	-0.07	0.32	220.19	20.60	-10.11	4.31	56.19	77.93	239.72	6.65	928.51	32.83	-0.49	0.40	-0.82	8.23	0.00	0.00	0.05	0.05	0.17	0.05
PM18AJ289-04	2.11	5.09	0.13	0.12	3.77	0.86	218.74	27.36	-5.41	5.23	21.94	80.03	210.87	6.20	918.88	26.93	0.57	0.62	-12.25	8.78	0.00	0.00	0.02	0.05	0.14	0.05
PM18AJ289-05	14.13	5.37	1.72	0.45	10.43	1.93	1303.48	150.74	-2.04	4.51	2440.64	549.31	225.04	5.41	889.13	30.04	11.84	2.17	20.59	10.63	0.05	0.04	0.18	0.08	3.01	0.61
PM18AJ289-06	15.56	5.48	1.94	0.78	4.77	2.55	1034.19	295.49	-7.46	4.22	2132.00	838.39	234.08	4.82	962.96	32.82	9.14	3.59	7.91	8.48	0.00	0.00	0.13	0.06	3.59	1.22
PM18AJ289-07	9.94	4.51	1.38	0.42	1.50	0.52	1132.78	218.14	-2.79	3.82	2418.98	611.17	240.90	5.57	987.11	28.75	10.92	2.68	12.73	7.10	0.00	0.00	0.16	0.07	3.47	0.82
PM18AJ289-08	6.68	3.92	0.28	0.18	0.28	0.42	375.23	68.18	0.55	4.21	370.79	188.20	237.61	6.69	961.54	28.44	1.88	0.79	2.23	7.84	0.00	0.00	0.12	0.06	0.76	0.28
PM18AJ289-09	6.36	4.35	1.53	0.42	5.13	2.46	1146.53	262.78	-1.04	3.69	3209.33	951.19	239.69	5.25	981.80	34.28	12.56	3.56	31.30	12.98	0.00	0.00	0.11	0.05	4.23	1.15
PM18AJ289-10	7.70	4.29	0.99	0.39	1.13	0.75	789.49	198.02	0.00	4.72	1697.68	642.30	247.20	6.14	970.88	29.98	7.95	2.89	14.25	8.72	0.04	0.03	0.13	0.06	2.40	0.77
PM18AJ289-11	-2.94	3.84	0.04	0.07	-0.09	0.34	230.48	22.67	3.86	3.75	59.22	84.51	222.99	4.68	955.15	28.59	-0.15	0.44	1.72	6.34	0.00	0.00	0.08	0.05	0.20	0.05
PM18AJ289-12	6.22	5.01	0.73	0.23	0.77	0.47	1140.34	151.86	1.66	4.37	2702.36	524.44	246.07	6.16	977.42	29.71	12.94	2.55	21.94	9.60	0.00	0.00	0.16	0.07	3.51	0.62
PM18AJ289-13	17.46	5.57	3.52	0.79	9.09	2.48	2073.61	317.75	2.95	4.20	6189.79	1208.13	254.29	6.22	992.17	30.53	33.04	6.01	41.19	13.54	0.00	0.00	0.25	0.07	7.33	1.35
PM18AJ289-14	1.55	4.52	-0.10	0.00	1.91	0.75	342.62	24.36	0.47	4.23	133.71	90.48	237.16	5.80	946.73	29.19	0.18	0.44	-1.15	6.83	0.05	0.04	0.30	0.09	0.35	0.07
PM18AJ289-15	2.33	4.92	0.11	0.10	0.34	0.42	307.92	23.32	3.36	3.99	343.42	124.41	238.07	5.54	1008.03	36.33	1.34	0.63	9.19	6.72	0.00	0.00	0.16	0.06	0.70	0.14
PM18AJ289-16	3.74	4.34	0.07	0.09	0.78	0.37	284.87	20.31	-3.41	3.84	-2.80	71.03	257.85	6.88	984.97	35.40	0.16	0.46	1.33	6.27	0.00	0.00	0.26	0.08	0.29	0.06
PM18AJ289-17	-2.86	3.80	0.04	0.05	0.19	0.34	363.77	21.31	3.92	3.61	-29.88	66.18	448.28	8.16	996.04	26.38	-0.43	0.52	-0.20	5.93	0.01	0.02	0.26	0.07	0.24	0.06
PM18AJ289-18	24.26	6.16	0.31	0.13	75.10	13.77	255.98	19.09	6.30	4.31	176.03	99.31	234.78	4.79	950.71	30.93	29.76	3.35	15.07	8.73	0.06	0.04	0.17	0.07	6.14	1.12
PM18AJ289-19	-0.61	4.51	0.05	0.08	4.17	0.55	322.72	26.89	0.37	3.67	30.59	100.38	247.61	5.55	977.96	26.01	1.44	0.54	0.91	7.44	0.00	0.00	0.18	0.06	0.35	0.08
PM18AJ289-20	11.00	4.64	0.47	0.23	3.14	0.62	942.45	204.89	2.86	4.23	2531.61	784.53	244.45	5.28	977.52	27.84	10.01	2.76	15.54	9.39	0.00	0.00	0.10	0.06	3.14	0.89
PM18AJ289-21	6.71	3.86	0.03	0.08	3.90	0.93	221.06	18.44	5.51	3.53	-30.93	63.59	244.40	4.89	989.88	27.51	0.14	0.44	-1.28	5.90	0.00	0.00	0.20	0.06	0.20	0.06
PM18AJ289-22	3.22	4.55	0.12	0.12	0.67	0.42	451.01	44.92	-2.60	4.36	499.60	192.58	232.19	6.20	982.03	32.94	3.33	0.95	3.29	7.24	0.02	0.02	0.19	0.07	0.73	0.19
PM18AJ289-23	67.77	20.55	0.44	0.21	158.22	51.49	1299.71	272.00	73.32	24.23	3389.69	865.82	237.70	6.12	963.37	25.47	16.42	5.66	22.12	11.02	0.07	0.04	0.37	0.11	4.58	1.24
PM18AJ289-24	190.69	24.30	2.42	0.42	522.50	68.89	890.73	73.65	277.86	38.69	2124.28	272.80	220.20	5.00	955.56	33.54	12.35	1.35	46.03	11.36	0.21	0.09	0.97	0.19	3.35	0.36

***All elements in ppm.**

Appendix C:
Pemberton Hills Zircon Trace Element Geochemistry (LA-ICP-MS)

Sample / spot	Na23	*2 Std Err*	Mg24	*2 Std Err*	Al27	*2 Std Err*	P31	*2 Std Err*	K39	*2 Std Err*	Ca43	*2 Std Err*	Sc45	*2 Std Err*	Ti47	*2 Std Err*	Mn55	*2 Std Err*	Fe57	*2 Std Err*	Ga69	*2 Std Err*	Rb85	*2 Std Err*	Sr88	*2 Std Err*
PM18AJ203-01	1.48	3.93	0.05	0.08	-0.02	0.37	461.23	24.55	1.15	4.10	-15.57	55.59	296.55	5.94	837.68	22.70	-0.43	0.55	4.67	7.92	0.00	0.00	0.31	0.07	0.27	0.06
PM18AJ203-02	3.33	4.40	-0.01	0.00	0.11	0.32	413.98	28.00	2.43	4.76	74.15	74.91	288.32	5.57	869.25	27.78	-0.12	0.43	2.04	7.14	0.00	0.00	0.36	0.10	0.25	0.07
PM18AJ203-03	2.93	4.01	0.11	0.08	0.06	0.36	505.75	28.12	-0.55	3.83	85.51	81.79	323.94	11.76	887.53	26.16	0.52	0.45	-4.69	5.01	0.00	0.00	0.32	0.08	0.31	0.07
PM18AJ203-04	-0.01	3.61	0.07	0.09	-0.01	0.34	415.52	21.61	-2.21	3.49	19.81	53.68	270.70	5.42	895.14	25.60	0.10	0.47	-1.48	5.25	0.02	0.03	0.45	0.11	0.33	0.07
PM18AJ203-05	4.83	4.11	0.04	0.09	0.09	0.36	515.61	26.64	-2.36	3.67	116.97	81.73	270.66	5.06	875.91	21.33	-0.07	0.47	-1.50	5.84	0.00	0.00	0.57	0.11	0.46	0.08
PM18AJ203-06	3.90	4.08	-0.03	0.08	0.12	0.35	588.82	27.20	0.31	3.53	-5.07	56.04	338.71	5.44	906.27	26.61	1.43	2.12	4.79	6.26	0.00	0.00	0.36	0.08	0.28	0.07
PM18AJ203-07	-0.37	3.48	-0.02	0.08	0.41	0.39	555.04	29.68	-7.24	4.10	20.40	63.95	255.90	5.21	890.36	24.22	-0.16	0.47	9.26	7.49	0.01	0.02	0.77	0.14	0.46	0.08
PM18AJ203-08	3.55	4.16	0.01	0.09	0.02	0.34	551.29	25.94	-3.95	3.85	32.23	73.40	266.25	5.48	876.31	27.11	-0.21	0.46	2.01	6.42	0.04	0.03	0.72	0.11	0.48	0.09
PM18AJ203-09	-4.39	3.23	-0.06	0.04	-0.11	0.35	561.94	25.00	2.19	3.81	-20.39	58.53	279.35	5.79	878.21	21.27	0.03	0.44	0.02	6.50	0.00	0.00	0.59	0.13	0.41	0.07
PM18AJ203-10	-2.91	3.87	0.09	0.11	0.02	0.32	518.14	30.09	-0.61	3.75	70.65	83.42	317.71	6.96	900.66	23.60	-0.28	0.50	-1.38	6.36	0.00	0.00	0.32	0.09	0.31	0.07
PM18AJ203-11	-0.32	3.51	0.03	0.09	-0.03	0.36	575.78	21.52	-4.01	2.95	34.71	83.23	254.18	4.68	871.11	20.83	-0.51	0.42	-6.87	5.06	0.00	0.00	0.71	0.12	0.54	0.08
PM18AJ203-12	-1.06	3.80	0.02	0.09	-0.09	0.33	501.62	22.54	-3.30	3.02	-9.10	63.21	254.55	4.13	906.56	27.97	-0.47	0.43	1.76	6.63	0.00	0.00	0.63	0.11	0.47	0.09
PM18AJ203-13	1.65	4.79	0.00	0.08	-0.07	0.43	828.87	30.84	-3.20	4.42	51.54	79.20	271.67	6.93	855.42	25.65	0.42	0.58	4.28	7.87	0.00	0.00	1.11	0.15	0.71	0.11
PM18AJ203-14	-1.95	3.43	0.11	0.10	-0.03	0.36	458.87	27.50	-1.28	4.12	21.46	65.24	262.56	5.02	874.59	23.63	-0.21	0.49	-1.07	5.51	0.01	0.02	0.56	0.11	0.44	0.08
PM18AJ203-15	0.22	3.56	0.15	0.09	-0.08	0.34	502.82	27.46	0.28	4.13	-47.50	74.98	335.02	6.17	900.32	23.49	-0.18	0.43	1.54	6.11	0.00	0.00	0.44	0.10	0.34	0.07
PM18AJ203-16	0.21	4.27	0.04	0.05	-0.33	0.36	356.20	26.59	-1.34	3.88	-2.95	80.97	254.25	5.38	897.68	28.39	-0.02	0.48	2.20	5.38	0.00	0.00	0.37	0.07	0.29	0.07
PM18AJ203-17	-0.43	4.36	0.03	0.08	-0.23	0.41	539.16	27.42	0.15	3.88	-40.69	67.55	303.15	6.02	916.07	29.96	0.10	0.53	5.58	7.55	0.00	0.00	0.58	0.10	0.43	0.08
PM18AJ203-18	0.37	5.12	0.00	0.08	-0.05	0.36	471.06	26.76	1.46	3.27	-31.37	62.22	283.06	5.85	904.34	23.24	0.17	0.51	2.69	7.47	0.02	0.03	0.59	0.13	0.42	0.07
PM18AJ203-19	1.97	3.91	-0.01	0.06	-0.30	0.33	442.82	25.12	-1.68	3.90	-18.14	64.79	378.02	5.98	925.46	23.31	-0.14	0.49	-0.22	5.90	0.00	0.00	0.30	0.09	0.25	0.06
PM18AJ203-20	0.46	3.29	0.09	0.09	-0.09	0.38	400.24	21.21	-1.71	3.83	1.01	75.66	311.12	5.92	876.03	23.74	-0.07	0.54	-1.62	5.65	0.00	0.00	0.38	0.11	0.26	0.05
PM18AJ203-21	0.12	3.93	0.06	0.06	0.57	0.39	450.25	22.87	0.17	3.96	-37.46	60.59	303.21	5.98	870.44	20.29	0.16	0.46	-1.79	5.74	0.04	0.03	0.34	0.08	0.31	0.07
PM18AJ203-22	-4.22	4.20	0.16	0.12	-0.05	0.38	467.91	27.09	-0.31	3.91	-18.41	61.77	253.88	4.96	845.00	22.69	-0.24	0.49	1.02	5.96	0.00	0.00	0.51	0.10	0.44	0.08
PM18AJ203-23	0.84	3.50	0.00	0.05	-0.16	0.36	408.49	26.64	-2.88	3.72	10.35	74.69	247.24	5.38	862.97	25.93	0.03	0.47	-0.26	5.76	0.05	0.04	0.56	0.10	0.40	0.07
PM18AJ203-24	-0.40	3.64	0.04	0.06	-0.08	0.37	573.85	27.73	-0.53	3.40	8.01	72.74	275.59	5.43	856.19	16.70	-0.42	0.45	-0.08	5.73	0.00	0.00	0.80	0.13	0.54	0.09
PM18AJ273-01	0.88	5.06	0.07	0.08	0.37	0.37	272.10	36.84	0.14	4.24	65.70	86.57	256.46	4.19	1017.05	24.89	0.34	0.55	-1.67	6.15	0.03	0.03	0.16	0.06	0.29	0.11
PM18AJ273-02	-1.12	4.40	0.19	0.12	0.91	0.48	342.87	34.93	-1.49	4.36	186.73	102.52	280.97	5.53	1003.50	27.84	0.56	0.55	-0.32	6.60	0.03	0.03	0.11	0.06	0.41	0.12
PM18AJ273-03	-1.22	4.41	0.11	0.13	0.62	0.45	254.43	36.53	4.34	4.00	141.84	121.25	239.79	4.07	1011.42	29.99	-0.20	0.44	5.20	6.56	0.00	0.00	0.14	0.07	0.28	0.10
PM18AJ273-04	2.97	4.81	-0.05	0.00	0.47	0.34	229.98	20.82	2.08	4.34	-10.08	60.96	240.66	5.12	997.08	31.84	0.01	0.46	1.12	6.90	0.00	0.00	0.11	0.06	0.20	0.05
PM18AJ273-05	-0.87	4.62	0.06	0.08	10.82	5.52	206.58	19.58	0.23	3.90	83.43	74.79	218.54	4.70	937.32	24.85	0.14	0.46	-2.16	6.06	0.00	0.00	0.06	0.05	0.19	0.05
PM18AJ273-06	2.51	4.99	1.84	0.43	11.83	6.20	667.15	77.84	8.83	5.60	1613.47	300.93	231.34	4.87	982.91	26.73	5.44	1.05	10.02	7.19	0.00	0.00	0.08	0.04	2.08	0.33
PM18AJ273-07	2.25	4.90	0.13	0.10	1.17	0.53	258.84	24.15	-0.31	4.12	-2.44	53.81	241.87	5.64	991.23	24.14	-0.29	0.43	0.60	6.25	0.00	0.00	0.07	0.05	0.15	0.05
PM18AJ273-08	15.86	5.33	5.19	1.24	34.42	8.59	1399.85	222.77	20.53	7.42	4093.06	851.18	232.29	3.76	994.75	29.08	14.01	2.75	27.54	10.03	0.00	0.00	0.12	0.06	5.09	0.98
PM18AJ273-09	-0.44	4.78	0.02	0.08	0.62	0.36	309.91	31.68	-0.29	3.61	121.01	87.95	250.27	4.78	981.16	25.06	0.49	0.53	9.71	7.59	0.00	0.00	0.14	0.06	0.35	0.08
PM18AJ273-10	6.26	4.36	2.16	0.51	5.90	1.69	829.20	133.95	2.86	4.38	1248.17	319.58	235.93	4.82	978.71	23.95	6.95	1.60	15.21	7.25	0.00	0.00	0.10	0.06	1.77	0.36
PM18AJ273-11	-1.56	5.48	6.55	1.20	22.59	4.01	338.83	42.24	2.93	4.21	220.98	153.12	260.73	6.08	954.92	25.86	1.18	0.69	15.48	7.22	0.00	0.00	0.20	0.08	0.38	0.13
PM18AJ273-12	0.45	4.10	-0.09	0.03	0.02	0.33	240.17	18.31	2.70	4.14	8.43	66.10	241.97	4.92	951.90	26.28	-0.42	0.46	-1.43	6.17	0.00	0.00	0.13	0.07	0.16	0.05
PM18AJ273-13	3.75	4.33	0.30	0.19	2.18	1.08	313.55	38.77	6.28	3.73	281.38	130.45	227.36	5.68	956.44	28.94	0.89	0.65	1.95	6.90	0.00	0.00	0.08	0.06	0.36	0.11
PM18AJ273-14	4.57	4.91	0.75	0.32	0.95	0.59	586.15	140.20	-1.23	3.87	976.02	409.93	233.80	7.28	941.28	25.82	3.86	1.73	-0.81	6.00	0.00	0.00	0.14	0.06	1.32	0.49
PM18AJ273-15	4.93	4.99	0.13	0.09	-0.25	0.37	221.29	22.86	-3.98	4.53	-25.18	61.79	239.01	5.90	921.31	25.27	-0.12	0.49	-5.07	6.18	0.01	0.02	0.12	0.06	0.24	0.06
PM18AJ273-16	6.09	4.49	1.88	0.44	0.09	0.36	884.11	89.65	4.83	4.27	1719.35	353.15	229.18	3.37	945.64	24.42	7.63	1.46	13.75	7.22	0.00	0.00	0.11	0.06	2.53	0.39
PM18AJ273-17	2.38	5.32	-0.08	0.00	-0.20	0.38	215.51	20.64	1.12	4.72	26.01	75.96	230.18	4.88	957.18	24.93	-0.49	0.41	-5.06	6.36	0.01	0.02	0.09	0.05	0.13	0.04
PM18AJ273-18	3.05	4.68	0.42	0.47	3.49	3.97	198.14	18.62	-1.49	3.88	-43.35	63.63	249.78	5.39	981.81	27.05	-0.30	0.42	-2.19	6.94	0.00	0.00	0.14	0.06	0.14	0.05
PM18AJ273-19	1.84	4.55	0.26	0.16	0.68	0.48	367.66	45.85	2.21	3.98	123.59	86.79	232.96	4.97	948.66	27.36	0.73	0.50	1.99	6.01	0.02	0.03	0.09	0.05	0.35	0.09
PM18AJ273-20	0.96	5.33	0.62	0.25	5.41	1.60	392.08	44.36	0.26	4.47	352.30	115.29	226.76	4.79	942.74	25.05	1.98	0.67	1.81	6.97	0.00	0.00	0.16	0.06	0.67	0.16
PM18AJ273-21	13.60	4.61	0.76	0.24	41.52	7.60	654.79	47.20	19.75	6.68	1243.34	209.02	219.05	4.33	925.06	25.15	7.98	0.90	1.63	7.11	0.06	0.04	0.13	0.05	1.65	0.17
PM18AJ273-22	0.58	4.92	0.04	0.07	0.06	0.35	208.24	20.81	-5.88	4.39	-102.57	55.50	219.65	3.66	966.18	22.40	-0.46	0.50	2.78	6.15	0.00	0.00	0.09	0.05	0.19	0.05
PM18AJ273-23	-3.17	4.41	0.88	0.30	8.76	2.36	205.60	19.20	-5.96	4.21	-17.51	74.49	242.94	4.72	956.48	24.96	-0.26	0.38	0.93	6.38	0.00	0.00	0.09	0.04	0.19	0.05
PM18AJ273-24	20.81	11.48	0.03	0.05	36.76	19.99	213.32	20.22	2.73	6.09	-68.93	60.79	230.77	5.07	975.70	26.12	-0.16	0.45	0.14	6.43	0.03	0.03	0.19	0.08	0.24	0.07

***All elements in ppm.**

Appendix C:
Pemberton Hills Zircon Trace Element Geochemistry (LA-ICP-MS)

Sample / spot	Y89	*2 Std Err*	Zr91	*2 Std Err*	Nb93	*2 Std Err*	Cs133	*2 Std Err*	Ba137	*2 Std Err*	La139	*2 Std Err*	Ce140	*2 Std Err*	Pr141	*2 Std Err*	Nd146	*2 Std Err*	Sm147	*2 Std Err*	Eu153	*2 Std Err*	Gd157	*2 Std Err*	Tb159	*2 Std Err*
PM18AJ248-01	9826.70	216.80	417151.40	8034.56	17.16	0.64	0.14	0.06	0.85	0.26	0.11	0.03	114.25	2.62	1.16	0.10	22.15	0.99	47.71	1.63	4.48	0.24	264.89	7.25	84.03	2.19
PM18AJ248-02	8174.19	645.92	444212.87	7160.52	12.07	1.31	0.06	0.03	0.00	0.00	0.16	0.04	67.73	4.44	0.94	0.09	15.66	1.26	34.47	2.74	4.20	0.43	202.61	18.36	64.82	5.49
PM18AJ248-03	8525.70	184.58	418892.04	7317.81	38.28	2.11	0.02	0.02	0.10	0.08	0.93	0.16	175.41	4.65	1.50	0.14	23.23	1.04	49.16	1.73	4.59	0.28	250.17	5.70	76.04	1.62
PM18AJ248-04	7745.72	212.03	401777.00	8920.55	24.15	1.07	0.15	0.04	8.41	1.36	1.15	0.21	107.26	2.67	1.17	0.10	17.23	0.93	37.31	1.55	3.79	0.22	201.08	6.18	63.47	1.72
PM18AJ248-05	14484.87	329.19	424682.25	8445.59	22.07	0.69	0.00	0.02	0.00	0.00	0.20	0.04	174.63	3.49	2.27	0.13	43.88	1.48	87.54	2.72	9.70	0.42	430.99	8.40	130.84	2.64
PM18AJ248-06	7462.96	158.08	436991.59	10450.26	9.54	0.38	0.02	0.02	0.00	0.00	0.06	0.02	57.25	1.71	0.62	0.07	12.63	0.81	30.86	1.36	3.84	0.23	184.52	4.99	59.16	1.47
PM18AJ248-07	8019.26	150.74	423862.52	5941.43	13.83	0.73	0.00	0.02	0.00	0.00	0.06	0.02	84.94	3.04	0.82	0.08	15.78	1.12	37.54	1.76	3.27	0.24	211.57	5.92	67.01	1.67
PM18AJ248-08	10589.88	178.15	434629.47	8727.71	15.83	0.53	-0.01	0.01	0.00	0.00	0.11	0.03	108.44	2.16	1.36	0.11	26.16	1.00	53.93	1.82	7.20	0.37	289.25	7.00	90.20	1.92
PM18AJ248-09	11121.81	258.84	436441.27	10471.96	21.14	0.67	0.01	0.02	0.00	0.00	0.10	0.03	126.42	2.90	1.47	0.11	25.50	1.15	57.25	1.69	7.14	0.32	301.16	6.32	92.12	1.78
PM18AJ248-10	15128.10	372.63	427153.94	9828.26	25.95	0.90	-0.01	0.01	0.00	0.00	4.79	4.39	236.23	10.91	3.84	0.79	54.94	3.65	95.20	3.08	8.55	0.33	465.86	12.10	138.38	3.50
PM18AJ248-11	11588.49	290.74	426662.49	11865.43	17.91	0.63	0.01	0.01	0.00	0.00	0.22	0.04	122.47	2.55	1.60	0.12	29.22	1.10	61.46	1.93	7.29	0.33	323.11	8.07	98.90	2.32
PM18AJ248-12	9975.29	333.45	398091.41	7986.49	15.48	0.58	0.24	0.11	0.03	0.05	0.33	0.08	111.61	4.85	1.76	0.14	30.65	1.77	55.62	3.12	7.43	0.43	289.19	12.13	88.95	3.79
PM18AJ248-13	13477.50	297.53	424298.72	9686.66	20.95	0.70	0.03	0.03	0.06	0.07	0.26	0.05	167.17	3.96	2.33	0.15	39.69	1.56	76.13	2.31	8.42	0.40	387.84	9.68	120.12	2.91
PM18AJ248-14	10923.77	373.94	433009.79	16175.43	28.74	1.10	0.08	0.04	0.00	0.00	4.53	0.91	188.19	7.32	3.21	0.42	39.12	2.73	63.83	2.93	5.93	0.42	319.83	10.65	97.48	2.97
PM18AJ248-15	6814.89	202.96	407574.63	9595.23	9.09	0.47	0.02	0.02	0.00	0.00	0.04	0.01	61.46	2.04	0.71	0.07	13.92	1.02	31.52	1.35	4.36	0.26	178.81	6.55	57.08	1.83
PM18AJ248-16	9323.45	172.94	433207.14	11022.73	16.88	0.60	0.01	0.01	0.00	0.00	0.09	0.03	99.94	2.68	0.88	0.08	18.62	1.04	45.66	1.77	5.64	0.29	252.11	6.08	77.69	1.47
PM18AJ248-17	6419.33	122.89	426190.64	9223.36	8.28	0.32	0.00	0.01	0.00	0.00	0.06	0.04	49.37	1.19	0.56	0.07	10.37	0.61	27.73	1.23	3.07	0.18	156.03	3.77	51.30	1.08
PM18AJ248-18	5695.92	219.06	428309.13	9338.76	9.24	0.49	0.01	0.02	0.16	0.10	0.22	0.06	58.80	2.18	0.83	0.08	14.26	1.01	28.58	1.50	3.51	0.25	147.66	6.73	47.51	2.16
PM18AJ248-19	5406.07	262.67	418496.70	14487.33	29.90	1.26	0.00	0.02	0.34	0.18	0.33	0.07	102.42	5.51	1.05	0.10	15.35	1.08	25.13	1.35	3.09	0.30	140.58	6.91	43.64	2.37
PM18AJ248-20	6440.76	356.61	434877.41	9735.76	9.38	0.67	0.01	0.02	2.02	0.43	0.04	0.02	59.78	4.21	0.66	0.07	12.57	1.05	28.96	1.99	2.76	0.25	161.53	10.35	51.94	3.24
PM18AJ248-21	5908.52	153.55	414443.97	8158.02	9.80	0.43	0.03	0.02	0.23	0.12	0.39	0.06	63.79	1.68	1.23	0.10	16.54	0.86	28.34	1.29	5.02	0.27	152.43	5.70	47.64	1.69
PM18AJ248-22	4948.61	355.05	451946.32	8763.56	7.23	0.60	0.00	0.02	0.00	0.00	0.03	0.02	47.33	3.38	0.49	0.08	9.79	0.96	20.96	2.16	2.07	0.26	122.62	9.93	39.33	3.08
PM18AJ248-23	10344.03	236.06	421627.21	11174.19	16.82	0.58	0.51	0.20	0.08	0.07	0.39	0.08	121.50	2.87	1.55	0.11	27.73	1.08	56.96	1.84	5.44	0.28	287.92	7.22	89.66	1.95
PM18AJ248-24	5098.29	162.47	425011.82	9321.45	5.98	0.32	0.01	0.02	0.00	0.00	0.02	0.01	39.31	1.46	0.42	0.05	8.89	0.65	21.03	1.40	2.50	0.20	121.37	4.37	40.18	1.54
PM18AJ289-01	627.22	24.20	427680.50	14245.85	1.57	0.16	0.02	0.02	1.36	0.61	10.44	1.64	32.24	3.78	3.12	0.48	13.81	2.23	3.71	0.51	0.62	0.10	10.64	0.74	3.81	0.17
PM18AJ289-02	715.18	31.78	429338.35	15632.12	1.82	0.19	0.00	0.01	0.00	0.00	6.13	1.85	21.71	3.77	1.83	0.56	7.24	2.04	2.80	0.55	0.38	0.09	10.28	0.67	3.79	0.15
PM18AJ289-03	747.47	24.64	435509.55	14425.37	2.08	0.23	0.01	0.02	0.00	0.00	0.00	0.00	8.94	0.40	0.02	0.01	0.48	0.13	1.06	0.24	0.30	0.07	8.91	0.65	3.49	0.16
PM18AJ289-04	513.84	16.42	422223.27	12957.40	1.89	0.20	0.00	0.02	0.00	0.00	0.05	0.03	8.86	0.40	0.07	0.03	0.63	0.17	0.83	0.21	0.36	0.08	7.06	0.62	2.65	0.16
PM18AJ289-05	875.76	27.27	417785.06	12891.91	1.65	0.18	0.01	0.02	0.16	0.10	7.65	1.65	26.50	3.68	2.39	0.50	10.65	2.16	4.16	0.61	0.82	0.11	14.35	0.88	4.71	0.22
PM18AJ289-06	642.58	19.41	434306.57	12475.24	1.43	0.16	0.00	0.01	0.00	0.00	8.10	2.93	26.91	6.55	2.49	0.92	11.58	3.98	3.14	0.76	0.52	0.10	11.22	0.87	3.57	0.19
PM18AJ289-07	620.19	18.57	455410.36	12446.26	1.41	0.16	0.00	0.01	0.00	0.00	8.49	2.06	27.95	4.50	2.59	0.64	11.22	2.77	2.94	0.55	0.57	0.10	10.41	0.68	3.67	0.18
PM18AJ289-08	685.02	23.02	448404.10	11986.09	1.57	0.15	0.01	0.02	0.00	0.00	1.24	0.58	11.37	1.42	0.43	0.18	1.57	0.57	2.01	0.33	0.39	0.07	10.01	0.67	3.46	0.20
PM18AJ289-09	789.25	22.66	446126.09	12276.57	1.81	0.16	0.01	0.01	0.42	0.20	9.11	2.56	29.54	5.48	2.62	0.71	12.54	3.38	3.76	0.75	0.68	0.11	12.51	0.88	4.14	0.18
PM18AJ289-10	786.44	25.81	454285.66	14151.88	2.10	0.21	0.01	0.02	0.00	0.00	7.54	2.59	26.67	5.69	2.07	0.73	7.94	2.67	2.63	0.47	0.49	0.08	9.94	0.84	3.80	0.18
PM18AJ289-11	593.59	17.82	438770.98	12765.67	1.34	0.15	0.02	0.02	0.00	0.00	0.22	0.08	8.64	0.41	0.07	0.03	0.60	0.16	1.34	0.26	0.29	0.06	8.21	0.60	3.19	0.14
PM18AJ289-12	832.06	28.09	442438.62	12272.75	2.15	0.18	0.03	0.02	0.15	0.10	9.54	1.68	29.80	3.46	2.54	0.43	12.36	2.16	3.83	0.58	0.53	0.08	11.99	0.90	4.28	0.20
PM18AJ289-13	1168.11	36.16	459592.92	14004.10	1.77	0.16	0.02	0.02	0.49	0.18	21.41	4.18	56.60	8.89	5.84	1.14	26.81	4.87	8.22	1.15	1.15	0.14	22.02	1.44	7.18	0.27
PM18AJ289-14	1609.08	78.08	445752.93	12611.12	2.98	0.30	-0.01	0.01	0.05	0.06	0.34	0.10	16.55	1.02	0.19	0.05	2.17	0.33	4.74	0.50	0.89	0.12	28.89	1.94	10.32	0.61
PM18AJ289-15	715.18	26.14	455309.44	13089.02	1.49	0.16	0.03	0.02	0.00	0.00	1.23	0.30	11.90	0.63	0.38	0.10	2.03	0.42	1.64	0.28	0.40	0.07	10.08	0.69	3.92	0.19
PM18AJ289-16	1282.05	52.04	438199.86	11127.21	2.71	0.24	0.02	0.02	0.00	0.00	0.04	0.02	14.25	0.47	0.07	0.02	1.39	0.25	3.09	0.40	0.68	0.10	17.98	1.07	6.76	0.30
PM18AJ289-17	1673.87	40.69	453623.51	12643.06	1.61	0.15	0.01	0.02	0.00	0.00	0.00	0.00	12.47	0.46	0.07	0.02	1.18	0.23	3.21	0.40	0.95	0.10	23.22	1.29	8.92	0.30
PM18AJ289-18	928.93	33.70	442035.43	12014.93	4.58	0.36	-0.01	0.01	4.17	1.03	2.14	0.37	36.37	3.96	2.80	0.54	16.03	2.99	6.58	1.06	6.95	1.41	18.70	1.55	5.81	0.34
PM18AJ289-19	920.86	24.46	442200.93	11446.30	2.44	0.22	0.00	0.01	0.00	0.00	0.86	0.16	11.51	0.44	0.26	0.06	1.66	0.28	2.57	0.39	0.82	0.10	12.74	0.70	4.91	0.20
PM18AJ289-20	809.11	17.69	443223.94	9254.95	2.34	0.19	0.00	0.01	0.00	0.00	8.59	2.56	31.98	5.64	2.61	0.76	10.76	2.99	3.30	0.67	0.66	0.10	12.37	0.87	4.07	0.19
PM18AJ289-21	802.24	28.43	449048.58	11275.29	1.86	0.16	0.00	0.01	0.05	0.05	0.02	0.01	10.31	0.52	0.02	0.01	0.71	0.15	1.70	0.30	0.45	0.07	9.70	0.72	3.84	0.18
PM18AJ289-22	878.29	21.32	438458.74	11499.92	1.80	0.19	0.00	0.01	0.00	0.00	1.80	0.56	14.02	1.46	0.63	0.18	2.77	0.61	2.46	0.33	0.70	0.10	13.83	0.76	4.79	0.22
PM18AJ289-23	707.21	29.00	444149.44	12173.27	1.70	0.15	0.01	0.02	3.00	1.33	12.30	3.08	34.69	6.61	3.50	0.92	15.22	4.00	3.71	0.68	0.49	0.09	11.56	0.72	3.71	0.20
PM18AJ289-24	683.41	22.10	429625.31	11256.17	1.87	0.18	0.02	0.02	10.54	1.81	7.91	0.86	27.83	1.77	2.02	0.25	8.74	1.06	2.55	0.34	0.48	0.08	9.95	0.80	3.34	0.16

***All elements in ppm.**

Appendix C:
Pemberton Hills Zircon Trace Element Geochemistry (LA-ICP-MS)

Sample / spot	Y89	*2 Std Err*	Zr91	*2 Std Err*	Nb93	*2 Std Err*	Cs133	*2 Std Err*	Ba137	*2 Std Err*	La139	*2 Std Err*	Ce140	*2 Std Err*	Pr141	*2 Std Err*	Nd146	*2 Std Err*	Sm147	*2 Std Err*	Eu153	*2 Std Err*	Gd157	*2 Std Err*	Tb159	*2 Std Err*
PM18AJ203-01	2312.55	59.69	432455.45	7449.89	7.15	0.38	-0.01	0.01	0.00	0.00	0.01	0.01	48.18	1.49	0.11	0.03	2.74	0.34	6.78	0.65	0.94	0.12	45.72	2.08	16.09	0.54
PM18AJ203-02	2146.91	25.80	434154.71	8886.76	5.25	0.33	0.02	0.02	0.00	0.00	0.00	0.00	27.12	0.63	0.13	0.03	3.23	0.35	6.73	0.56	1.07	0.11	43.43	1.51	15.41	0.39
PM18AJ203-03	2215.25	84.42	436029.05	7363.36	6.89	0.48	0.00	0.01	0.00	0.00	0.00	0.01	38.99	1.61	0.14	0.03	2.97	0.36	6.79	0.67	1.20	0.14	41.86	1.91	15.06	0.54
PM18AJ203-04	3119.43	79.34	447801.20	8532.70	3.18	0.22	0.01	0.01	0.00	0.00	0.00	0.00	22.75	0.74	0.24	0.04	4.43	0.45	10.80	0.82	1.71	0.15	70.25	2.17	23.21	0.71
PM18AJ203-05	4195.38	104.34	433946.14	7646.48	4.38	0.34	-0.01	0.01	0.00	0.00	0.02	0.01	26.75	0.75	0.38	0.05	6.51	0.54	16.66	0.92	2.52	0.16	98.70	3.27	32.87	0.87
PM18AJ203-06	2789.17	45.60	443166.72	7508.38	10.02	0.44	0.01	0.02	0.00	0.00	0.00	0.00	59.42	1.15	0.16	0.04	3.25	0.36	8.46	0.64	1.29	0.12	54.91	1.98	19.38	0.45
PM18AJ203-07	4474.13	96.37	436661.98	8833.65	5.50	0.34	0.00	0.02	0.00	0.00	0.02	0.01	29.08	1.04	0.35	0.05	4.80	0.44	11.73	0.70	2.30	0.17	89.04	2.53	31.32	0.76
PM18AJ203-08	4538.54	70.70	436856.76	6634.10	5.34	0.32	-0.01	0.01	0.00	0.00	0.02	0.01	31.39	0.61	0.34	0.05	5.52	0.57	13.74	0.87	2.66	0.20	98.21	2.31	33.83	0.65
PM18AJ203-09	4378.74	86.91	434715.38	7625.97	5.95	0.34	0.00	0.02	0.00	0.00	0.03	0.01	28.31	0.76	0.30	0.05	5.19	0.42	14.41	0.81	2.40	0.20	101.45	3.07	32.91	0.86
PM18AJ203-10	2346.98	72.47	438666.32	9408.18	7.58	0.46	0.00	0.01	0.00	0.00	0.00	0.00	43.23	1.60	0.15	0.03	2.86	0.40	7.04	0.56	1.20	0.13	46.80	2.23	16.04	0.65
PM18AJ203-11	5214.70	108.61	431508.83	8385.24	5.91	0.31	0.00	0.01	0.00	0.00	0.03	0.01	26.39	0.77	0.35	0.05	6.45	0.60	16.05	0.86	2.77	0.19	117.61	3.32	39.52	1.05
PM18AJ203-12	4071.11	56.32	444998.31	6776.78	4.22	0.26	0.00	0.01	0.00	0.00	0.02	0.01	22.80	0.61	0.34	0.05	4.93	0.50	10.74	0.69	1.97	0.17	81.85	2.42	28.46	0.53
PM18AJ203-13	6755.52	211.48	429202.94	8049.78	10.37	0.63	0.00	0.01	0.00	0.00	0.03	0.02	51.29	2.76	0.45	0.06	7.39	0.66	17.58	1.19	3.20	0.25	135.47	6.15	48.09	1.80
PM18AJ203-14	3820.76	84.26	435182.02	7296.54	4.17	0.24	0.00	0.01	0.00	0.00	0.03	0.01	27.25	0.77	0.27	0.04	5.24	0.49	12.17	1.03	2.14	0.17	83.20	2.90	27.45	0.83
PM18AJ203-15	2551.52	50.94	441124.68	8561.74	7.53	0.38	0.01	0.02	0.00	0.00	0.00	0.00	43.45	1.05	0.21	0.04	3.53	0.39	7.61	0.53	1.27	0.14	51.82	1.67	17.75	0.55
PM18AJ203-16	2398.40	66.61	439815.37	9466.11	1.91	0.21	0.01	0.02	0.00	0.00	0.00	0.00	16.20	0.60	0.15	0.03	3.61	0.39	9.55	0.80	1.42	0.15	51.71	2.08	17.49	0.66
PM18AJ203-17	4297.25	110.79	451895.70	9508.69	4.90	0.32	-0.03	0.01	0.00	0.00	0.01	0.01	38.82	1.23	0.34	0.05	6.39	0.54	15.81	1.02	2.57	0.16	96.53	3.31	31.99	1.02
PM18AJ203-18	3832.56	65.68	445788.39	7333.79	3.90	0.25	-0.03	0.01	0.00	0.00	0.03	0.01	25.51	0.70	0.31	0.04	5.34	0.51	13.37	0.85	2.42	0.18	84.38	2.64	28.27	0.59
PM18AJ203-19	2336.44	34.92	454101.25	7988.40	8.40	0.39	0.00	0.01	0.00	0.00	0.01	0.01	31.56	0.78	0.09	0.02	2.20	0.30	5.13	0.53	0.88	0.11	34.45	1.31	12.85	0.28
PM18AJ203-20	1875.46	28.14	438825.23	6169.92	5.43	0.31	-0.01	0.01	0.00	0.00	0.00	0.00	28.98	0.76	0.05	0.02	1.47	0.25	4.05	0.46	0.63	0.09	28.09	1.34	10.54	0.32
PM18AJ203-21	2171.78	50.40	433997.87	7180.96	6.47	0.37	0.00	0.01	0.00	0.00	0.00	0.00	40.01	1.22	0.16	0.03	2.32	0.32	6.08	0.48	0.99	0.12	40.62	1.80	14.32	0.51
PM18AJ203-22	3800.36	62.80	424566.03	7437.44	3.72	0.25	0.00	0.01	0.00	0.00	0.02	0.01	20.26	0.51	0.33	0.05	5.54	0.49	13.58	0.76	2.39	0.18	87.76	2.21	28.86	0.63
PM18AJ203-23	3304.50	61.22	433442.20	7333.12	3.26	0.26	0.00	0.01	0.00	0.00	0.01	0.01	22.94	0.66	0.25	0.04	4.28	0.47	9.85	0.72	1.53	0.14	67.84	2.23	23.55	0.63
PM18AJ203-24	4999.10	86.85	431561.20	7319.79	5.77	0.29	0.00	0.01	0.00	0.00	0.05	0.02	31.81	0.75	0.37	0.05	6.95	0.57	17.59	0.87	2.94	0.25	116.91	3.18	38.18	0.92
PM18AJ273-01	692.35	13.09	449513.18	8164.26	1.42	0.14	-0.02	0.01	0.00	0.00	0.63	0.48	8.12	0.49	0.15	0.09	0.71	0.24	1.17	0.22	0.38	0.06	9.16	0.67	3.60	0.15
PM18AJ273-02	806.10	17.63	454015.34	8594.38	1.80	0.16	-0.02	0.01	0.00	0.00	0.58	0.22	10.88	0.55	0.20	0.07	1.17	0.35	1.50	0.27	0.48	0.07	11.15	0.61	4.09	0.18
PM18AJ273-03	661.07	10.97	461923.31	8246.19	1.23	0.13	0.01	0.02	0.00	0.00	0.27	0.28	6.94	0.52	0.09	0.07	0.92	0.40	1.56	0.26	0.44	0.07	8.82	0.61	3.41	0.15
PM18AJ273-04	516.68	11.46	461126.63	9672.99	1.11	0.12	0.01	0.01	0.00	0.00	0.00	0.00	7.63	0.33	0.02	0.01	0.39	0.12	0.87	0.21	0.26	0.05	7.35	0.61	2.64	0.12
PM18AJ273-05	465.86	10.05	430490.63	6637.50	1.19	0.13	0.01	0.01	0.00	0.00	0.00	0.00	7.56	0.29	0.01	0.01	0.25	0.09	0.81	0.19	0.28	0.05	5.80	0.52	2.23	0.13
PM18AJ273-06	542.07	11.25	443593.67	7990.97	1.40	0.15	0.00	0.01	0.13	0.13	4.92	0.76	18.40	1.68	1.42	0.23	6.48	1.07	2.07	0.32	0.35	0.07	7.63	0.58	2.82	0.15
PM18AJ273-07	662.39	18.06	447458.13	8795.03	1.58	0.14	0.01	0.02	0.00	0.00	0.02	0.03	9.03	0.32	0.05	0.03	0.54	0.14	1.29	0.23	0.35	0.07	8.43	0.67	3.28	0.16
PM18AJ273-08	510.10	10.15	450469.45	6170.37	1.18	0.16	0.00	0.01	0.89	0.31	12.06	2.33	33.70	5.18	3.55	0.69	14.88	2.84	3.71	0.68	0.56	0.09	9.55	0.89	3.04	0.17
PM18AJ273-09	815.59	15.96	450738.42	8477.49	2.21	0.17	0.00	0.01	0.00	0.00	0.63	0.21	12.77	0.68	0.16	0.06	1.45	0.32	1.46	0.27	0.35	0.06	9.84	0.64	3.85	0.17
PM18AJ273-10	703.54	13.60	446173.45	7296.66	1.83	0.14	0.00	0.01	0.00	0.00	5.15	1.05	22.79	2.44	1.51	0.33	6.99	1.41	2.61	0.46	0.47	0.07	9.62	0.74	3.54	0.17
PM18AJ273-11	904.90	27.67	443001.17	7827.62	2.56	0.24	-0.01	0.01	0.00	0.00	0.60	0.35	10.98	0.84	0.19	0.08	1.34	0.48	1.74	0.29	0.37	0.06	11.37	0.86	4.18	0.20
PM18AJ273-12	721.26	19.57	454612.49	7276.67	1.40	0.14	-0.02	0.01	0.00	0.00	0.00	0.00	6.93	0.25	0.02	0.01	0.76	0.18	1.54	0.28	0.42	0.06	10.13	0.67	3.81	0.19
PM18AJ273-13	628.67	20.95	440233.71	8480.62	1.37	0.13	0.00	0.01	0.00	0.00	1.03	0.37	12.06	0.78	0.29	0.09	1.89	0.48	1.43	0.26	0.35	0.06	8.83	0.68	3.35	0.18
PM18AJ273-14	708.87	22.39	441891.99	8552.87	1.53	0.14	-0.01	0.01	0.00	0.00	3.02	1.35	17.19	3.31	0.87	0.38	4.26	1.59	1.95	0.32	0.49	0.08	10.16	0.68	3.67	0.18
PM18AJ273-15	734.87	21.51	433918.20	9018.40	1.86	0.18	-0.01	0.02	0.00	0.00	0.00	0.00	8.09	0.38	0.00	0.00	0.35	0.11	1.07	0.23	0.36	0.06	8.59	0.77	3.44	0.18
PM18AJ273-16	684.44	10.98	443615.34	7052.58	1.46	0.14	0.00	0.01	0.00	0.00	6.16	0.90	23.45	2.03	1.73	0.28	7.26	1.08	2.69	0.40	0.44	0.08	10.37	0.64	3.65	0.15
PM18AJ273-17	626.49	17.66	447168.96	7275.46	1.40	0.14	0.00	0.01	0.00	0.00	0.00	0.00	8.85	0.31	0.01	0.01	0.34	0.10	1.21	0.23	0.36	0.06	8.06	0.55	2.94	0.18
PM18AJ273-18	601.54	14.84	451627.08	7280.45	1.12	0.12	0.02	0.02	0.00	0.00	0.00	0.00	7.26	0.34	0.01	0.01	0.43	0.13	1.34	0.24	0.41	0.07	8.49	0.53	3.18	0.18
PM18AJ273-19	716.96	35.12	432686.74	6182.86	1.50	0.16	0.00	0.01	0.00	0.00	0.47	0.20	9.45	0.65	0.16	0.07	0.87	0.23	1.58	0.29	0.40	0.07	9.63	0.89	3.64	0.24
PM18AJ273-20	849.58	71.43	445145.75	7872.36	1.06	0.14	0.00	0.01	0.13	0.10	1.53	0.43	11.35	1.29	0.38	0.10	2.53	0.58	2.19	0.35	0.56	0.10	13.74	1.60	4.70	0.43
PM18AJ273-21	626.48	12.42	424958.36	6720.28	1.55	0.13	0.02	0.02	0.85	0.29	4.74	0.39	19.68	0.67	1.38	0.13	5.80	0.66	2.14	0.33	0.41	0.08	9.50	0.67	3.27	0.16
PM18AJ273-22	645.63	8.58	440175.50	6638.37	1.16	0.15	0.00	0.01	0.00	0.00	0.00	0.00	6.77	0.31	0.03	0.01	0.49	0.12	1.36	0.27	0.36	0.07	8.89	0.67	3.12	0.15
PM18AJ273-23	780.69	31.43	441493.04	7077.52	1.29	0.13	0.00	0.01	0.00	0.00	0.00	0.00	8.48	0.34	0.03	0.01	0.73	0.17	1.86	0.29	0.51	0.07	10.93	0.87	4.30	0.24
PM18AJ273-24	572.75	15.97	448743.53	8427.60	1.29	0.14	-0.01	0.02	0.08	0.08	0.00	0.01	8.09	0.33	0.02	0.01	0.27	0.10	1.03	0.23	0.27	0.06	7.45	0.60	2.90	0.16

***All elements in ppm.**

Appendix C:
Pemberton Hills Zircon Trace Element Geochemistry (LA-ICP-MS)

Sample / spot	Dy163	*2 Std Err*	Ho165	*2 Std Err*	Er166	*2 Std Err*	Tm169	*2 Std Err*	Yb172	*2 Std Err*	Lu175	*2 Std Err*	Hf179	*2 Std Err*	Ta181	*2 Std Err*	Pb204	*2 Std Err*	Pb206	*2 Std Err*	Pb207	*2 Std Err*	Pb208	*2 Std Err*	Th232	*2 Std Err*	U238	*2 Std Err*
PM18AJ248-01	977.20	23.87	343.11	7.19	1517.72	36.77	283.73	6.76	2360.13	52.32	441.72	9.28	9615.82	193.11	3.13	0.15	-0.70	0.60	176.95	3.12	9.82	0.38	21.84	0.42	1327.85	22.88	1580.34	27.34
PM18AJ248-02	789.10	66.75	283.46	23.35	1290.88	104.43	247.55	19.67	2103.79	169.11	409.71	31.68	8300.15	205.50	2.49	0.18	0.13	0.79	129.16	7.78	7.39	0.53	15.26	1.38	944.25	96.20	1200.41	82.72
PM18AJ248-03	861.60	21.21	294.44	6.82	1284.12	31.74	236.33	6.03	1951.49	51.52	352.44	9.99	9812.84	224.92	7.98	0.43	0.35	0.65	303.35	12.62	16.14	0.81	53.88	3.25	3284.38	177.93	2726.19	99.87
PM18AJ248-04	753.10	21.25	271.54	6.98	1227.73	32.66	234.14	6.43	1964.29	48.13	378.59	9.39	6354.17	185.73	4.53	0.20	1.07	0.88	176.22	4.38	9.99	0.39	20.85	0.65	1340.16	36.22	1675.35	36.85
PM18AJ248-05	1469.95	29.17	509.61	9.77	2239.87	42.85	419.62	7.51	3412.40	64.39	630.03	11.38	8251.12	155.76	3.15	0.16	-0.36	0.74	196.49	3.40	10.37	0.41	29.65	0.50	1852.89	37.13	1790.03	34.51
PM18AJ248-06	702.88	16.30	257.51	4.98	1177.04	24.68	226.48	5.04	1907.54	37.38	368.50	6.85	8073.16	201.90	2.42	0.14	-0.47	0.60	119.63	2.56	6.44	0.29	12.67	0.36	796.93	16.89	1087.81	19.88
PM18AJ248-07	784.16	19.71	277.90	6.58	1242.76	27.18	235.53	5.14	1959.66	39.26	371.14	7.89	8108.97	225.52	3.16	0.22	-0.63	0.76	143.59	3.89	7.77	0.32	15.13	0.43	954.73	20.03	1292.75	27.50
PM18AJ248-08	1037.71	22.14	360.39	5.74	1616.59	29.65	304.48	5.30	2578.86	54.38	485.06	9.95	8377.20	198.98	2.67	0.15	0.26	0.80	153.97	3.46	8.61	0.37	20.10	0.53	1264.88	25.43	1413.80	25.55
PM18AJ248-09	1070.87	21.14	374.03	7.29	1668.83	34.36	316.17	6.57	2657.26	58.06	500.60	11.74	8183.25	205.32	3.57	0.19	-0.33	0.70	169.89	3.33	9.29	0.28	22.93	0.50	1465.57	33.90	1570.27	29.57
PM18AJ248-10	1545.54	41.52	521.07	12.81	2271.93	66.92	412.96	13.17	3379.21	113.25	608.92	18.17	8939.02	252.53	3.74	0.17	0.63	0.78	233.00	4.90	12.53	0.45	35.13	0.72	2167.21	52.79	2105.11	46.11
PM18AJ248-11	1147.81	25.23	404.58	9.49	1761.66	42.83	333.98	7.97	2779.91	71.70	517.68	14.12	8580.80	215.50	2.94	0.14	0.34	0.68	170.17	4.76	9.56	0.43	22.16	0.69	1396.13	39.54	1613.44	44.00
PM18AJ248-12	1009.04	41.06	353.91	13.26	1593.52	56.07	299.68	10.77	2497.22	84.21	469.26	14.78	6154.70	151.96	2.39	0.11	1.71	1.01	142.59	3.13	8.83	0.47	20.24	0.64	1170.62	38.62	1312.52	36.89
PM18AJ248-13	1349.67	32.48	468.87	13.10	2076.10	48.47	388.59	8.53	3242.36	67.18	604.66	14.16	7220.56	154.74	3.32	0.16	0.11	0.66	201.36	3.60	11.14	0.39	27.38	0.69	1714.57	40.30	1863.79	45.24
PM18AJ248-14	1116.96	38.13	383.20	12.13	1635.91	46.54	303.91	8.85	2494.89	73.45	460.55	17.60	9712.56	265.69	5.53	0.28	0.49	0.79	244.86	6.39	14.21	0.63	40.69	1.94	2687.52	137.16	2378.50	66.84
PM18AJ248-15	672.92	20.72	241.80	7.45	1103.31	33.65	211.58	6.06	1791.61	51.05	347.52	9.66	6953.06	147.96	2.08	0.13	0.08	0.66	114.23	3.60	6.22	0.33	12.25	0.54	737.43	27.89	1024.18	28.44
PM18AJ248-16	912.76	17.70	320.22	5.29	1447.57	24.99	275.51	5.05	2297.06	40.57	444.35	8.97	7773.42	215.53	3.46	0.15	0.27	0.65	170.65	4.72	9.70	0.37	22.54	1.71	1359.91	38.12	1583.74	34.38
PM18AJ248-17	612.35	11.22	220.85	4.07	1022.78	19.44	196.98	3.46	1695.98	31.80	327.72	5.73	7209.82	145.23	2.02	0.12	0.03	0.67	103.39	1.95	5.54	0.25	10.18	0.29	636.00	11.58	946.52	15.45
PM18AJ248-18	554.19	23.65	198.39	7.49	892.82	33.05	175.18	6.71	1499.82	52.24	289.88	9.62	8923.81	276.38	2.41	0.13	0.83	0.66	113.21	2.79	6.42	0.30	10.04	0.38	629.60	23.31	1061.02	18.54
PM18AJ248-19	512.35	26.40	184.46	9.47	834.01	39.26	161.33	7.62	1367.28	67.95	258.04	12.12	8242.78	287.49	5.68	0.26	0.19	0.81	170.36	6.04	9.68	0.56	22.58	1.16	1505.38	92.37	1673.88	86.61
PM18AJ248-20	614.57	34.45	225.25	13.74	1004.38	57.93	194.78	11.33	1665.41	90.18	318.83	17.19	7735.97	208.70	2.29	0.18	0.02	0.61	106.21	4.58	5.87	0.33	10.97	0.57	665.81	45.33	980.08	53.30
PM18AJ248-21	568.83	18.45	204.10	6.92	922.36	29.68	175.62	5.76	1491.06	46.23	286.79	8.41	7861.91	164.26	2.30	0.10	0.52	0.69	116.84	3.02	6.78	0.36	10.53	0.36	648.68	16.78	1167.21	23.14
PM18AJ248-22	468.64	35.94	171.43	12.17	780.55	55.79	152.02	11.49	1279.15	94.02	243.96	16.41	8945.24	182.51	1.84	0.15	0.66	0.94	79.73	5.22	4.57	0.33	7.75	0.67	497.39	48.72	762.90	56.10
PM18AJ248-23	1037.12	22.73	362.90	7.45	1619.37	35.38	304.83	5.78	2569.74	50.31	483.09	9.99	7472.21	169.97	3.04	0.16	2.10	1.00	167.44	3.67	10.61	0.83	21.71	0.77	1234.96	26.83	1543.71	37.14
PM18AJ248-24	488.50	16.83	178.05	6.19	825.40	29.54	157.28	5.12	1355.72	44.08	260.84	9.16	7121.66	207.89	1.78	0.12	0.53	0.62	87.48	2.85	4.60	0.26	8.10	0.32	489.67	20.71	773.71	26.61
PM18AJ289-01	49.32	1.51	20.34	0.69	108.89	3.80	25.64	0.87	261.79	9.14	59.55	2.51	10847.84	305.34	0.67	0.08	0.17	0.69	17.78	0.72	1.00	0.12	1.05	0.08	65.56	2.09	159.88	4.41
PM18AJ289-02	52.66	1.81	22.51	0.76	124.93	4.69	30.11	1.23	317.93	12.24	77.08	3.15	10556.11	276.92	0.81	0.08	0.27	0.72	17.56	0.76	0.96	0.10	0.91	0.07	53.05	2.02	161.99	6.18
PM18AJ289-03	50.03	1.65	22.63	0.68	134.44	3.29	32.45	0.78	343.40	8.82	82.26	2.17	11047.82	312.82	0.93	0.07	0.95	0.83	17.61	0.57	1.05	0.12	0.90	0.06	53.78	1.68	165.43	4.49
PM18AJ289-04	36.68	1.32	16.23	0.56	91.33	2.88	20.87	0.60	223.33	6.30	52.62	1.49	10925.63	333.40	0.86	0.12	0.61	0.77	18.29	1.01	1.86	0.24	1.60	0.19	46.63	1.54	169.62	6.59
PM18AJ289-05	67.12	1.80	28.44	0.68	156.09	3.73	35.47	0.89	359.87	7.49	82.62	1.94	10621.47	223.01	0.67	0.07	0.42	0.75	19.28	0.73	1.08	0.10	1.26	0.10	67.69	2.06	174.45	4.95
PM18AJ289-06	48.21	1.64	20.07	0.67	112.81	3.19	25.99	0.89	260.22	7.99	59.13	1.66	10624.50	235.72	0.63	0.06	-0.13	0.60	14.68	0.64	0.82	0.11	0.77	0.07	51.78	1.45	135.71	4.21
PM18AJ289-07	47.19	1.44	19.83	0.52	109.30	2.51	24.44	0.72	251.12	6.94	57.24	1.56	11204.48	257.95	0.56	0.06	0.70	0.70	14.59	0.61	0.82	0.10	0.75	0.06	47.66	1.13	134.08	3.22
PM18AJ289-08	50.53	1.66	21.22	0.67	117.45	3.70	27.77	0.93	283.51	8.69	66.47	2.19	10594.07	257.90	0.66	0.07	0.04	0.64	15.96	0.53	0.83	0.10	0.80	0.06	49.07	1.38	144.79	3.96
PM18AJ289-09	56.16	1.44	24.10	0.70	135.01	3.82	31.76	0.88	333.46	8.45	76.92	1.87	10718.95	240.13	0.77	0.07	0.96	0.62	19.23	0.68	1.50	0.19	1.37	0.13	58.83	1.63	168.22	4.70
PM18AJ289-10	54.49	2.10	23.64	0.82	135.30	3.71	32.92	1.03	345.27	10.00	82.78	2.56	11369.94	323.22	0.89	0.09	0.45	0.65	22.50	0.81	1.35	0.12	1.26	0.08	73.89	2.02	203.48	5.24
PM18AJ289-11	41.06	1.28	17.98	0.49	104.04	2.85	23.94	0.59	243.36	6.19	56.55	1.56	10604.76	265.27	0.56	0.07	0.15	0.54	15.76	0.63	0.86	0.10	0.78	0.06	47.28	1.24	139.34	3.23
PM18AJ289-12	58.37	2.13	25.20	0.80	142.78	5.00	33.93	1.29	359.29	14.12	85.56	3.73	10591.60	264.93	0.79	0.08	-0.02	0.62	21.48	0.80	1.23	0.15	1.12	0.08	68.48	2.21	186.59	4.86
PM18AJ289-13	89.63	2.36	35.95	0.77	194.82	4.25	43.32	0.92	428.12	8.93	97.74	2.29	10811.68	277.47	0.64	0.07	-0.14	0.56	19.02	0.66	1.04	0.11	1.37	0.09	79.59	2.22	177.49	4.91
PM18AJ289-14	132.72	6.68	53.62	2.62	261.57	12.13	54.51	2.33	501.34	19.69	108.37	3.78	10735.61	262.87	1.43	0.15	0.66	0.71	37.76	2.22	2.24	0.21	3.94	0.38	224.81	22.97	345.83	21.52
PM18AJ289-15	52.86	2.12	22.59	0.79	124.81	4.80	28.94	0.98	296.97	10.28	67.31	2.41	11015.74	276.73	0.61	0.07	1.11	0.86	19.10	0.52	1.18	0.13	1.14	0.08	65.02	2.04	172.86	5.36
PM18AJ289-16	93.59	4.04	39.34	1.60	217.70	8.18	50.89	2.03	522.97	20.15	120.41	4.83	10864.19	290.04	0.91	0.07	0.40	0.65	30.61	1.02	1.63	0.16	2.08	0.14	124.11	3.93	269.70	7.84
PM18AJ289-17	122.15	3.09	52.67	1.17	280.09	6.03	58.52	1.33	551.38	12.53	119.17	2.68	9222.94	240.20	0.53	0.05	0.43	0.67	28.56	1.07	1.59	0.12	0.97	0.07	48.83	1.33	214.45	4.97
PM18AJ289-18	72.43	2.77	28.79	1.09	155.78	5.41	36.21	1.44	361.10	10.99	82.75	2.67	11314.86	295.82	0.93	0.09	1.09	0.79	33.75	1.57	2.86	0.35	4.60	0.34	334.43	27.34	464.23	37.07
PM18AJ289-19	67.85	1.97	29.55	0.79	164.72	4.28	38.41	0.97	394.01	10.28	92.05	2.62	10678.84	237.66	0.84	0.08	0.08	0.67	20.37	0.76	1.32	0.12	1.31	0.09	64.22	2.12	226.17	6.33
PM18AJ289-20	57.98	1.61	24.60	0.71	141.35	3.41	34.36	0.93	356.29	8.21	84.65	2.13	11436.43	243.11	0.82	0.09	-0.09	0.57	28.23	0.91	1.76	0.13	1.90	0.10	105.75	2.49	261.36	6.17
PM18AJ289-21	54.60	2.44	24.42	0.93	141.02	4.71	33.16	1.03	344.13	10.89	81.49	2.53	11218.47	301.55	0.75	0.06	-0.17	0.58	20.13	0.77	1.29	0.13	1.07	0.08	68.03	2.99	185.06	5.85
PM18AJ289-22	65.83	1.82	27.85	0.65	151.37	3.05	34.18	0.78	347.38	7.30	78.71	1.98	10472.45	231.06	0.55	0.07	-0.75	0.46	20.53	0.63	1.21	0.11	1.33	0.09	75.35	1.83	183.22	4.92
PM18AJ289-23	50.18	2.00	21.03	0.77	119.20	5.18	27.88	1.24	288.73	11.66	69.55	3.01	10445.54	213.43	0.69	0.06	-0.21	0.50	16.62	0.71	1.04	0.12	0.88	0.08	54.81	2.61	150.36	6.51
PM18AJ289-24	47.92	1.70	20.88	0.63	116.50	3.52	27.36	0.83	282.36	8.23	66.24	1.91	10804.69	256.63	0.70	0.07	0.20	0.70	27.13	0.96	1.69	0.18	2.29	0.14	126.73	6.39	235.93	8.50

***All elements in ppm.**

Appendix C:
Pemberton Hills Zircon Trace Element Data (LA-ICP-MS)

Sample / spot	Dy163	*2 Std Err*	Ho165	*2 Std Err*	Er166	*2 Std Err*	Tm169	*2 Std Err*	Yb172	*2 Std Err*	Lu175	*2 Std Err*	Hf179	*2 Std Err*	Ta181	*2 Std Err*	Pb204	*2 Std Err*	Pb206	*2 Std Err*	Pb207	*2 Std Err*	Pb208	*2 Std Err*	Th232	*2 Std Err*	U238	*2 Std Err*
PM18AJ203-01	213.12	6.54	82.21	2.20	406.98	10.47	82.90	2.04	738.69	18.40	146.27	3.53	11092.80	227.27	2.48	0.18	1.24	0.83	51.54	1.23	2.84	0.19	4.96	0.19	303.13	8.77	462.41	11.24
PM18AJ203-02	202.37	3.88	75.85	1.45	361.07	7.23	74.60	1.33	658.36	11.29	129.68	2.47	9379.83	226.18	1.63	0.12	0.41	0.66	53.34	0.94	2.93	0.17	5.81	0.21	365.00	7.70	502.55	9.51
PM18AJ203-03	197.78	7.49	77.07	3.23	374.85	15.17	75.61	3.38	675.69	31.33	132.86	6.55	9599.24	208.30	2.02	0.14	0.47	0.58	71.54	1.41	3.91	0.19	9.52	0.35	585.42	15.08	653.48	15.29
PM18AJ203-04	296.42	7.85	109.48	3.13	517.12	14.48	103.43	2.89	907.61	26.45	179.68	5.14	9086.28	192.81	1.04	0.09	0.70	0.61	43.51	0.98	2.38	0.17	4.37	0.16	267.99	7.26	394.00	9.78
PM18AJ203-05	401.12	9.95	146.53	3.28	692.12	16.84	136.64	3.35	1179.58	28.28	228.29	5.34	8972.77	151.86	1.28	0.10	0.82	0.60	61.65	1.10	3.42	0.18	6.45	0.24	397.41	10.76	557.82	12.81
PM18AJ203-06	252.37	4.44	95.33	1.49	456.84	7.56	91.72	1.52	796.56	11.53	154.07	2.06	10364.84	189.50	2.85	0.12	0.18	0.60	83.97	1.85	4.69	0.28	13.09	0.43	813.51	19.79	776.28	12.65
PM18AJ203-07	409.42	9.66	155.36	3.50	745.43	17.67	148.60	3.16	1311.92	32.41	258.84	5.94	9812.18	206.91	1.89	0.11	0.75	0.63	68.26	1.79	3.62	0.24	7.59	0.29	468.73	13.29	622.27	16.66
PM18AJ203-08	428.60	7.35	158.83	2.58	752.67	11.43	148.76	2.47	1284.98	18.13	250.12	3.72	9588.26	159.72	1.64	0.10	0.38	0.64	63.25	1.05	3.39	0.20	7.32	0.18	454.90	6.71	585.85	8.63
PM18AJ203-09	413.91	9.26	154.08	3.20	711.05	14.68	140.98	2.78	1210.90	24.67	234.70	5.22	8386.11	163.06	1.68	0.11	0.39	0.61	69.43	1.27	3.84	0.22	8.17	0.20	484.92	8.47	625.99	10.58
PM18AJ203-10	210.39	7.39	79.27	2.64	382.90	12.17	78.11	2.44	688.35	20.29	133.00	3.70	9650.40	197.80	2.11	0.15	0.33	0.67	75.07	1.86	4.15	0.21	11.75	0.38	659.63	33.07	667.99	22.95
PM18AJ203-11	492.43	11.70	183.79	3.98	848.62	17.97	166.01	3.63	1436.22	32.58	279.37	5.90	8789.43	171.61	1.67	0.10	-0.02	0.49	74.28	1.37	4.04	0.20	8.32	0.21	518.17	12.62	680.72	14.76
PM18AJ203-12	367.49	6.53	140.38	2.37	672.22	9.55	133.05	2.06	1167.26	18.09	228.18	3.38	9530.28	189.86	1.41	0.10	0.04	0.57	56.80	1.08	3.07	0.20	6.06	0.20	375.22	5.41	516.02	7.67
PM18AJ203-13	612.90	21.04	236.69	7.53	1107.00	31.62	220.76	6.74	1884.83	57.25	364.25	10.13	9600.81	198.76	2.45	0.16	-0.18	0.60	100.86	2.43	5.56	0.32	12.76	0.40	780.48	30.14	903.29	27.46
PM18AJ203-14	347.64	8.10	131.60	2.64	616.32	13.28	122.43	2.81	1066.98	23.26	207.87	4.35	8830.47	139.30	1.38	0.11	0.13	0.56	52.81	1.01	2.80	0.19	5.85	0.21	351.01	7.42	480.83	9.41
PM18AJ203-15	227.77	5.28	85.90	1.94	407.64	8.69	82.47	1.77	726.63	14.38	143.73	3.27	9863.14	181.41	2.32	0.13	0.68	0.79	56.48	1.12	3.22	0.20	6.54	0.23	416.81	6.86	532.81	8.49
PM18AJ203-16	218.56	7.60	81.39	2.47	383.70	11.02	76.50	2.37	664.36	19.81	131.14	3.96	9326.79	199.77	0.87	0.09	0.37	0.74	31.84	0.90	1.67	0.15	2.91	0.16	173.62	5.81	281.20	7.66
PM18AJ203-17	397.77	10.29	145.45	3.49	686.73	18.03	136.78	3.78	1176.67	30.02	228.85	6.15	9700.40	201.92	1.52	0.11	0.11	0.70	61.65	1.57	3.28	0.22	6.86	0.26	424.86	11.73	561.29	14.54
PM18AJ203-18	352.92	5.80	131.68	2.18	617.84	10.81	120.97	2.09	1069.33	18.93	211.24	3.77	9201.09	196.38	1.27	0.10	0.13	0.53	48.70	1.11	2.66	0.17	5.34	0.19	328.31	5.73	452.81	7.90
PM18AJ203-19	178.46	3.38	74.98	1.46	393.24	5.96	85.49	1.48	793.97	12.97	167.32	2.95	9804.75	191.28	2.02	0.13	-0.41	0.48	49.38	1.36	2.63	0.18	3.20	0.21	190.63	5.15	453.08	7.98
PM18AJ203-20	148.72	2.97	60.33	1.18	311.41	6.59	66.58	1.44	602.02	11.18	124.84	2.26	10172.07	197.41	1.67	0.09	0.61	0.76	34.02	0.83	1.88	0.17	2.49	0.12	150.55	2.97	306.52	5.04
PM18AJ203-21	185.27	4.91	71.13	1.72	352.38	8.62	71.29	1.73	634.57	14.23	127.05	3.13	9866.89	172.01	2.00	0.15	0.42	0.68	45.28	1.05	2.43	0.18	4.49	0.18	259.50	8.49	401.78	10.33
PM18AJ203-22	354.10	6.46	130.38	2.68	609.96	10.79	121.86	2.58	1039.45	19.84	202.68	4.07	8540.91	170.95	1.23	0.10	-0.26	0.58	52.41	1.14	2.84	0.19	5.38	0.21	322.54	5.64	468.81	7.26
PM18AJ203-23	300.95	6.88	112.36	2.26	540.42	11.22	106.42	2.36	936.85	20.50	183.52	4.39	9630.90	188.13	1.19	0.09	-0.33	0.53	48.39	0.96	2.75	0.19	4.98	0.19	303.83	5.93	434.90	8.33
PM18AJ203-24	469.74	8.69	171.22	3.18	792.48	15.63	154.53	3.23	1343.49	27.04	260.14	5.07	8934.92	191.35	1.58	0.11	-0.36	0.50	69.68	1.35	4.04	0.21	7.98	0.22	476.89	9.42	628.01	11.93
PM18AJ273-01	48.12	1.35	21.17	0.50	114.45	2.27	26.80	0.69	273.14	5.92	64.32	1.36	10142.46	199.51	0.66	0.07	0.07	0.58	11.71	0.34	0.66	0.10	0.51	0.05	36.36	0.78	108.37	2.06
PM18AJ273-02	58.41	1.66	25.12	0.66	135.80	3.24	30.65	0.77	311.90	7.76	70.85	1.63	10145.80	199.89	0.69	0.07	0.20	0.63	13.81	0.43	0.76	0.09	0.78	0.06	47.29	0.91	127.34	2.42
PM18AJ273-03	45.78	1.19	19.76	0.55	110.93	2.39	25.61	0.64	267.77	5.13	61.60	1.24	9897.87	207.45	0.55	0.07	0.70	0.63	9.92	0.37	0.48	0.08	0.50	0.06	30.17	0.82	94.87	2.14
PM18AJ273-04	36.11	1.26	15.50	0.43	84.11	2.40	19.38	0.60	194.38	4.57	44.01	1.18	10570.99	228.45	0.45	0.06	-0.03	0.63	10.14	0.37	0.52	0.08	0.56	0.05	33.64	0.95	95.67	2.69
PM18AJ273-05	31.40	1.28	13.81	0.47	78.46	2.19	18.67	0.60	195.94	4.86	44.90	1.35	10511.41	218.03	0.52	0.06	0.12	0.66	12.79	0.42	0.75	0.09	0.61	0.05	37.28	0.89	118.40	2.70
PM18AJ273-06	38.32	1.17	16.25	0.46	91.27	2.23	21.30	0.57	222.79	6.45	51.82	1.46	10505.18	229.41	0.58	0.07	-0.16	0.48	12.83	0.53	0.64	0.08	0.61	0.05	37.58	1.07	115.66	3.25
PM18AJ273-07	46.14	1.57	20.00	0.69	111.42	3.28	26.81	0.86	279.63	8.02	65.21	2.07	10660.40	175.09	0.63	0.06	-0.28	0.47	17.88	0.55	0.99	0.10	1.04	0.07	57.47	1.47	160.26	2.44
PM18AJ273-08	36.97	1.36	15.58	0.42	82.48	2.31	19.51	0.57	196.83	4.70	45.49	0.95	10412.84	166.52	0.41	0.06	-0.60	0.48	11.93	0.42	0.73	0.10	0.63	0.05	36.44	0.84	105.41	2.36
PM18AJ273-09	54.07	1.50	23.50	0.59	135.23	2.85	32.59	0.72	335.68	6.66	77.22	1.63	10664.04	172.64	0.78	0.07	0.09	0.52	21.63	0.52	1.17	0.11	1.24	0.09	77.87	1.77	204.96	4.62
PM18AJ273-10	49.06	1.59	20.97	0.43	117.12	2.95	27.95	0.71	290.44	5.50	66.82	1.41	10970.83	195.56	1.03	0.10	0.80	0.66	26.14	0.69	1.48	0.12	1.65	0.09	88.37	1.81	233.69	3.66
PM18AJ273-11	59.62	2.26	26.73	0.83	150.94	4.80	36.73	1.09	389.06	12.21	92.56	3.01	10060.90	209.18	0.90	0.09	-0.27	0.51	19.53	0.61	1.07	0.12	1.03	0.08	57.52	2.19	182.04	5.88
PM18AJ273-12	52.31	1.74	21.42	0.63	117.47	3.55	27.11	0.86	267.53	9.17	59.44	2.16	9922.51	174.59	0.56	0.07	0.50	0.65	10.54	0.37	0.56	0.08	0.55	0.06	34.45	0.77	101.24	2.39
PM18AJ273-13	44.81	1.99	19.21	0.70	105.71	3.69	25.44	0.85	263.27	9.22	59.98	2.09	10787.83	224.71	0.60	0.08	-0.51	0.43	18.31	0.64	0.91	0.12	1.07	0.08	63.99	2.73	169.44	5.69
PM18AJ273-14	50.26	1.93	22.04	0.85	120.83	4.15	27.78	0.95	298.59	12.29	68.60	3.03	10464.65	216.27	0.68	0.08	0.20	0.58	20.13	0.49	1.19	0.13	1.16	0.07	68.65	1.24	188.61	3.31
PM18AJ273-15	50.05	1.59	21.80	0.77	126.72	3.77	30.70	0.96	326.76	10.04	78.08	2.55	10177.20	213.09	0.79	0.08	-0.24	0.64	16.29	0.58	0.84	0.11	0.80	0.07	45.00	1.50	150.25	4.94
PM18AJ273-16	49.83	1.41	20.62	0.50	115.59	2.57	27.33	0.62	277.75	4.54	63.90	1.19	10593.69	155.97	0.66	0.07	0.11	0.64	20.48	0.49	1.23	0.12	1.16	0.07	69.18	1.23	186.96	3.11
PM18AJ273-17	42.62	1.29	18.73	0.61	107.09	2.87	25.39	0.82	264.49	8.38	60.96	1.95	10667.20	168.29	0.61	0.06	0.29	0.60	16.04	0.44	0.95	0.10	0.76	0.07	50.78	0.97	151.42	2.78
PM18AJ273-18	43.70	1.45	18.42	0.53	100.99	3.17	23.40	0.68	229.49	6.07	52.85	1.45	10112.64	125.70	0.50	0.06	-0.08	0.53	9.51	0.36	0.56	0.09	0.54	0.05	31.65	0.56	89.14	1.50
PM18AJ273-19	50.42	2.54	21.26	1.08	121.15	6.23	28.67	1.54	293.62	14.35	67.31	3.37	9984.89	156.35	0.59	0.07	0.47	0.63	17.04	0.52	0.88	0.10	0.89	0.07	52.53	1.91	152.99	3.64
PM18AJ273-20	63.34	5.41	26.46	2.26	138.34	11.55	31.60	2.44	307.90	23.99	68.78	5.26	10760.97	178.68	0.43	0.06	0.38	0.60	13.59	1.02	0.74	0.10	0.93	0.11	54.75	6.34	125.19	10.70
PM18AJ273-21	44.09	1.45	19.14	0.56	105.27	2.23	24.39	0.59	246.36	5.21	57.33	1.26	9953.08	181.94	0.55	0.07	-0.33	0.52	15.81	0.43	0.96	0.12	0.93	0.07	54.73	1.72	142.29	2.91
PM18AJ273-22	42.80	1.42	19.22	0.43	108.48	2.36	25.59	0.53	260.32	5.01	59.27	0.94	9705.98	150.20	0.48	0.06	-0.42	0.41	12.63	0.47	0.80	0.09	0.71	0.05	40.36	1.48	114.89	3.59
PM18AJ273-23	58.75	2.77	24.09	1.05	126.77	4.45	29.33	0.90	293.92	9.26	64.73	2.01	9895.12	169.03	0.47	0.06	0.59	0.63	14.44	0.64	0.90	0.11	1.00	0.10	55.79	3.65	124.86	3.79
PM18AJ273-24	40.85	1.43	17.28	0.54	95.32	2.75	22.38	0.62	231.49	6.06	52.96	1.48	10693.93	173.96	0.52	0.06	0.06	0.51	12.84	0.40	0.74	0.10	0.63	0.06	42.66	0.87	120.60	2.47

***All elements in ppm.**

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ248-01	PM18AJ248-02	PM18AJ248-03	PM18AJ248-04	PM18AJ248-05	PM18AJ248-06	PM18AJ248-07	PM18AJ248-08	PM18AJ248-09	PM18AJ248-10	PM18AJ248-11	PM18AJ248-12
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (µm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**176.11**	**170.03**	**172.53**	**164.26**	**170.55**	**170.02**	**172.36**	**168.99**	**166.65**	**170.89**	**163.47**	**167.83**
2 Std. Err.	**3.40**	**3.18**	**2.56**	**3.22**	**2.68**	**2.75**	**3.44**	**3.46**	**3.74**	**3.62**	**3.43**	**3.54**
206Pb/238U	0.0277	0.0267	0.0271	0.0258	0.0268	0.0267	0.0271	0.0266	0.0262	0.0269	0.0257	0.0264
2 Std. Err.	0.0005	0.0005	0.0004	0.0005	0.0004	0.0004	0.0005	0.0006	0.0006	0.0006	0.0005	0.0006
207Pb/235U	0.1872	0.1838	0.1738	0.1746	0.1689	0.1721	0.1788	0.1811	0.1841	0.1842	0.1789	0.2030
2 Std. Err.	0.0073	0.0093	0.0054	0.0063	0.0071	0.0076	0.0068	0.0075	0.0069	0.0069	0.0064	0.0133
207Pb/206Pb	0.0496	0.0510	0.0466	0.0494	0.0456	0.0465	0.0478	0.0491	0.0510	0.0497	0.0507	0.0554
2 Std. Err.	0.0019	0.0028	0.0013	0.0017	0.0017	0.0018	0.0018	0.0019	0.0019	0.0019	0.0017	0.0029
208Pb/232Th	0.0092	0.0094	0.0094	0.0091	0.0094	0.0093	0.0091	0.0090	0.0079	0.0083	0.0082	0.0089
2 Std. Err.	0.0002	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0003
Total Pb ppm	55.90	40.50	104.34	55.34	64.91	36.76	44.13	49.29	55.01	77.20	54.73	47.06
232Th ppm	1327.85	944.25	3284.38	1340.16	1852.89	796.93	954.73	1264.88	1465.57	2167.21	1396.13	1170.62
238U ppm	1580.34	1200.41	2726.19	1675.35	1790.03	1087.81	1292.75	1413.80	1570.27	2105.11	1613.44	1312.52
207Pb/235U age	173.85	172.20	162.47	163.13	158.07	160.86	166.72	168.61	171.22	171.33	166.83	186.52
2 Std. Err.	6.25	8.32	4.67	5.38	6.14	6.63	5.84	6.47	5.93	5.90	5.53	10.95
207Pb/206Pb age	350.36	468.91	253.86	314.19	268.77	294.10	284.44	359.76	368.01	362.12	397.26	547.19
2 Std. Err.	71.17	102.96	53.52	62.10	71.13	56.73	64.72	70.85	63.65	66.25	60.22	102.11
208Pb/232Th age	184.99	188.86	189.00	182.73	189.72	187.45	183.66	180.27	159.60	166.45	164.98	179.86
2 Std. Err.	3.83	5.61	3.53	3.39	3.36	4.84	4.13	4.09	3.82	2.74	2.93	5.48
Concordance (%)	98.71	98.72	94.17	99.31	92.68	94.61	96.72	99.77	97.26	99.75	97.94	88.86

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ248-13	PM18AJ248-14	PM18AJ248-15	PM18AJ248-16	PM18AJ248-17	PM18AJ248-18	PM18AJ248-19	PM18AJ248-20	PM18AJ248-21	PM18AJ248-22	PM18AJ248-23	PM18AJ248-24
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (µm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**167.52**	**156.72**	**170.43**	**164.56**	**165.36**	**162.67**	**154.87**	**167.12**	**152.90**	**160.34**	**163.92**	**171.58**
2 Std. Err.	**3.56**	**3.71**	**2.88**	**3.11**	**2.59**	**3.02**	**5.18**	**4.06**	**2.81**	**3.41**	**3.47**	**3.31**
206Pb/238U	0.0263	0.0246	0.0268	0.0259	0.0260	0.0256	0.0243	0.0263	0.0240	0.0252	0.0258	0.0270
2 Std. Err.	0.0006	0.0006	0.0005	0.0005	0.0004	0.0005	0.0008	0.0006	0.0004	0.0005	0.0006	0.0005
207Pb/235U	0.1751	0.1683	0.1714	0.1736	0.1875	0.2008	0.1977	0.2149	0.2073	0.2151	0.2367	0.1924
2 Std. Err.	0.0068	0.0072	0.0082	0.0062	0.0086	0.0085	0.0100	0.0106	0.0104	0.0110	0.0209	0.0104
207Pb/206Pb	0.0484	0.0500	0.0465	0.0487	0.0506	0.0555	0.0580	0.0590	0.0639	0.0633	0.0673	0.0537
2 Std. Err.	0.0017	0.0019	0.0020	0.0015	0.0023	0.0024	0.0026	0.0027	0.0030	0.0032	0.0047	0.0029
208Pb/232Th	0.0084	0.0081	0.0089	0.0087	0.0086	0.0095	0.0099	0.0128	0.0152	0.0155	0.0166	0.0139
2 Std. Err.	0.0002	0.0003	0.0002	0.0006	0.0002	0.0003	0.0003	0.0005	0.0005	0.0005	0.0007	0.0004
Total Pb ppm	65.52	83.36	35.41	55.15	31.49	34.00	55.08	32.65	35.21	24.35	54.29	26.39
232Th ppm	1714.57	2687.52	737.43	1359.91	636.00	629.60	1505.38	665.81	648.68	497.39	1234.96	489.67
238U ppm	1863.79	2378.50	1024.18	1583.74	946.52	1061.02	1673.88	980.08	1167.21	762.90	1543.71	773.71
207Pb/235U age	163.53	157.78	160.15	162.24	174.00	185.32	182.84	196.89	190.58	197.07	213.21	177.93
2 Std. Err.	5.87	6.27	7.09	5.31	7.28	7.24	8.45	8.81	8.78	9.01	16.07	8.79
207Pb/206Pb age	316.86	308.94	373.40	306.58	464.88	548.84	576.81	625.74	785.13	736.45	745.57	548.50
2 Std. Err.	67.70	70.23	66.33	56.14	80.01	72.01	80.81	83.51	86.12	104.52	99.30	87.63
208Pb/232Th age	168.93	163.31	178.73	174.81	173.80	190.64	199.18	257.01	305.08	310.34	332.39	279.58
2 Std. Err.	3.27	5.08	3.99	11.15	4.57	5.26	6.31	9.27	9.18	9.46	13.48	8.08
Concordance (%)	97.62	99.32	93.97	98.59	94.77	86.07	81.94	82.19	75.35	77.09	69.93	96.30

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ289-01	PM18AJ289-02	PM18AJ289-03	PM18AJ289-04	PM18AJ289-05	PM18AJ289-06	PM18AJ289-07	PM18AJ289-08	PM18AJ289-09	PM18AJ289-10	PM18AJ289-11	PM18AJ289-12
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (μm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**169.44**	**167.94**	**165.67**	**164.24**	**171.40**	**165.69**	**168.93**	**170.77**	**178.49**	**173.33**	**175.64**	**178.18**
2 Std. Err.	**6.20**	**6.37**	**5.30**	**5.93**	**6.46**	**6.56**	**7.31**	**4.97**	**5.95**	**6.06**	**6.62**	**5.81**
206Pb/238U	0.0266	0.0264	0.0260	0.0258	0.0270	0.0260	0.0266	0.0269	0.0281	0.0273	0.0276	0.0280
2 Std. Err.	0.0010	0.0010	0.0008	0.0009	0.0010	0.0010	0.0012	0.0008	0.0009	0.0010	0.0011	0.0009
207Pb/235U	0.1427	0.1452	0.1574	0.2691	0.1655	0.1643	0.1767	0.1657	0.2696	0.2017	0.1934	0.2019
2 Std. Err.	0.0172	0.0167	0.0184	0.0313	0.0151	0.0218	0.0231	0.0188	0.0316	0.0177	0.0225	0.0224
207Pb/206Pb	0.0383	0.0390	0.0426	0.0748	0.0443	0.0460	0.0485	0.0444	0.0704	0.0538	0.0512	0.0531
2 Std. Err.	0.0048	0.0045	0.0050	0.0085	0.0042	0.0062	0.0063	0.0050	0.0084	0.0050	0.0063	0.0062
208Pb/232Th	0.0043	0.0049	0.0052	0.0115	0.0069	0.0060	0.0069	0.0080	0.0131	0.0101	0.0098	0.0100
2 Std. Err.	0.0003	0.0004	0.0004	0.0013	0.0005	0.0006	0.0006	0.0007	0.0012	0.0007	0.0008	0.0007
Total Pb ppm	5.08	4.93	4.97	5.70	5.57	4.13	4.12	4.49	5.84	6.42	4.44	6.10
232Th ppm	65.56	53.05	53.78	46.63	67.69	51.78	47.66	49.07	58.83	73.89	47.28	68.48
238U ppm	159.88	161.99	165.43	169.62	174.45	135.71	134.08	144.79	168.22	203.48	139.34	186.59
207Pb/235U age	136.09	135.58	145.99	240.67	153.94	151.14	161.56	153.19	236.73	184.46	176.13	183.47
2 Std. Err.	16.15	14.84	15.99	26.58	13.07	18.90	19.62	16.16	24.34	14.89	18.99	18.58
207Pb/206Pb age	601.95	599.54	713.52	1337.57	599.97	899.40	857.26	656.49	1109.38	759.54	921.30	847.63
2 Std. Err.	147.88	132.66	170.35	174.78	139.59	173.04	165.61	157.93	176.85	154.40	178.66	179.88
208Pb/232Th age	86.90	98.57	105.66	230.29	139.68	120.02	138.78	160.83	262.31	203.48	197.80	201.90
2 Std. Err.	6.42	7.24	7.70	26.31	10.93	11.46	12.20	13.48	23.22	13.01	15.27	14.12
Concordance (%)	80.32	80.73	88.12	53.46	89.81	91.22	95.64	89.7	67.37	93.58	99.73	97.03

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ289-13	PM18AJ289-14	PM18AJ289-15	PM18AJ289-16	PM18AJ289-17	PM18AJ289-18	PM18AJ289-19	PM18AJ289-20	PM18AJ289-21	PM18AJ289-22	PM18AJ289-23	PM18AJ289-24
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (μm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**165.60**	**170.51**	**172.57**	**176.02**	**204.18**	**121.72**	**138.84**	**165.66**	**166.21**	**173.05**	**168.37**	**175.31**
2 Std. Err.	**5.62**	**4.74**	**5.80**	**5.19**	**6.50**	**8.25**	**4.41**	**4.76**	**5.52**	**5.57**	**4.95**	**7.02**
206Pb/238U	0.0260	0.0268	0.0271	0.0277	0.0322	0.0191	0.0218	0.0260	0.0261	0.0272	0.0265	0.0276
2 Std. Err.	0.0009	0.0008	0.0009	0.0008	0.0010	0.0013	0.0007	0.0008	0.0009	0.0009	0.0008	0.0011
207Pb/235U	0.1817	0.2020	0.2115	0.1813	0.2257	0.1779	0.1709	0.1958	0.2009	0.1909	0.2031	0.2034
2 Std. Err.	0.0200	0.0150	0.0237	0.0162	0.0187	0.0131	0.0154	0.0145	0.0197	0.0174	0.0241	0.0172
207Pb/206Pb	0.0504	0.0543	0.0565	0.0480	0.0499	0.0762	0.0555	0.0526	0.0540	0.0491	0.0538	0.0525
2 Std. Err.	0.0054	0.0037	0.0061	0.0041	0.0040	0.0094	0.0052	0.0039	0.0056	0.0045	0.0063	0.0056
208Pb/232Th	0.0104	0.0106	0.0100	0.0091	0.0090	0.0065	0.0095	0.0085	0.0079	0.0089	0.0084	0.0098
2 Std. Err.	0.0006	0.0004	0.0007	0.0005	0.0007	0.0004	0.0007	0.0005	0.0005	0.0006	0.0007	0.0006
Total Pb ppm	5.58	11.73	5.49	8.86	7.80	11.26	5.91	8.22	5.73	5.94	4.73	8.31
232Th ppm	79.59	224.81	65.02	124.11	48.83	334.43	64.22	105.75	68.03	75.35	54.81	126.73
238U ppm	177.49	345.83	172.86	269.70	214.45	464.23	226.17	261.36	185.06	183.22	150.36	235.93
207Pb/235U age	166.76	185.37	191.24	167.38	204.41	165.09	160.98	180.13	183.31	175.34	187.33	185.99
2 Std. Err.	17.21	12.56	19.25	13.84	15.34	11.26	14.20	12.23	16.52	14.74	20.76	14.52
207Pb/206Pb age	746.02	711.27	886.26	594.83	638.29	1210.04	834.93	631.75	903.45	635.55	901.13	655.86
2 Std. Err.	148.38	117.04	172.36	114.42	129.95	211.14	149.04	118.91	154.11	130.40	166.82	142.10
208Pb/232Th age	208.28	212.93	200.11	183.56	181.51	131.05	191.57	171.36	158.09	179.55	168.46	196.35
2 Std. Err.	11.78	8.94	13.32	10.98	13.08	7.92	14.51	9.51	10.66	11.64	13.81	11.98
Concordance (%)	99.3	91.28	89.18	95.09	99.88	64.37	84.05	91.26	89.71	98.68	88.74	93.91

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ203-01	PM18AJ203-02	PM18AJ203-03	PM18AJ203-04	PM18AJ203-05	PM18AJ203-06	PM18AJ203-07	PM18AJ203-08	PM18AJ203-09	PM18AJ203-10	PM18AJ203-11	PM18AJ203-12
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (µm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**172.04**	**164.45**	**168.97**	**171.22**	**171.39**	**166.98**	**170.01**	**167.18**	**171.67**	**176.49**	**170.16**	**170.56**
2 Std. Err.	**3.69**	**3.77**	**3.11**	**3.87**	**3.38**	**2.59**	**3.30**	**2.84**	**3.08**	**3.65**	**3.58**	**3.07**
206Pb/238U	0.0271	0.0258	0.0266	0.0269	0.0269	0.0262	0.0267	0.0263	0.0270	0.0278	0.0268	0.0268
2 Std. Err.	0.0006	0.0006	0.0005	0.0006	0.0005	0.0004	0.0005	0.0005	0.0005	0.0006	0.0006	0.0005
207Pb/235U	0.1907	0.1823	0.1893	0.1896	0.1916	0.1882	0.1804	0.1799	0.1884	0.1930	0.1842	0.1833
2 Std. Err.	0.0128	0.0109	0.0104	0.0148	0.0106	0.0112	0.0108	0.0106	0.0112	0.0107	0.0093	0.0116
207Pb/206Pb	0.0506	0.0502	0.0510	0.0510	0.0507	0.0515	0.0488	0.0494	0.0507	0.0501	0.0497	0.0495
2 Std. Err.	0.0033	0.0027	0.0026	0.0040	0.0027	0.0030	0.0030	0.0030	0.0030	0.0026	0.0024	0.0032
208Pb/232Th	0.0083	0.0081	0.0082	0.0083	0.0083	0.0082	0.0082	0.0082	0.0086	0.0093	0.0082	0.0082
2 Std. Err.	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002	0.0003	0.0002	0.0002	0.0003	0.0002	0.0003
Total Pb ppm	15.74	16.61	23.19	13.38	19.07	28.23	21.32	19.92	21.94	25.27	23.24	17.61
232Th ppm	303.13	365.00	585.42	267.99	397.41	813.51	468.73	454.90	484.92	659.63	518.17	375.22
238U ppm	462.41	502.55	653.48	394.00	557.82	776.28	622.27	585.85	625.99	667.99	680.72	516.02
207Pb/235U age	176.13	169.23	175.31	174.82	177.27	174.25	167.58	167.23	176.10	180.01	171.07	169.95
2 Std. Err.	10.92	9.32	8.76	12.52	8.97	9.49	9.24	9.15	10.05	9.55	7.93	9.97
207Pb/206Pb age	553.71	496.84	490.68	615.25	482.76	508.35	477.33	472.96	507.21	464.11	443.73	526.97
2 Std. Err.	97.90	84.49	91.07	115.55	89.77	107.21	109.08	100.24	102.75	80.02	84.35	97.12
208Pb/232Th age	166.18	162.24	165.73	166.54	166.24	164.75	165.45	164.97	172.75	186.59	164.43	164.99
2 Std. Err.	5.97	5.66	5.22	5.90	6.55	3.77	5.33	4.41	4.98	5.39	4.42	5.41
Concordance (%)	97.62	97.09	96.25	97.9	96.57	95.65	98.57	99.97	97.42	98	99.47	99.64

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ203-13	PM18AJ203-14	PM18AJ203-15	PM18AJ203-16	PM18AJ203-17	PM18AJ203-18	PM18AJ203-19	PM18AJ203-20	PM18AJ203-21	PM18AJ203-22	PM18AJ203-23	PM18AJ203-24
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (µm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**173.77**	**170.61**	**165.87**	**177.17**	**171.89**	**168.08**	**170.98**	**172.35**	**176.49**	**174.13**	**173.67**	**173.81**
2 Std. Err.	**3.11**	**3.58**	**3.38**	**4.73**	**3.63**	**3.54**	**3.84**	**3.43**	**3.24**	**3.12**	**3.53**	**3.57**
206Pb/238U	0.0273	0.0268	0.0261	0.0279	0.0270	0.0264	0.0269	0.0271	0.0278	0.0274	0.0273	0.0273
2 Std. Err.	0.0005	0.0006	0.0005	0.0008	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005	0.0006	0.0006
207Pb/235U	0.1902	0.1791	0.1851	0.1846	0.1828	0.1801	0.1773	0.1876	0.1840	0.1842	0.1909	0.1961
2 Std. Err.	0.0099	0.0119	0.0105	0.0170	0.0128	0.0114	0.0112	0.0176	0.0126	0.0119	0.0130	0.0094
207Pb/206Pb	0.0502	0.0482	0.0523	0.0483	0.0488	0.0496	0.0482	0.0502	0.0483	0.0484	0.0512	0.0522
2 Std. Err.	0.0027	0.0033	0.0034	0.0045	0.0033	0.0032	0.0031	0.0048	0.0036	0.0031	0.0035	0.0028
208Pb/232Th	0.0085	0.0085	0.0080	0.0086	0.0083	0.0084	0.0084	0.0086	0.0090	0.0086	0.0085	0.0087
2 Std. Err.	0.0002	0.0003	0.0003	0.0004	0.0002	0.0003	0.0004	0.0004	0.0004	0.0003	0.0003	0.0002
Total Pb ppm	32.26	16.52	17.83	9.61	19.27	15.19	14.22	9.97	13.87	16.12	14.93	21.95
232Th ppm	780.48	351.01	416.81	173.62	424.86	328.31	190.63	150.55	259.50	322.54	303.83	476.89
238U ppm	903.29	480.83	532.81	281.20	561.29	452.81	453.08	306.52	401.78	468.81	434.90	628.01
207Pb/235U age	176.13	166.33	173.45	170.02	169.31	167.23	164.84	172.45	170.43	170.71	178.22	182.69
2 Std. Err.	8.42	10.23	9.60	14.56	10.94	9.85	9.61	14.90	10.86	10.19	11.62	7.53
207Pb/206Pb age	486.34	563.86	609.75	660.18	510.71	552.14	517.26	719.12	542.64	528.24	648.75	521.03
2 Std. Err.	83.52	116.84	119.79	126.71	115.89	88.41	97.35	142.70	97.81	90.97	109.47	89.52
208Pb/232Th age	170.45	170.84	162.04	172.79	166.53	169.78	169.08	172.18	181.59	173.98	171.76	175.27
2 Std. Err.	4.24	5.78	5.05	8.33	4.70	5.10	8.20	7.99	7.03	6.19	6.20	4.55
Concordance (%)	98.64	97.49	95.43	95.96	98.5	99.49	96.41	99.94	96.56	98.04	97.38	94.9

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ273-01	PM18AJ273-02	PM18AJ273-03	PM18AJ273-04	PM18AJ273-05	PM18AJ273-06	PM18AJ273-07	PM18AJ273-08	PM18AJ273-09	PM18AJ273-10	PM18AJ273-11	PM18AJ273-12
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (μm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**165.67**	**167.34**	**164.25**	**164.38**	**167.66**	**171.20**	**173.61**	**173.86**	**163.03**	**173.96**	**167.88**	**160.12**
2 Std. Err.	**5.02**	**4.65**	**6.46**	**5.57**	**5.78**	**5.50**	**4.30**	**5.40**	**3.94**	**4.97**	**4.97**	**4.90**
206Pb/238U	0.0260	0.0263	0.0258	0.0258	0.0264	0.0269	0.0273	0.0273	0.0256	0.0274	0.0264	0.0252
2 Std. Err.	0.0008	0.0007	0.0010	0.0009	0.0009	0.0009	0.0007	0.0009	0.0006	0.0008	0.0008	0.0008
207Pb/235U	0.1805	0.1825	0.1545	0.1740	0.1890	0.1683	0.1872	0.2155	0.1725	0.1901	0.1736	0.1661
2 Std. Err.	0.0276	0.0237	0.0242	0.0274	0.0235	0.0211	0.0199	0.0321	0.0160	0.0156	0.0180	0.0239
207Pb/206Pb	0.0503	0.0490	0.0452	0.0479	0.0514	0.0457	0.0478	0.0568	0.0475	0.0518	0.0490	0.0491
2 Std. Err.	0.0080	0.0061	0.0080	0.0075	0.0065	0.0058	0.0046	0.0088	0.0042	0.0048	0.0053	0.0075
208Pb/232Th	0.0073	0.0082	0.0084	0.0083	0.0082	0.0084	0.0091	0.0087	0.0079	0.0093	0.0090	0.0079
2 Std. Err.	0.0008	0.0006	0.0010	0.0008	0.0007	0.0007	0.0006	0.0007	0.0006	0.0005	0.0007	0.0009
Total Pb ppm	3.25	3.91	2.78	2.87	3.59	3.57	5.08	3.38	6.14	7.52	5.51	2.99
232Th ppm	36.36	47.29	30.17	33.64	37.28	37.58	57.47	36.44	77.87	88.37	57.52	34.45
238U ppm	108.37	127.34	94.87	95.67	118.40	115.66	160.26	105.41	204.96	233.69	182.04	101.24
207Pb/235U age	167.43	166.43	141.69	157.70	171.97	154.82	171.60	191.68	159.75	177.48	162.89	151.95
2 Std. Err.	24.46	19.86	21.13	23.53	19.98	18.08	16.81	26.13	13.90	13.96	16.35	20.71
207Pb/206Pb age	1114.79	841.98	918.96	1038.12	896.90	750.64	729.09	1032.98	593.19	737.70	833.10	1002.61
2 Std. Err.	223.04	184.24	216.33	190.46	178.52	153.71	156.77	210.69	117.10	150.96	133.32	197.31
208Pb/232Th age	146.92	164.49	167.93	167.59	165.04	169.56	183.12	174.69	159.74	186.50	181.75	159.62
2 Std. Err.	15.59	12.81	19.16	15.85	13.82	14.67	12.80	14.31	11.18	10.05	13.96	17.02
Concordance (%)	98.94	99.46	86.27	95.94	97.43	90.43	98.84	89.75	97.99	97.98	97.03	94.9

Appendix C:
Pemberton Hills Zircon Geochronology Data (LA-ICP-MS)

Sample / spot	PM18AJ273-13	PM18AJ273-14	PM18AJ273-15	PM18AJ273-16	PM18AJ273-17	PM18AJ273-18	PM18AJ273-19	PM18AJ273-20	PM18AJ273-21	PM18AJ273-22	PM18AJ273-23	PM18AJ273-24
Method	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**	**U-Pb**
Mineral	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**	**Zircon**
Spot size (μm)	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**	**32**
206Pb/238U age (Ma)	**167.58**	**164.64**	**168.36**	**168.67**	**163.78**	**164.11**	**171.80**	**169.76**	**173.01**	**171.10**	**178.34**	**165.97**
2 Std. Err.	**4.30**	**4.01**	**5.07**	**4.38**	**4.47**	**7.03**	**5.03**	**4.79**	**5.21**	**6.23**	**5.31**	**5.28**
206Pb/238U	0.0263	0.0259	0.0265	0.0265	0.0256	0.0258	0.0270	0.0267	0.0272	0.0269	0.0281	0.0261
2 Std. Err.	0.0007	0.0006	0.0008	0.0007	0.0007	0.0011	0.0008	0.0008	0.0008	0.0010	0.0008	0.0008
207Pb/235U	0.1644	0.1877	0.1663	0.1994	0.1903	0.1812	0.1737	0.1810	0.2058	0.2132	0.2151	0.1878
2 Std. Err.	0.0209	0.0196	0.0207	0.0192	0.0196	0.0285	0.0194	0.0229	0.0267	0.0245	0.0233	0.0260
207Pb/206Pb	0.0457	0.0526	0.0461	0.0543	0.0538	0.0522	0.0473	0.0495	0.0554	0.0567	0.0555	0.0535
2 Std. Err.	0.0061	0.0055	0.0061	0.0051	0.0054	0.0084	0.0056	0.0066	0.0072	0.0064	0.0063	0.0078
208Pb/232Th	0.0084	0.0085	0.0090	0.0085	0.0075	0.0085	0.0086	0.0087	0.0085	0.0089	0.0091	0.0075
2 Std. Err.	0.0006	0.0005	0.0008	0.0006	0.0007	0.0008	0.0007	0.0007	0.0006	0.0006	0.0006	0.0007
Total Pb ppm	5.19	5.75	4.52	5.87	4.50	2.70	4.80	3.95	4.54	3.59	4.19	3.62
232Th ppm	63.99	68.65	45.00	69.18	50.78	31.65	52.53	54.75	54.73	40.36	55.79	42.66
238U ppm	169.44	188.61	150.25	186.96	151.42	89.14	152.99	125.19	142.29	114.89	124.86	120.60
207Pb/235U age	151.43	172.04	156.22	182.16	174.37	167.68	162.93	165.31	185.40	192.37	194.31	174.00
2 Std. Err.	18.10	16.70	19.00	16.18	16.43	25.26	17.71	19.80	21.99	20.15	19.46	22.77
207Pb/206Pb age	844.52	758.20	885.91	747.39	765.46	1001.36	726.63	943.41	966.95	906.44	996.80	1023.35
2 Std. Err.	177.87	143.35	171.45	136.12	146.57	225.35	174.42	188.82	192.29	191.51	163.37	233.86
208Pb/232Th age	169.34	170.29	180.03	171.12	150.95	171.36	173.02	175.52	171.82	179.66	182.56	151.57
2 Std. Err.	11.58	10.73	15.09	11.22	13.78	15.89	14.41	13.06	12.40	12.09	11.77	13.80
Concordance (%)	90.37	95.51	92.79	92.01	93.53	97.82	94.84	97.38	92.83	87.57	91.05	95.16

Appendix D:
Pemberton Hills Epidote Geochronology Data (LA-ICP-MS)

Sample	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274
Method	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb
Mineral	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote
Spot size (µm)	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Corrected 206Pb/238U Age (Ma)	168.9	172.7	350.1	175.0	168.8	210.1	169.3	285.1	162.9	222.6	168.9	168.6	151.6	167.1	145.3	281.3	233.4	280.2	289.6	228.6	210.1
2 Std. Err.	8.7	10.6	18.5	10.4	6.5	13.1	8.6	16.9	15.1	31.9	8.2	8.2	9.5	12.5	10.3	13.5	13.9	21.1	13.0	25.1	9.6
206Pb/238U	0.053	0.054	0.253	0.059	0.041	0.119	0.057	0.215	0.063	0.198	0.080	0.088	0.061	0.060	0.051	0.216	0.133	0.193	0.229	0.139	0.141
1 Std. Err.	3.3	3.6	3.7	3.5	3.0	3.4	3.2	3.2	3.9	3.3	1.5	1.4	1.9	2.9	2.3	1.4	2.4	2.8	1.7	3.1	2.0
207Pb/235U	3.267	3.407	26.236	3.957	1.838	10.686	3.805	22.082	4.651	20.851	6.619	7.543	4.599	4.122	3.523	22.253	12.112	19.165	24.014	12.952	13.587
1 Std. Err.	3.8	4.1	4.0	4.0	3.4	3.8	3.5	3.4	4.4	2.9	2.2	1.8	2.3	3.3	3.1	1.8	2.5	3.3	2.1	4.3	2.2
207Pb/206Pb	0.4503	0.4547	0.7516	0.4842	0.3282	0.6531	0.4829	0.7457	0.5338	0.7675	0.5986	0.6242	0.5456	0.5030	0.4981	0.7491	0.6601	0.7204	0.7599	0.6765	0.6982
1 Std. Err.	2.4	3.3	2.0	2.8	1.5	1.7	2.0	1.7	3.9	3.0	1.3	1.1	2.3	3.8	3.2	1.2	2.1	2.7	1.1	3.8	0.6
238U/206Pb	18.99	18.39	3.95	16.84	24.58	8.41	17.46	4.65	15.83	5.06	12.48	11.39	16.33	16.83	19.46	4.64	7.52	5.17	4.35	7.21	7.09
1 Std. Err.	3.2	3.6	3.6	3.4	3.0	3.4	3.1	3.1	3.9	2.9	1.3	1.2	1.8	2.7	2.3	1.4	2.2	2.6	1.6	3.0	1.9
204Pb ppm	<0.0299	<0.0453	0.14	<0.0291	0.07	0.12	0.03	0.11	<0.0277	0.11	0.22	0.24	<0.0282	<0.0273	<0.0294	0.46	0.04	0.05	0.32	<0.0339	1.18
206Pb ppm	1.64	2.06	3.56	1.12	4.83	3.30	2.27	2.62	0.50	2.19	6.28	6.37	1.47	0.54	0.97	9.17	1.64	1.53	6.77	0.72	25.55
207Pb ppm	0.74	0.94	2.69	0.55	1.60	2.17	1.10	1.96	0.27	1.69	3.78	4.01	0.81	0.27	0.48	6.92	1.09	1.11	5.19	0.49	17.99
208Pb ppm	1.70	2.40	6.62	1.34	3.51	5.31	2.41	4.78	0.68	4.03	8.97	9.52	1.91	0.64	1.06	16.87	2.58	2.78	12.63	1.24	43.71
232Th ppm	0.07	0.03	0.01	0.16	0.89	1.45	1.77	1.79	0.47	0.06	0.64	1.67	4.64	1.45	0.04	5.02	2.54	2.55	16.44	0.26	2.36
235U ppm	0.22	0.26	0.08	0.14	0.81	0.20	0.28	0.10	0.06	0.06	0.45	0.48	0.15	0.06	0.12	0.30	0.08	0.05	0.22	0.02	1.22
238U ppm	31.81	37.26	14.48	19.08	119.60	28.17	39.71	12.15	7.80	10.58	75.85	72.15	23.86	8.96	18.87	40.92	12.23	7.68	29.47	5.00	179.44
206Pb/238U age	330.8	341.4	1456.3	371.4	256.8	723.1	358.7	1255.2	396.0	1162.7	498.1	542.1	382.9	373.0	322.6	1258.8	806.8	1137.6	1330.8	839.8	851.9
2 Std. Err.	6.6	7.2	7.5	6.9	6.1	6.8	6.4	6.4	7.8	6.5	3.0	2.7	3.7	5.7	4.6	2.9	4.8	5.7	3.4	6.2	3.9
207Pb/235U age	1473.1	1505.9	3355.4	1625.4	1059.0	2496.2	1593.9	3187.3	1758.6	3131.7	2061.8	2178.1	1749.1	1658.6	1532.3	3194.8	2613.1	3050.2	3268.9	2676.1	2721.3
2 Std. Err.	7.6	8.2	8.0	7.9	6.8	7.6	7.0	6.8	8.7	5.8	4.4	3.5	4.6	6.7	6.1	3.6	5.0	6.6	4.3	8.6	4.3
207Pb/206Pb age	4085.7	4100.0	4832.1	4193.3	3608.2	4630.3	4189.2	4820.8	4336.7	4861.9	4504.0	4564.6	4368.8	4249.4	4235.0	4827.3	4645.6	4771.3	4847.8	4681.0	4726.3
2 Std. Err.	0.9	1.2	0.6	1.0	0.6	0.5	0.7	0.5	1.3	0.9	0.4	0.3	0.8	1.3	1.1	0.4	0.6	0.8	0.3	1.2	0.2
Common Pb at 206Pb/238U age	0.858	0.858	0.949	0.861	0.853	0.886	0.860	0.931	0.862	0.922	0.870	0.873	0.861	0.861	0.857	0.931	0.893	0.920	0.937	0.896	0.897

Appendix D:
Pemberton Hills Epidote Geochronology Data (LA-ICP-MS)

Sample	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274	PM18AJ274
Method	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb
Mineral	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote	Epidote
Spot size (µm)	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Corrected 206Pb/238U Age (Ma)	171.4	164.7	168.0	182.8	180.2	512.0	180.0	373.8	171.0	229.0	173.9	338.5	176.5	249.4	168.4	165.2	159.0	164.4	162.1	166.8
2 Std. Err.	8.5	15.6	8.2	7.9	7.5	17.0	8.0	6.5	9.2	11.2	8.7	10.7	11.3	17.9	11.0	8.1	8.0	8.4	8.0	8.0
206Pb/238U	0.047	0.078	0.051	0.060	0.050	0.401	0.058	0.060	0.050	0.132	0.064	0.258	0.087	0.182	0.085	0.054	0.035	0.033	0.039	0.031
1 Std. Err.	2.9	2.9	2.7	2.4	2.5	2.5	2.5	3.3	2.9	2.2	2.4	1.9	3.2	3.4	3.2	3.2	3.6	3.8	3.4	3.8
207Pb/235U	2.594	6.364	3.083	3.945	2.710	45.424	3.689	3.970	2.872	12.110	4.512	27.186	7.264	18.236	7.184	3.535	1.335	1.038	1.794	0.790
1 Std. Err.	3.7	3.2	3.4	2.8	3.6	2.7	3.1	4.0	3.7	2.5	2.9	2.1	3.8	3.8	3.7	3.8	4.7	6.4	4.4	5.7
207Pb/206Pb	0.3973	0.5953	0.4390	0.4743	0.3961	0.8217	0.4630	0.4820	0.4195	0.6627	0.5136	0.7635	0.6084	0.7274	0.6147	0.4718	0.2774	0.2267	0.3314	0.1822
1 Std. Err.	3.6	3.2	2.8	2.3	3.1	1.8	2.5	4.2	3.7	1.5	2.2	0.7	1.7	1.9	1.5	1.8	3.7	5.0	3.1	5.0
238U/206Pb	21.11	12.91	19.60	16.57	20.16	2.49	17.30	16.71	20.11	7.55	15.70	3.87	11.53	5.49	11.78	18.36	28.61	30.08	25.39	31.72
1 Std. Err.	2.9	2.8	2.6	2.4	2.5	2.5	2.5	3.3	2.7	2.1	2.3	1.9	3.2	3.3	3.2	3.2	3.5	3.7	3.4	3.7
204Pb ppm	<0.0308	<0.0316	0.03	0.05	0.06	0.23	0.04	<0.0256	<0.0256	0.13	<0.026	0.84	0.10	0.18	0.10	0.05	<0.0281	<0.0293	<0.027	<0.0296
206Pb ppm	1.03	1.03	1.69	2.04	3.09	4.54	1.38	0.46	0.82	3.00	1.67	17.06	2.63	5.29	3.06	2.70	0.95	0.85	1.08	0.94
207Pb ppm	0.41	0.62	0.75	0.97	1.23	3.77	0.64	0.22	0.35	2.00	0.86	13.13	1.61	3.88	1.90	1.29	0.27	0.19	0.36	0.17
208Pb ppm	0.99	1.42	1.73	2.37	3.11	8.88	1.48	0.51	0.79	5.10	2.01	32.13	3.90	9.49	4.52	3.03	0.55	0.46	0.97	0.31
232Th ppm	0.46	0.20	0.01	0.04	28.25	0.06	0.00	<0.00075	<0.000751	7.77	5.57	15.86	0.30	29.76	10.45	0.75	0.08	2.79	22.74	0.16
235U ppm	0.12	0.08	0.25	0.19	0.41	0.05	0.17	0.05	0.11	0.19	0.18	0.44	0.22	0.22	0.23	0.35	0.21	0.17	0.17	0.23
238U ppm	21.67	12.77	31.93	33.15	58.38	11.47	23.07	7.59	16.40	22.58	26.38	66.98	30.30	30.42	35.74	49.07	26.78	24.75	26.92	29.54
206Pb/238U age	298.5	481.8	320.7	377.8	312.5	2172.5	362.3	373.8	312.3	801.5	398.3	1480.4	535.2	1075.8	524.4	341.0	221.3	210.5	248.2	199.6
2 Std. Err.	5.7	5.8	5.4	4.9	5.1	5.1	5.0	6.5	5.7	4.4	4.9	3.8	6.4	6.8	6.3	6.4	7.2	7.6	6.9	7.5
207Pb/235U age	1299.0	2027.3	1428.4	1623.0	1331.2	3896.9	1569.1	1628.1	1374.7	2613.0	1733.2	3390.2	2144.4	3002.3	2134.5	1535.0	861.2	722.9	1043.4	591.2
2 Std. Err.	7.4	6.5	6.8	5.6	7.3	5.4	6.1	8.0	7.4	5.0	5.7	4.2	7.6	7.6	7.5	7.6	9.4	12.9	8.7	11.4
207Pb/206Pb age	3898.2	4495.9	4047.6	4162.7	3893.6	4959.2	4127.0	4186.6	3979.8	4651.2	4280.0	4854.6	4527.6	4785.2	4542.5	4154.6	3347.8	3028.3	3623.0	2672.2
2 Std. Err.	1.4	1.0	1.0	0.8	1.2	0.5	0.9	1.5	1.4	0.5	0.8	0.2	0.5	0.6	0.5	0.6	1.7	2.6	1.3	3.1
Common Pb at 206Pb/238U age	0.855	0.868	0.857	0.861	0.856	1.020	0.860	0.861	0.856	0.893	0.862	0.951	0.872	0.915	0.872	0.858	0.850	0.849	0.852	0.849

Appendix E:
Pemberton Hills Garnet Geochronology Data (LA-ICP-MS)

Sample	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242
Method	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb
Mineral	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet
Spot size (µm)	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
Corrected 206Pb/238U Age (Ma)	171.3	176.8	174.7	167.2	173.9	271.4	182.1	166.9	171.1	164.9	169.4	164.9	163.0	168.0	184.1	180.8	171.1	154.8
2 Std. Err.	4.9	5.7	5.8	5.5	6.9	58.6	10.2	3.9	7.3	8.6	3.5	4.5	4.7	7.3	21.3	6.5	4.9	16.2
206Pb/238U	0.030	0.031	0.028	0.028	0.029	0.840	0.033	0.027	0.030	0.030	0.029	0.031	0.030	0.029	0.065	0.032	0.029	0.048
207Pb/235U	0.533	0.506	0.305	0.333	0.379	93.375	0.736	0.320	0.565	0.700	0.424	0.820	0.654	0.505	4.433	0.553	0.378	2.898
1 Std. Err.	4.1	5.2	6.6	5.9	7.8	2.4	8.5	5.0	7.1	6.4	4.5	4.1	4.1	7.5	8.6	7.0	6.1	5.3
207Pb/206Pb	0.1289	0.1201	0.0775	0.0876	0.0948	0.8046	0.1608	0.0844	0.1353	0.1670	0.1072	0.1893	0.1594	0.1251	0.4938	0.1270	0.0961	0.4399
1 Std. Err.	3.8	5.1	6.5	5.8	7.9	0.9	9.0	5.0	7.5	6.9	4.4	3.8	4.2	8.0	6.7	7.4	6.2	6.7
238U/206Pb	33.4	32.8	35.1	36.2	34.5	1.2	30.0	36.4	33.2	32.9	34.8	31.8	33.6	34.3	15.3	31.7	35.0	20.9
1 Std. Err.	2.4	2.8	2.8	2.7	3.3	2.1	4.7	1.9	3.4	4.0	1.6	2.0	2.2	3.4	5.0	3.0	2.3	3.5
208Pb/232Th	1.0400	0.4692	0.0504	0.1329	0.4309	26.9088	0.1844	0.1470	0.1717	0.1368	0.0308	0.2854	0.4383	0.5082	0.1259	0.0429	0.0146	0.6438
1 Std. Err.	8.1	9.0	13.1	11.4	18.8	5.0	11.4	10.2	15.6	10.0	6.0	5.3	7.3	12.2	9.0	10.0	7.0	10.4
204Pb ppm	0.005	0.005	0.004	0.004	0.004	0.033	0.003	0.004	0.003	0.002	0.003	0.004	0.003	0.004	0.005	0.004	0.003	0.003
206Pb ppm	0.05	0.03	0.02	0.03	0.01	0.61	0.01	0.04	0.01	0.01	0.06	0.05	0.03	0.01	0.03	0.02	0.02	0.02
207Pb ppm	0.007	0.003	0.002	0.003	0.001	0.491	0.001	0.003	0.002	0.002	0.006	0.010	0.005	0.002	0.017	0.002	0.002	0.008
208Pb ppm	0.010	0.006	0.002	0.003	0.001	1.192	0.003	0.004	0.001	0.004	0.012	0.019	0.009	0.004	0.047	0.004	0.007	0.019
232Th ppm	0.011	0.014	0.044	0.025	0.003	0.047	0.017	0.027	0.009	0.034	0.432	0.077	0.024	0.008	0.479	0.122	0.584	0.036
235U ppm	0.011	0.007	0.007	0.009	0.003	0.005	0.001	0.011	0.003	0.003	0.015	0.011	0.007	0.004	0.003	0.005	0.006	0.003
238U ppm	1.85	0.98	0.93	1.13	0.51	0.73	0.22	1.51	0.39	0.43	2.04	1.68	1.13	0.46	0.57	0.55	0.81	0.40
206Pb/238U age	159.5	142.1	135.8	124.0	149.9	146.9	152.8	135.4	136.8	142.3	130.2	146.6	162.3	125.8	190.8	119.5	126.6	148.3
2 Std. Err.	4.8	5.5	5.7	5.4	6.7	4.2	9.3	3.7	6.7	8.0	3.3	3.9	4.3	6.8	10.0	6.0	4.7	7.0
207Pb/235U age	446.3	392.0	243.7	243.6	322.3	4630.1	557.6	267.5	439.8	540.4	337.7	630.5	577.1	394.4	1972.1	401.5	313.8	1434.7
2 Std. Err.	8.3	10.4	13.2	11.8	15.6	4.8	17.0	9.9	14.1	12.8	9.0	8.3	8.2	15.1	17.3	13.9	12.2	10.7
207Pb/206Pb age	190.0	193.7	181.0	175.6	184.2	3931.7	211.2	174.5	191.5	193.1	182.5	199.5	188.8	185.5	407.6	200.0	181.6	300.6
2 Std. Err.	35.0	46.6	71.8	63.5	81.0	0.3	72.4	55.6	68.1	59.9	43.8	31.0	37.7	76.1	24.3	64.8	64.6	33.2
208Pb/232Th age	433.5	415.9	270.0	291.9	326.1	4617.2	559.9	281.9	454.7	538.7	359.0	608.2	511.1	414.9	1718.5	447.2	325.6	1381.5
2 Std. Err.	16.1	18.0	26.3	22.7	37.7	9.9	22.8	20.5	31.3	20.0	11.9	10.7	14.7	24.4	18.0	20.0	14.1	20.9
Common Pb at 206Pb/238U age	0.846	0.845	0.844	0.844	0.845	0.845	0.846	0.844	0.845	0.845	0.844	0.845	0.846	0.844	0.848	0.843	0.844	0.845

Appendix E:
Pemberton Hills Garnet Geochronology Data (LA-ICP-MS)

Sample	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242	PM18AJ242
Method	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb	U-Pb
Mineral	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet	Garnet
Spot size (µm)	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
Corrected 206Pb/238U Age (Ma)	168.5	169.8	170.3	165.1	166.9	169.8	174.3	201.8	184.1	180.1	174.5	167.5	165.9	175.5	150.9	171.5	167.7
2 Std. Err.	4.1	5.1	5.9	10.6	7.0	5.8	5.9	9.8	9.2	5.4	6.1	6.1	11.2	12.0	69.0	7.3	5.0
206Pb/238U	0.028	0.031	0.029	0.028	0.027	0.027	0.028	0.074	0.052	0.029	0.028	0.033	0.033	0.047	0.172	0.032	0.027
207Pb/235U	0.392	0.725	0.478	0.380	0.236	0.225	0.212	5.080	2.828	0.216	0.297	1.003	0.989	2.435	17.446	0.760	0.232
1 Std. Err.	4.9	4.7	5.9	12.4	9.2	7.2	8.1	3.4	4.2	6.7	7.9	4.2	8.7	7.3	5.3	5.7	6.1
207Pb/206Pb	0.1005	0.1678	0.1183	0.0988	0.0641	0.0603	0.0555	0.5010	0.3976	0.0550	0.0756	0.2179	0.2172	0.3787	0.7333	0.1724	0.0629
1 Std. Err.	4.9	3.7	5.9	13.0	9.3	7.1	8.1	2.7	3.9	6.6	7.9	4.0	8.9	4.8	5.0	5.8	5.9
238U/206Pb	35.3	31.9	34.1	36.2	37.4	37.0	36.2	13.6	19.4	35.1	35.2	30.0	30.3	21.3	5.8	31.3	37.3
1 Std. Err.	2.0	2.4	2.8	5.1	3.4	2.9	2.9	2.5	2.9	2.7	3.0	2.7	4.7	4.6	4.2	3.3	2.5
208Pb/232Th	0.0585	0.0422	0.0212	0.1301	< DL	0.0209	< DL	1.0518	0.3964	0.0354	0.0394	0.0493	0.0368	0.5009	2.9635	0.0428	0.0707
1 Std. Err.	8.3	6.4	8.1	18.2	29.5	18.6	32.0	6.6	6.5	14.4	10.4	7.5	11.3	6.7	9.4	9.4	18.0
204Pb ppm	0.004	0.004	0.003	0.003	0.003	0.003	0.002	0.004	0.003	0.004	0.003	0.003	0.002	0.003	0.003	0.003	0.003
206Pb ppm	0.03	0.08	0.02	0.01	0.01	0.03	0.03	0.06	0.02	0.06	0.06	0.03	0.02	0.04	0.02	0.01	0.03
207Pb ppm	0.003	0.013	0.002	0.001	0.001	0.002	0.001	0.031	0.009	0.003	0.005	0.007	0.004	0.016	0.017	0.003	0.002
208Pb ppm	0.005	0.031	0.008	0.002	<0.000605	0.001	<0.000639	0.075	0.024	0.003	0.010	0.017	0.008	0.040	0.040	0.004	0.001
232Th ppm	0.099	0.860	0.422	0.014	0.001	0.049	0.029	0.082	0.069	0.105	0.324	0.386	0.261	0.099	0.017	0.117	0.016
235U ppm	0.009	0.018	0.005	0.002	0.004	0.007	0.007	0.006	0.004	0.017	0.018	0.006	0.004	0.006	0.001	0.004	0.009
238U ppm	1.21	2.63	0.75	0.28	0.54	0.97	0.98	0.87	0.47	2.31	2.49	0.98	0.55	0.96	0.15	0.48	1.32
206Pb/238U age	134.2	140.9	135.6	149.2	122.8	131.6	130.5	141.5	120.3	129.9	135.4	163.5	152.1	158.6	105.2	128.2	140.1
2 Std. Err.	3.9	4.8	5.6	10.1	6.9	5.7	5.9	5.0	5.9	5.4	6.0	5.4	9.5	9.2	8.5	6.7	5.0
207Pb/235U age	343.2	586.0	413.2	362.7	204.4	208.6	194.7	1897.1	1304.0	188.9	256.5	819.4	753.4	1353.1	2708.2	558.4	223.3
2 Std. Err.	9.7	9.4	11.8	24.8	18.3	14.3	16.1	6.8	8.4	13.5	15.8	8.5	17.4	14.5	10.5	11.4	12.2
207Pb/206Pb age	179.9	199.1	186.2	175.9	170.0	172.1	175.7	457.3	324.3	181.3	180.4	211.6	209.4	296.3	1023.9	202.5	170.6
2 Std. Err.	50.8	31.5	57.0	137.6	115.6	89.1	102.1	8.8	18.0	81.3	87.9	30.2	68.5	24.5	7.0	48.0	74.0
208Pb/232Th age	336.0	553.8	396.4	327.2	215.2	206.1	195.2	1832.7	1363.1	199.0	264.2	705.4	698.1	1253.0	2959.7	574.3	212.2
2 Std. Err.	16.5	12.7	16.2	36.4	58.9	37.3	63.9	13.2	12.9	28.8	20.9	15.0	22.6	13.3	18.9	18.8	36.1
Common Pb at 206Pb/238U age	0.844	0.845	0.844	0.845	0.844	0.844	0.844	0.845	0.843	0.844	0.844	0.846	0.846	0.846	0.842	0.844	0.845

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ209	E19JN26a350.csv	<0.0328	<0.0355	118572.8	164.422458	<0.0061	73.6054572	72.8972888	0.3738521	156721.459	1.66178634	0.48408541	7.27786632	<0.414	0.8495843	95538.1748
PM18AJ209	E19JN26a351.csv	<0.0283	<0.0308	114385.139	44.6884492	<0.00534	20.6039778	19.7268333	0.04540196	167731.876	1.15009361	0.18137657	<0.525	<0.358	0.48278871	111305.387
PM18AJ209	E19JN26a352.csv	<0.0281	<0.0306	122608.426	80.7165112	<0.00524	30.8480281	29.0453349	0.50087046	161959.915	2.26373192	0.26163574	18.1230299	<0.353	0.86014598	91828.853
PM18AJ209	E19JN26a353.csv	<0.0322	<0.0352	122513.584	112.116299	<0.00596	61.6564561	48.654068	0.42905237	161211.666	0.92867151	0.28736388	6.87932341	<0.404	0.89388341	87867.3389
PM18AJ209	E19JN26a355.csv	<0.0292	<0.0321	111608.639	44.5307962	<0.00543	23.2804329	14.8916703	0.16112069	161719.927	0.33139561	0.3338484	23.363827	<0.364	0.64356022	110862.725
PM18AJ209	E19JN26a356.csv	<0.0328	<0.0361	123789.681	72.3849677	<0.00608	29.9043642	36.7363669	0.45486653	169225.296	1.42787575	0.18588742	2.22808134	<0.41	0.58500552	91751.1174
PM18AJ209	E19JN26a359.csv	<0.0284	<0.0315	112930.406	80.6559162	<0.00524	47.2920464	17.8353801	0.63754883	163460.464	3.18415737	0.07874678	2.04520792	<0.352	1.41234802	113909.064
PM18AJ209	E19JN26a361.csv	<0.0296	<0.0329	115617.621	98.6232351	<0.00542	118.869184	26.6670421	0.69350962	162039.629	24.7251362	0.4364026	7.28782593	<0.365	2.23379152	103961.947
PM18AJ209	E19JN26a362.csv	<0.0355	<0.0396	107467.153	13.9896334	<0.00652	9.61120964	16.2255109	0.25456458	164233.676	283.853701	0.12745927	1.07809848	<0.437	22.4824472	110907.689
PM18AJ209	E19JN26a363.csv	<0.0529	<0.0591	118302.834	134.535351	<0.00942	41.9331117	47.5711466	0.35498795	157202.731	0.93033045	0.2727246	5.85640614	<0.653	0.61832969	95256.4822
PM18AJ209	E19JN26a364.csv	<0.0268	<0.03	111971.7	50.8247972	<0.00491	20.8565428	31.543124	0.15908587	159106.702	0.99458593	0.61402082	25.2694422	1.11563553	0.34596732	110823.606
PM18AJ209	E19JN26a366.csv	<0.0315	<0.0354	116902.704	154.128111	<0.00573	71.1417208	55.8518058	0.63141095	158448.692	15.7551891	0.46397818	4.27118518	<0.385	2.84666496	98460.8222
PM18AJ209	E19JN26a367.csv	<0.0425	<0.0478	135690.172	22.4953393	<0.00796	16.4385065	9.17784647	0.11784728	171179.583	4.02668794	0.10658172	1.08541806	<0.522	0.48294593	76561.3573
PM18AJ209	E19JN26a370.csv	<0.0264	<0.0299	112012.018	49.5088828	<0.00483	51.4832009	17.3773769	0.34386416	162664.876	17.6933139	0.19456694	<0.472	<0.321	3.40774636	111773.47
PM18AJ209	E19JN26a371.csv	<0.0269	<0.0305	113923.33	21.3614016	<0.00492	36.1998861	12.8162573	0.19311472	162220.666	3.14108482	0.16851151	3.94106924	<0.329	1.3197327	108734.93
PM18AJ212	C19AU08C322.csv	<0.0505	<0.0537	110698.299	1.60760503	<0.0151	21.9668597	5.6010158	0.76365365	155206.928	19.0663106	1.04162181	6.81229435	<0.491	0.73620344	111143.697
PM18AJ212	C19AU08C323.csv	<0.0415	<0.0439	114765.388	6.19284695	<0.0123	12.5511026	5.42305423	0.86933843	158711.588	111.597499	0.56296611	<0.908	<0.402	3.51451595	101004.046
PM18AJ212	C19AU08C325.csv	<0.0309	<0.0323	105133.801	26.5519905	<0.00915	163.791209	11.6439378	3.7065581	160023.215	201.997157	1.94913401	<0.669	1.14855966	14.4440479	116839.469
PM18AJ212	C19AU08C326.csv	<0.0321	<0.0334	115357.304	9.39037474	0.01467403	6.54121072	17.2130342	0.67331059	157942.902	34.6807276	0.58791742	<0.697	<0.306	1.79445805	102554.88
PM18AJ212	C19AU08C327.csv	<0.0346	<0.0358	107827.968	0.93795193	<0.0103	8.51907799	2.32525913	0.6529469	162565.451	17.2401678	0.64098485	1.99677623	<0.33	1.66028737	120706.745
PM18AJ212	C19AU08C328.csv	<0.0481	<0.0495	117100.861	57.3757084	<0.0144	15.8218725	10.3781579	0.43585358	155679.656	9.72350728	0.27211089	<1.05	<0.456	2.27174728	98051.5966
PM18AJ212	C19AU08C329.csv	<0.0483	<0.0495	107005.126	3.7648678	<0.0145	19.3286269	11.1655301	0.0604637	159346.64	5.05635475	1.03221243	<1.07	<0.461	0.61083041	115734.994
PM18AJ212	C19AU08C330.csv	<0.0328	<0.0335	110535.802	<0.301	<0.00978	6.53670891	2.84203075	0.10443986	162010.672	3.37926466	0.23988045	<0.72	<0.309	0.68005023	116746.271
PM18AJ212	C19AU08C331.csv	<0.0596	<0.0605	104621.881	2.56750608	<0.0178	103.644725	19.5718327	0.51162168	152795.415	12.9029188	3.27347125	<1.32	<0.558	2.19349341	113624.381
PM18AJ212	C19AU08C332.csv	<0.0354	<0.0358	114907.97	3.2351974	<0.0107	161.199998	14.6401612	0.21934364	161203.545	9.04046947	0.46350171	<0.783	<0.328	1.62046688	101466.706
PM18AJ212	C19AU08C333.csv	<0.0313	<0.0315	110351.991	2.48839516	<0.00944	76.6619796	1.28113133	0.02502534	161274.588	3.41819989	0.50728019	<0.694	<0.288	1.18229288	113681.799
PM18AJ212	C19AU08C334.csv	<0.0301	<0.0303	108039.022	5.08374957	<0.00901	24.4654028	8.9337554	0.21883855	160201.342	5.7885533	0.74695694	<0.671	<0.274	1.11563231	117246.159
PM18AJ212	C19AU08C335.csv	<0.0304	<0.0305	115192.588	1.63634869	<0.00909	24.5144389	26.9006368	0.00726425	156927.109	5.17689108	0.49767304	<0.679	<0.274	0.79345933	103193.627
PM18AJ212	C19AU08C336.csv	<0.0368	<0.0368	113421.992	6.02102841	<0.011	14.1259848	8.39827627	2.13868133	159071.911	183.426961	0.7813979	<0.82	<0.327	5.60110612	105293.682
PM18AJ212	C19AU08C337.csv	<0.0362	<0.0361	109199.391	15.6586651	<0.0108	107.179587	13.311521	3.25256988	157221.137	287.175248	1.59973572	1.41329897	0.39929422	22.3642263	109851.512
PM18AJ212	C19AU08C338.csv	<0.0453	<0.0451	112771.194	5.49698216	<0.013	22.4332862	2.9629972	0.06044903	171368.444	5.03276749	0.96771293	<0.982	<0.39	0.54341641	115485.142
PM18AJ212	C19AU08C342.csv	<0.0478	<0.0471	108686.816	4.92133416	<0.0136	33.4239034	11.2270372	0.68823582	154890.913	37.6104899	0.59848612	<1.05	<0.38	2.31380661	109698.092
PM18AJ212	C19AU08C344.csv	<0.036	<0.0352	117993.254	2.26637195	<0.00971	11.0852488	24.2924195	0.4287088	157623.545	11.2395269	0.59202912	<0.757	<0.266	3.16791556	98426.2872
PM18AJ212	C19AU08C345.csv	<0.0364	<0.0353	115438.677	4.57568716	<0.00964	10.3955796	24.9875861	0.73336606	158118.12	29.6793769	0.52540933	<0.757	<0.26	2.69363374	102039.543
PM18AJ212	C19AU08C346.csv	<0.0447	<0.0431	118637.545	2.97970815	0.01798668	13.4891981	12.5777942	4.01145212	164540.379	137.824808	0.38679469	<0.905	<0.311	10.9717778	104369.694
PM18AJ215	E19JN26a373.csv	<0.0301	<0.0341	119491.047	10.455745	0.00901854	36.4403258	1.60555342	0.32277206	168057.199	9.38097765	0.65043418	<0.54	0.40932241	1.41386095	101551.27
PM18AJ215	E19JN26a374.csv	<0.0282	<0.032	119415.462	12.8805933	<0.00515	22.6155099	2.25420399	0.85123377	164820.039	9.95344098	0.61544823	<0.505	0.57089164	1.33655099	100944.477
PM18AJ215	E19JN26a375.csv	<0.0278	<0.0316	122713.839	12.3522348	<0.0051	59.9971115	0.95411384	0.55260876	166065.015	5.02489036	0.67801827	<0.498	<0.338	3.91742653	92197.8972
PM18AJ215	E19JN26a376.csv	<0.0272	<0.0309	117834.71	4.53258294	<0.00499	3.67709088	0.16905776	0.13797444	166606.424	0.27235523	0.30736392	<0.486	<0.33	0.11296787	102140.158
PM18AJ215	E19JN26a377.csv	<0.0264	<0.0301	114006.051	3.73201528	<0.00486	3.95443534	0.24620938	0.13976621	163911.401	0.2511674	0.45230233	<0.473	<0.321	0.11427661	111163.443
PM18AJ215	E19JN26a378.csv	<0.0269	<0.0306	118274.763	3.9941887	<0.00495	3.35046707	0.68281531	0.12863301	165691.198	4.94156209	0.38340522	<0.482	<0.327	0.48912682	101472.962
PM18AJ215	E19JN26a379.csv	<0.0269	<0.0307	115440.808	10.8447488	<0.00497	30.6026384	1.95428453	0.39949954	163630.871	0.61244702	0.51166108	<0.484	<0.327	0.08858375	105817.475
PM18AJ215	E19JN26a380.csv	<0.0433	<0.0493	125863.899	10.6972662	0.01958868	13.8026034	4.48636482	0.16090036	171585.877	0.39352464	0.59794448	<0.805	<0.531	0.08516737	96518.2464
PM18AJ215	E19JN26a381.csv	0.13409898	0.08113762	116529.553	8.21325695	0.0079995	26.7876588	2.69909495	0.29269788	164026.745	222.777918	0.45370196	<0.481	8.16549703	12.1041354	102760.231
PM18AJ215	E19JN26a382.csv	<0.0272	<0.0311	119415.637	3.90454376	<0.00507	20.8665933	1.07382115	0.33028091	164858.849	0.84808717	0.61411601	<0.491	5.82582274	1.90184555	98552.9059
PM18AJ215	E19JN26a383.csv	<0.0282	<0.0322	113301.66	2.6178672	<0.00528	21.5550128	0.71112162	0.12274566	164829.051	2.03529744	0.94844097	<0.51	<0.345	0.44956867	111590.163
PM18AJ215	E19JN26a384.csv	<0.0339	<0.0387	124405.919	1.26782522	<0.00637	14.0826282	0.76824109	0.09402905	164000.13	1.20991285	0.29141915	<0.615	<0.415	0.32084695	90503.6263
PM18AJ215	E19JN26a385.csv	<0.026	<0.0297	115184.834	6.72119533	<0.00488	10.7956471	2.29878118	0.27808496	162802.71	129.689939	0.29299509	<0.473	<0.319	5.73572335	105813.262
PM18AJ215	E19JN26a386.csv	<0.0423	<0.0483	114115.375	5.75876109	<0.00816	49.8931681	1.90376854	0.33841903	158865.374	0.37679662	0.49666719	<0.79	<0.533	2.28596685	101123.687
PM18AJ215	E19JN26a387.csv	<0.0303	<0.0346	115528.992	1.97395273	<0.00581	16.4363712	0.7212703	0.0660041	167814.719	0.37069229	0.40385299	<0.556	<0.375	0.185667	109358.373
PM18AJ215	E19JN26a394.csv	<0.0257	<0.0292	113993.574	4.57422894	<0.00508	26.7193643	1.40579511	0.257605	160375.938	3.94295795	0.93615082	0.93109824	<0.323	0.40947485	108291.645
PM18AJ215	E19JN26a395.csv	<0.0255	<0.0288	121948.537	3.80123321	<0.00505	43.735856	1.89762296	0.25766294	166357.104	17.1346631	0.66315521	1.33277316	<0.322	9.30834748	94190.8186

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ215	E19JN26a396.csv	<0.0248	<0.0281	117213.83	18.1651424	0.00543989	32.7412979	2.0768752	2.37417055	162922.968	2.87335916	0.72848997	<0.472	<0.315	0.63250956	100564.69
PM18AJ215	E19JN26a397.csv	<0.0357	<0.0403	124056.416	16.049446	<0.00716	28.2204475	14.6407133	1.05544932	170343.334	12.6836412	2.24641799	3.44459629	<0.458	0.68844218	94869.8488
PM18AJ215	E19JN26a398.csv	<0.024	<0.027	118546.93	15.027625	<0.00485	29.6822113	2.29375082	1.32407588	164784.146	1.49016677	0.76789388	<0.46	1.93820243	0.19578464	98502.1171
PM18AJ215	E19JN26a400.csv	<0.0269	<0.0301	133700.175	43.10784	<0.00552	37.8160988	2.28836987	0.69398309	166932.332	28.5278105	0.5388856	3.8532378	<0.347	46.6097193	72238.0723
PM18AJ215	E19JN26a401.csv	<0.0294	<0.0329	114144.89	7.83837173	<0.0061	55.4246325	1.77191445	0.33268272	162628.456	3.691611	0.36269338	<0.575	<0.382	1.71478006	104503.637
PM18AJ215	E19JN26a402.csv	<0.0257	<0.0286	124824.86	30.214235	<0.00535	65.538682	3.59329082	0.8963707	165616.083	0.72353185	1.03450852	<0.506	<0.336	1.38233707	88247.8515
PM18AJ219	E19JN26a296.csv	<0.0257	<0.0243	127186.906	12.8502116	<0.00518	33.8372802	3.96256894	1.39718907	160435.65	0.95708052	0.22844477	0.84246714	<0.339	0.37519083	85990.8054
PM18AJ219	E19JN26a297.csv	<0.0248	<0.0234	123118.235	11.7543054	<0.00501	18.6628172	6.07880553	0.61435905	161634.208	1.30652672	0.27399675	<0.483	<0.328	0.89518396	89615.9313
PM18AJ219	E19JN26a299.csv	<0.0258	<0.0244	125233.776	12.1013123	<0.00522	38.1789	5.23826853	1.48039528	161918.55	1.67274663	0.29474655	<0.503	<0.342	1.15693637	86271.1466
PM18AJ219	E19JN26a300.csv	<0.0269	<0.0255	130333.385	14.0117977	<0.00545	44.0370698	6.91712369	3.98941687	162333.327	7.18323879	0.5283291	20.6393504	<0.358	0.71012479	79165.3339
PM18AJ219	E19JN26a301.csv	<0.0259	<0.0246	128023.787	14.0153826	<0.00524	41.0176509	5.73152752	1.56585293	161744.416	1.63636623	0.36135015	1.23213603	<0.344	0.46803794	82220.9733
PM18AJ219	E19JN26a302.csv	<0.0258	<0.0246	124702.147	14.0154042	<0.00524	31.4253411	5.78443353	2.19160567	162623.091	2.84723452	0.35832934	<0.507	<0.344	3.37065465	88741.2605
PM18AJ219	E19JN26a303.csv	<0.0264	<0.0252	127697.847	12.374394	<0.00536	42.1563215	5.95755228	1.96588131	161089.264	2.80466863	0.29644173	<0.518	<0.352	3.6191578	83497.6384
PM18AJ219	E19JN26a304.csv	<0.0262	<0.025	128685.405	14.6735744	<0.00532	45.8797675	5.17658626	1.58773223	161014.973	5.12513431	0.39215678	0.98583505	<0.35	1.08821996	80792.2006
PM18AJ219	E19JN26a305.csv	<0.0259	<0.0247	128619.817	11.6314592	<0.00525	42.7281081	5.36831553	0.97531719	162496.206	2.25169411	0.29083242	<0.508	<0.346	0.75892312	81569.8679
PM18AJ219	E19JN26a306.csv	<0.0262	<0.0251	127122.997	15.1953537	<0.00532	35.5429181	5.2784164	1.48009054	159480.657	4.47410966	0.3321179	<0.515	<0.35	0.85968889	83617.5358
PM18AJ219	E19JN26a307.csv	<0.0263	<0.0252	131452.641	12.328087	<0.00534	45.6133184	7.71057172	0.9899928	162621.056	9.97994631	0.38790593	2.43990825	<0.354	0.99333568	76120.9897
PM18AJ219	E19JN26a309.csv	<0.0256	<0.0247	122441.082	11.3786243	<0.0052	20.9727086	5.06967288	1.05547634	162598.205	1.58666515	0.3036624	1.0238294	<0.343	1.33632841	91330.0898
PM18AJ219	E19JN26a310.csv	<0.0262	<0.0254	129719.973	15.863007	<0.00533	43.9854218	5.68326476	1.09251681	160832.187	2.82246827	0.3807064	0.57384049	<0.352	0.66705564	78750.896
PM18AJ219	E19JN26a311.csv	<0.0253	<0.0245	124520.46	13.724916	<0.00513	23.7408199	4.03834311	1.66812558	162790.377	1.19390788	0.33923499	<0.501	<0.339	0.27654592	89458.0173
PM18AJ219	E19JN26a312.csv	<0.026	<0.0253	128140.457	15.3956238	<0.00528	38.1028016	4.72039227	1.67939962	159885.136	1.52800955	0.45927128	<0.514	<0.35	0.27014775	82464.0116
PM18AJ219	E19JN26a313.csv	<0.0257	<0.025	128172.036	15.1421663	<0.0052	40.0275248	5.09314489	1.79971292	161580.217	2.44454697	0.48642968	0.59024084	<0.345	0.57258389	81993.1224
PM18AJ219	E19JN26a314.csv	<0.0248	<0.0242	119080.881	10.7067766	<0.00504	10.7243232	5.31245784	0.71567928	163563.734	2.23325001	0.25849739	<0.49	<0.334	0.21764643	95810.4543
PM18AJ219	E19JN26a315.csv	<0.0258	<0.0252	125176.244	12.3597889	<0.00522	34.3558918	5.52285887	1.42021189	161967.158	2.37046435	0.26169082	<0.508	<0.346	0.58025591	86772.5883
PM18AJ219	E19JN26a316.csv	<0.0266	<0.0261	129375.785	16.6352691	<0.00539	47.5739236	6.14692564	1.44654619	159611.833	3.78270952	0.56145994	2.14942785	<0.357	0.64464193	78399.7574
PM18AJ219	E19JN26a317.csv	<0.0261	<0.0256	124743.466	12.9820117	<0.00527	32.0416689	7.14770581	1.19969946	159027.999	6.46603158	0.392801	4.84701498	<0.35	1.86426931	87041.3486
PM18AJ220	E19JN25a281.csv	<0.0377	<0.0321	120709.453	30.5889176	<0.00575	77.7604744	7.76649988	<0.019	162169.611	5.65577966	0.75180008	<0.536	0.3402936	1.54682779	95802.5271
PM18AJ220	E19JN25a282.csv	<0.0381	<0.0323	117006.069	28.0016935	<0.00581	47.1013319	5.98785422	0.02924179	159361.47	12.7681449	2.65861095	4.56881577	0.40008997	3.08960465	97675.3463
PM18AJ220	E19JN25a283.csv	<0.05	<0.0421	115533.812	2.96188159	<0.00777	13.5765472	5.18799583	<0.0258	166136.376	3.98743081	0.81258741	<0.701	<0.425	0.34435423	106344.734
PM18AJ220	E19JN25a284.csv	<0.0351	<0.0294	116505.883	3.47902794	<0.0053	28.1292981	1.32074275	<0.0174	160804.076	0.29931538	3.72027494	32.2998932	<0.297	0.04840554	98543.2222
PM18AJ220	E19JN25a285.csv	<0.0712	<0.0593	105447.324	2.62161658	<0.0108	61.6286297	12.1472943	<0.0367	156302.862	2.90594338	2.74217764	2.29090324	<0.628	1.25010825	117810.186
PM18AJ220	E19JN25a286.csv	<0.0374	<0.031	109955.791	4.39037959	<0.00565	20.5050557	7.52451084	<0.0184	158493.091	64.3348372	1.06008648	132.802662	<0.316	2.51545126	114588.733
PM18AJ220	E19JN25a293.csv	<0.0386	<0.031	118488.281	4.12966165	<0.00589	29.4690341	17.288892	<0.0188	161824.425	110.9974	0.64528075	0.73358983	<0.331	3.71402977	101635.71
PM18AJ220	E19JN25a294.csv	<0.0476	<0.0381	129287.275	12.1031204	<0.00729	32.716878	1.94498575	<0.023	169831.813	10.7051455	0.96323022	5.03770481	0.90243132	3.32281731	87612.3818
PM18AJ220	E19JN25a295.csv	<0.0361	<0.0287	127037.091	27.536508	<0.00558	23.3637574	3.84319319	<0.0175	161463.074	7.12880129	1.04263133	<0.518	<0.313	2.37458051	84713.699
PM18AJ220	E19JN25a297.csv	<0.0489	<0.0386	108901.106	2.99600389	<0.00768	36.6340955	17.5586682	<0.0238	154576.847	2.86877842	1.49552371	<0.728	<0.438	0.79909057	113861.421
PM18AJ220	E19JN25a298.csv	<0.0346	<0.0272	116363.759	4.11050297	<0.00543	49.5940393	1.97565435	<0.0165	162323.641	0.00696318	2.23033587	<0.509	0.38993569	0.58512373	101738.834
PM18AJ220	E19JN25a300.csv	<0.0318	<0.0249	105053.813	3.55962671	<0.00512	32.8344046	16.1954111	<0.0152	160631.069	58.3360503	1.04288823	1.67834689	<0.287	2.62426642	122871.872
PM18AJ220	E19JN25a302.csv	<0.0316	<0.0246	111517.179	6.01094733	<0.0052	22.6819869	12.5823893	<0.015	163416.3	11.8159183	0.41364925	<0.486	0.35833751	1.99995603	113245.677
PM18AJ220	E19JN25a303.csv	<0.0333	<0.0258	122649.732	5.68119845	<0.00554	49.6451732	1.74907517	<0.0157	161454.374	0.01131499	2.33571313	<0.518	<0.311	1.33736627	91856.398
PM18AJ220	E19JN25a304.csv	<0.0308	<0.0238	110649.738	4.42084919	<0.00518	23.1915517	10.3359233	<0.0145	163121.283	9.9792478	0.71083361	0.51061053	<0.292	2.37294726	113260.033
PM18AJ220	E19JN25a305.csv	<0.0322	<0.0248	116352.047	7.52649673	<0.00549	13.126175	6.48365287	<0.0151	163350.247	3.38682602	1.33994547	<0.516	<0.309	1.46962747	104256.34
PM18AJ220	E19JN25a307.csv	<0.0435	<0.0334	111478.759	3.92746474	<0.00771	22.0895702	2.78845929	<0.0203	154928.304	2.27405536	3.4282021	26.8766046	<0.434	1.91880968	103208.789
PM18AJ220	E19JN25a308.csv	<0.031	<0.0237	124955.617	7.23952425	<0.00557	112.575528	1.49176644	<0.0144	162420.636	7.04915174	1.27681604	<0.521	<0.312	2.77580813	88328.6752
PM18AJ220	E19JN25a309.csv	<0.0318	<0.0244	114556.156	2.47314666	<0.00577	9.4128314	2.98689101	<0.0147	160411.736	5.78890174	0.93701131	<0.546	<0.327	0.93632883	107240.67
PM18AJ220	E19JN25a310.csv	<0.0281	<0.0215	117220.208	5.09019982	<0.00524	34.1126762	2.54146286	<0.013	161243.057	16.1361553	1.60034472	0.7049417	<0.294	1.96415983	103360.774
PM18AJ225	E19JN25a322.csv	<0.0218	<0.0173	115411.387	2.47723292	<0.00528	11.986313	0.94324517	0.01029254	162131.835	0.08957435	0.47920965	<0.494	<0.296	0.18538012	107225.067
PM18AJ225	E19JN25a323.csv	<0.0208	<0.0167	113855.388	3.7087598	<0.00515	15.1746139	1.50838615	<0.00973	162663.879	0.26371608	0.27478316	<0.482	<0.289	0.13565203	109378.94
PM18AJ225	E19JN25a324.csv	<0.0228	<0.0185	114961.7	2.90879574	<0.00575	14.4187751	4.1585064	<0.0108	157824.977	0.61555409	0.35383887	<0.538	<0.322	0.77748467	104318.748
PM18AJ225	E19JN25a325.csv	<0.0209	<0.0171	111440.153	2.21467574	<0.00534	9.23833478	5.63237399	<0.0099	163895.006	0.16871498	0.20298863	<0.5	<0.3	0.0309756	112843.389
PM18AJ225	E19JN25a326.csv	<0.02	<0.0166	114362.689	2.08938199	0.00549957	10.5511566	9.55876235	<0.0096	159301.515	0.50341192	0.33403985	<0.486	<0.291	0.09660306	108383.725
PM18AJ225	E19JN25a327.csv	<0.0297	<0.0249	102995.559	1.56377276	<0.0078	5.36062669	1.56918839	<0.0146	158530.937	0.51260486	0.73196068	155.948567	<0.438	0.16517532	124590.327

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ225	E19JN25a328.csv	<0.0196	<0.0166	107410.46	1.26384404	<0.00518	1.71065109	1.6792656	<0.00964	163555.847	0.14584199	0.22966409	<0.485	<0.291	0.01485148	122558.653
PM18AJ225	E19JN25a330.csv	<0.0205	<0.0179	114027.696	2.98078538	<0.00544	20.0113435	1.74742114	<0.0104	164406.897	0.34378856	0.2008043	<0.509	<0.306	0.06065119	107190.093
PM18AJ225	E19JN25a331.csv	<0.0205	<0.0182	118761.122	2.60473835	<0.00544	23.69289	2.10794112	<0.0107	163068.178	0.23974332	0.5431278	<0.511	<0.307	0.19076843	98218.2266
PM18AJ225	E19JN25a332.csv	<0.0202	<0.0182	111581.033	1.59668022	<0.00531	7.81719545	10.6773138	<0.0107	163062.621	0.67483232	0.17083231	<0.497	<0.299	0.14427976	112100.615
PM18AJ225	E19JN25a333.csv	<0.022	<0.02	127678.511	2.84362076	<0.00567	51.8872559	1.68225457	<0.0118	164207.407	0.05493424	0.13162844	<0.531	<0.319	0.02383145	83639.5739
PM18AJ225	E19JN25a334.csv	<0.021	<0.0195	118398.35	2.86718367	<0.00531	12.0735913	3.02511895	<0.0116	163041.772	0.70308336	0.28396418	<0.498	<0.299	0.1403339	100980.525
PM18AJ225	E19JN25a335.csv	<0.0212	<0.0198	109957.654	3.21961046	<0.00522	9.50237324	8.97066679	<0.0119	158808.715	0.99365242	3.43787891	105.364245	<0.294	0.89937383	116473.586
PM18AJ225	E19JN25a336.csv	<0.0222	<0.021	115657.552	5.95980029	<0.00529	46.3002108	4.89638061	<0.0127	158791.329	11.4252522	0.39487768	156.417621	<0.298	2.77454902	108229.535
PM18AJ225	E19JN25a337.csv	<0.0231	<0.0221	115050.008	6.32159061	<0.00528	37.9122223	5.0400445	<0.0135	157709.514	11.042152	0.51538637	287.576658	<0.298	2.74799024	107694.532
PM18AJ225	E19JN25a338.csv	<0.0238	<0.023	112356.398	4.72510723	<0.00521	24.2485085	1.95377213	<0.0142	161887.258	116.298424	0.52810327	261.599065	<0.294	12.2826217	112194.877
PM18AJ225	E19JN25a339.csv	<0.0258	<0.025	114047.676	9.20803271	<0.00536	82.6882841	2.92115147	<0.0156	159966.612	13.7051227	0.44357613	322.859273	<0.302	3.4826179	108359.145
PM18AJ225	E19JN25a340.csv	<0.0283	<0.0276	121236.562	3.79943974	<0.00555	11.0422515	5.91286625	<0.0174	162295.533	0.45003865	0.66101932	<0.521	<0.313	0.08998074	96513.116
PM18AJ225	E19JN25a341.csv	<0.0282	<0.0276	112656.501	1.220845	<0.00522	1.87454398	7.06200882	<0.0176	160623.616	0.2360334	0.17776916	<0.494	<0.294	0.05698584	112750.046
PM18AJ225	E19JN25a342.csv	<0.0302	<0.0296	111408.433	1.78812795	<0.00525	11.0169104	3.51017812	<0.0191	165978.415	0.35517864	0.36825151	<0.495	<0.297	0.08751549	113479.379
PM18AJ225	E19JN25a343.csv	<0.0318	<0.0312	110218.012	2.23414165	<0.00514	2.87682672	2.68125906	<0.0204	163154.583	0.35273955	0.23160449	<0.485	<0.29	0.22981659	116202.402
PM18AJ225	E19JN25a344.csv	<0.0352	<0.0345	108573.659	1.5751186	<0.00529	102.628841	5.93250087	<0.0226	163572.127	205.916344	1.20379244	30.3989019	<0.3	17.1970821	114589.657
PM18AJ225	E19JN25a345.csv	<0.0607	<0.0594	109284.923	0.99856753	<0.00823	171.005674	6.3297178	<0.0394	156215.462	25.0663467	1.06217131	6.70853491	<0.475	16.3645247	111374.407
PM18AJ225	E19JN25a346.csv	<0.0404	<0.0394	114061.053	9.30406959	<0.00521	104.204725	3.34399432	<0.0265	160307.37	3.77876273	0.74708379	406.212301	<0.295	2.58535179	108501.117
PM18AJ228	E19JL11a018.csv	<0.0946	<0.107	132112.582	9.78048095	<0.00975	17.7300954	11.7634042	17.6032368	158169.071	8.99135824	0.1244623	<1.42	<0.508	0.30316182	76557.5209
PM18AJ228	E19JL11a019.csv	<0.089	<0.102	124960.722	7.44378639	<0.00947	18.5887339	3.02800753	27.0704847	159980.108	3.84731919	0.18828035	<1.37	<0.491	0.70602913	85821.7511
PM18AJ228	E19JL11a121.csv	<0.0314	<0.0384	127782.879	5.95255451	<0.00604	10.8296988	4.49715317	32.2112821	161691.12	2.96925464	0.35295007	<0.59	<0.247	0.51133381	81077.9177
PM18AJ228	E19JL11a122.csv	<0.0363	<0.0444	130890.205	7.39922369	<0.00701	19.6619461	8.80990969	19.2183355	156633.72	3.58930238	0.19785903	<0.679	<0.286	1.24303182	77119.4661
PM18AJ228	E19JL11a123.csv	<0.0384	<0.0471	124486.193	5.10032742	<0.00738	5.58147973	3.31693434	3.0476817	161932.352	4.47142408	0.08726005	<0.728	<0.305	0.5951253	88582.6574
PM18AJ228	E19JL11a124.csv	<0.0315	<0.0387	129739.704	5.28670624	<0.00618	16.2955678	3.48999964	4.7120518	164317.272	10.5278505	0.08896591	<0.602	<0.251	0.44640386	79180.4879
PM18AJ228	E19JL11a125.csv	<0.0315	<0.0388	127682.62	6.22476923	<0.00622	15.3687038	3.94111703	4.75034471	165889.24	50.4405477	0.08603737	<0.604	<0.252	2.59717746	83472.2222
PM18AJ228	E19JL11a126.csv	<0.0356	<0.0438	133623.75	5.15829793	<0.00705	9.6657382	4.06219519	24.0251992	162024.647	19.1418375	0.12680746	<0.681	<0.286	1.90758082	75215.777
PM18AJ228	E19JL11a127.csv	<0.0313	<0.0386	132349.386	6.35559063	<0.00624	12.5236647	3.47629398	27.3098532	161190.101	9.74113678	0.12723585	<0.607	<0.252	1.03665938	72273.1249
PM18AJ228	E19JL11a128.csv	<0.0398	<0.0491	131824.838	7.26412661	<0.00799	377.808121	5.55929639	21.1778619	150264.803	58.4351195	0.17565624	<0.769	<0.322	2.54226008	75023.8193
PM18AJ228	E19JL11a129.csv	<0.0308	<0.0381	133083.941	4.7603884	<0.00622	43.6130825	6.73252911	4.7218275	163127.399	70.3411437	0.20426634	<0.604	<0.251	4.50631027	72060.1189
PM18AJ228	E19JL11a130.csv	<0.0303	<0.0374	127640.804	9.43637986	<0.00613	17.5892461	2.11688329	13.9548565	162714.598	3.75758333	0.12464581	<0.595	<0.247	0.98276864	81754.3043
PM18AJ228	E19JL11a131.csv	<0.0304	<0.0376	127926.597	7.70613537	<0.00619	17.3876112	5.51552109	36.0126585	160480.234	2.09935937	0.16722914	<0.6	<0.249	0.77324964	79420.6001
PM18AJ228	E19JL11a132.csv	<0.0323	<0.0398	129233.052	3.35870737	<0.00658	16.245968	1.59537166	0.78164903	166962.55	74.4284585	0.21081957	<0.638	<0.264	0.91027766	81757.6399
PM18AJ228	E19JL11a133.csv	<0.0306	<0.0378	129726.546	5.62339398	<0.00628	18.2935821	8.67743649	13.0690618	155237.947	15.4559174	0.24313373	<0.608	<0.252	1.94945637	80350.4318
PM18AJ228	E19JL11a134.csv	<0.037	<0.0456	137829.936	3.63200513	<0.00749	16.7289159	2.8970101	0.0214565	167868.063	0.04181282	0.79138536	<0.734	<0.304	0.01759319	62713.4921
PM18AJ228	E19JL11a135.csv	<0.0414	<0.0509	133219.228	7.78411385	<0.00851	14.1120246	4.11802834	1.05417364	171165.853	14.7427238	0.57524589	<0.824	<0.342	0.11122293	74422.9565
PM18AJ228	E19JL11a136.csv	<0.0333	<0.0409	136382.357	2.97145898	<0.00688	16.8325444	1.98333619	0.03420297	171307.881	0.35549397	0.80043827	<0.661	<0.274	0.02986813	64501.2154
PM18AJ228	E19JL11a137.csv	<0.0314	<0.0385	132817.008	9.13461654	<0.00653	875.463876	106.086302	7.78783071	149004.847	16.0822718	0.32325745	<0.629	36.7166535	1.45855933	74349.8393
PM18AJ228	E19JL11a138.csv	<0.03	<0.0368	129383.47	8.30165384	<0.00625	54.8229644	13.9417423	5.89996269	160231.249	5.33992293	0.09741278	<0.603	<0.249	0.64061647	73527.3972
PM18AJ228	E19JL11a139.csv	<0.0372	<0.0455	136212.876	8.0151516	<0.00774	20.0565845	6.14925912	22.184353	154231.441	1.66538758	0.14385488	<0.749	<0.309	1.18200097	72842.5953
PM18AJ229	E19JN25a012.csv	<0.061	<0.0672	131031.554	11.6355397	<0.00619	27.0594937	29.5455755	<0.0302	164780.462	3.70439786	1.5756265	<0.845	0.5105684	4.56196694	78511.025
PM18AJ229	E19JN25a013.csv	<0.0501	<0.0557	125165.663	13.1297059	<0.00532	33.5836945	34.5943252	0.12459477	163335.547	3.17599209	1.7813754	<0.712	<0.304	1.84551063	81969.4201
PM18AJ229	E19JN25a014.csv	<0.0512	<0.0571	126019.22	9.72887015	<0.00556	41.9549	21.7920185	0.19204083	164400.687	3.19151683	1.15935018	<0.743	<0.322	0.96585619	85634.3872
PM18AJ229	E19JN25a015.csv	<0.0488	<0.0547	130281.075	29.4505765	<0.00553	41.0423138	66.3767523	0.05734394	162498.841	2.09806966	1.72921722	<0.724	<0.319	0.73986174	74642.447
PM18AJ229	E19JN25a016.csv	<0.0456	<0.0513	123715.949	15.9661351	<0.00534	40.6478228	37.8541163	0.23080526	161723.841	4.22856102	1.94297429	0.92180189	<0.31	1.55139669	84391.3503
PM18AJ229	E19JN25a027.csv	<0.0425	<0.0463	116930.054	19.3396514	<0.00589	55.8889755	23.2704447	0.18943523	157351.057	3.37193515	2.3967493	3.12196656	<0.354	2.76125931	95177.905
PM18AJ229	E19JN25a028.csv	<0.04	<0.0432	132060.712	10.6168835	<0.00552	22.8297322	44.7976216	<0.0181	163336.08	2.95875733	1.16068771	12.3758448	<0.334	2.39290885	71467.9311
PM18AJ229	E19JN25a029.csv	<0.0392	<0.042	124844.485	11.5679775	<0.0054	37.831206	26.1923936	0.06537227	164877.629	5.45587616	1.18969266	<0.661	<0.328	1.52473236	83998.2412
PM18AJ229	E19JN25a030.csv	<0.0382	<0.0406	122360.942	15.6986278	<0.0053	44.6646828	21.4579101	0.07954903	163619.664	6.27503047	1.45497634	0.7499773	<0.321	1.81997899	88950.5783
PM18AJ229	E19JN25a031.csv	<0.047	<0.0495	128728.13	8.34965496	<0.00642	22.2211816	20.3673762	0.0344754	168233.402	0.4188979	1.47461197	<0.792	<0.395	0.3454262	82175.9343
PM18AJ229	E19JN25a032.csv	<0.0395	<0.0413	124060.949	10.0346833	<0.00546	39.6211683	17.5518529	0.17598996	166276.267	3.53796847	1.07231909	<0.662	<0.332	1.23979034	87023.6947
PM18AJ229	E19JN25a044.csv	<0.0379	<0.0357	116102.68	123.958736	<0.00492	396.727156	86.6693523	0.85260766	162224.821	169.255294	2.90527567	86.3305956	<0.302	1.80199399	96156.0398
PM18AJ229	E19JN25a045.csv	<0.0414	<0.0387	126194.744	22.5214127	<0.00535	42.0434057	57.6473883	0.21979286	162060.217	3.36141529	1.7955191	<0.651	<0.33	1.15659982	81334.8421

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ229	E19JN25a046.csv	<0.0412	<0.0382	123915.435	23.2613714	<0.00528	62.8737458	39.4734754	0.12705295	162267.001	4.87450492	1.72831093	<0.64	<0.325	1.59147582	82323.8367
PM18AJ229	E19JN25a047.csv	<0.043	<0.0396	132923.995	9.92890121	<0.00548	19.5602053	52.7963731	<0.0196	160389.701	3.19790063	1.38681247	0.76895553	<0.337	2.46274989	72602.1723
PM18AJ229	E19JN25a048.csv	<0.0462	<0.0423	123324.56	15.1014596	<0.00581	49.453685	22.2290953	0.14180525	161282.502	4.2410342	1.27405236	<0.71	<0.359	1.34698786	87826.7802
PM18AJ229	E19JN25a049.csv	<0.0423	<0.0385	128748.98	22.387153	<0.00535	104.213085	23.9829985	0.03476112	165748.099	2.71406162	2.09158834	0.97156381	<0.328	0.83639562	77208.0807
PM18AJ229	E19JN25a050.csv	<0.0426	<0.0386	128469.002	18.7495454	<0.00536	58.4314835	37.8665869	0.09588189	163572.08	1.86736468	1.46995943	<0.65	<0.329	0.89497101	80387.4246
PM18AJ229	E19JN25a051.csv	<0.0425	<0.0383	126468.128	7.26918393	<0.00532	20.1459249	14.355052	<0.0194	164062.028	1.29599819	1.06494316	<0.645	<0.326	1.23018216	84094.8802
PM18AJ229	E19JN25a052.csv	<0.0505	<0.0452	113567.485	80.0952927	<0.00629	269.471215	60.3485343	1.1611131	159590.087	1.44887979	2.46304918	7.15601785	<0.385	0.37588565	99945.5899
PM18AJ229	E19JN25a053.csv	<0.0426	<0.038	123931.197	20.1153571	<0.00529	69.8953072	30.4085425	0.14120758	164623.199	2.37556655	1.8630096	<0.642	<0.324	0.86802876	84884.5537
PM18AJ229	E19JN25a060.csv	<0.0435	<0.0378	125055.84	21.8691743	<0.00533	41.0552647	47.4922153	0.11026222	162882.937	2.40530013	1.36092391	1.0047158	<0.325	1.51084211	82608.0239
PM18AJ231	E19JL15a026.csv	<0.0921	<0.1	130692.083	2.76018778	<0.0151	8.51964977	1.16619105	<0.0281	169250.217	9.87285904	0.27338214	<1.26	<0.735	1.8354874	80198.7862
PM18AJ231	E19JL15a027.csv	<0.0964	<0.104	119873.685	5.0710579	<0.0159	8.9534487	0.89288476	<0.0301	159959.546	3.39225008	0.16012608	<1.36	<0.772	0.10030945	96110.1645
PM18AJ231	E19JL15a028.csv	<0.0849	<0.0915	126510.311	12.7328129	<0.0141	11.678054	1.09291021	<0.0268	166666.705	29.7107471	0.18459096	<1.17	<0.681	4.16468928	85218.5867
PM18AJ231	E19JL15a030.csv	<0.0704	<0.0753	125556.726	5.49770493	<0.0116	9.31736664	0.13514357	0.03198747	168151.059	4.96117591	0.1868778	<0.968	<0.567	0.30298078	89048.8269
PM18AJ231	E19JL15a031.csv	<0.0701	<0.0746	125499.361	20.8511365	<0.0113	54.4036668	4.17320889	0.06910287	161515.349	3.90186037	0.88541264	<0.959	<0.563	2.25840546	85703.7364
PM18AJ231	E19JL15a033.csv	<0.0773	<0.0817	122008.832	17.8654009	<0.0125	50.7466217	0.58073641	0.03928111	160491.48	1.1647453	0.61762546	<1.05	<0.619	0.91571772	89919.8635
PM18AJ231	E19JL15a034.csv	<0.0736	<0.0775	124228.346	16.3664206	<0.0119	43.0545547	0.36976068	0.08152411	168046.219	9.16099786	0.61204689	<1.00	<0.588	1.99364938	91611.6426
PM18AJ231	E19JL15a035.csv	<0.0984	<0.103	113452.815	9.14208738	<0.0158	7.37546453	0.60100272	<0.0352	156567.158	0.66663323	0.43354543	<1.35	<0.795	0.37981049	105687.477
PM18AJ231	E19JL15a037.csv	<0.085	<0.0887	132988.507	6.265685	<0.0135	25.9463498	1.53729157	<0.0315	170983.962	3.47639445	0.61864874	<1.13	<0.673	0.45456896	79434.2365
PM18AJ231	E19JL15a038.csv	<0.0721	<0.075	121057.207	13.4217291	<0.0113	29.0612481	1.75628191	0.05712308	161250.411	1.17248184	0.262211	<0.962	<0.566	0.17608326	95110.164
PM18AJ231	E19JL15a039.csv	<0.0747	<0.0775	129600.866	15.0004467	<0.0117	30.5639029	7.20341154	0.06045659	160545.349	21.7487095	0.59866506	<0.992	<0.584	2.62660294	79448.6728
PM18AJ231	E19JL15a041.csv	<0.0804	<0.0831	118777.647	28.0882151	<0.0123	34.86367	0.72180379	0.10163628	162570.56	117.960564	0.56282474	<1.06	<0.623	4.08908153	96339.9413
PM18AJ231	E19JL15a042.csv	<0.0777	<0.0802	127245.816	35.5196384	<0.012	52.4488553	1.7387642	0.06059224	169089.034	39.0870136	0.38729104	<1.02	<0.599	4.9950694	86994.9078
PM18AJ231	E19JL15a043.csv	<0.0827	<0.0852	129692.804	12.2134608	<0.0127	39.4798239	7.40288987	<0.0343	166238.599	41.7059933	0.56429062	<1.10	<0.648	5.11996138	78399.4267
PM18AJ231	E19JL15a044.csv	<0.0745	<0.0766	121575.506	11.0100684	<0.0113	19.9308738	0.88933352	<0.0312	166519.692	12.0331675	0.52801666	<0.971	<0.57	1.87921709	95421.7117
PM18AJ231	E19JL15a045.csv	<0.0987	<0.101	136871.766	12.8877398	<0.0153	70.3662312	0.90210347	<0.0428	173458.804	80.8211805	0.46378622	<1.29	<0.756	14.55492	74924.5293
PM18AJ231	E19JL15a046.csv	<0.0856	<0.0878	119600.908	6.45742175	<0.0129	12.8042065	0.11287923	<0.0371	158089.242	0.30589911	0.2886746	<1.11	<0.65	0.09910854	94364.0198
PM18AJ233	E19JN25a145.csv	<0.033	<0.0311	127254.475	14.9730862	<0.00525	26.8680894	1.28046797	0.12738483	162377.672	49.534259	1.96668911	0.9923351	<0.281	7.31589816	83243.7773
PM18AJ233	E19JN25a146.csv	<0.0342	<0.0323	125094.036	17.2529545	<0.00545	27.7639043	1.14556326	0.14299168	162033.203	39.0146391	1.30659607	<0.576	<0.294	7.64338543	87247.2863
PM18AJ233	E19JN25a147.csv	<0.0342	<0.0323	132016.954	17.7296444	<0.00544	34.3702168	1.75675052	0.15844316	163211.839	82.0451768	1.31302447	0.72833648	<0.291	10.9869365	74024.5737
PM18AJ233	E19JN25a148.csv	<0.0354	<0.0334	129966.841	16.1563618	<0.00559	30.0418384	1.85916098	0.04708292	162400.172	55.6779797	1.33261548	<0.59	<0.301	13.5593842	78557.8392
PM18AJ233	E19JN25a149.csv	<0.0383	<0.0361	127607.73	12.5286738	<0.00613	18.8297747	3.36537082	0.05863481	168707.474	2.39610911	1.55739793	4.61432175	<0.326	1.01923117	83896.2012
PM18AJ233	E19JN25a150.csv	<0.0333	<0.0314	126185.703	13.2434533	<0.00529	16.5937022	1.1661615	0.09488411	163971.961	1.57610698	1.18267156	1.56100883	<0.283	0.69429949	85206.7257
PM18AJ233	E19JN25a151.csv	<0.0343	<0.0324	125674.249	13.155529	<0.00546	23.0614973	4.02385572	0.06561695	164820.914	4.24318496	1.68234931	42.2380608	<0.292	0.88439213	84527.7296
PM18AJ233	E19JN25a152.csv	<0.0334	<0.0315	120279.687	5.95520204	<0.00531	4.1819903	4.14188143	<0.0168	164940.627	1.32917404	2.2728363	12.7465876	<0.284	0.49233131	94112.9662
PM18AJ233	E19JN25a153.csv	<0.0336	<0.0317	126897.862	10.3187265	<0.00534	12.3008368	1.25011939	0.08226677	165335.835	1.6713201	1.15352274	13.6770182	<0.286	0.89909711	82737.4773
PM18AJ233	E19JN25a154.csv	<0.0361	<0.034	129272.949	14.5756184	<0.00574	18.7075995	1.43729816	0.09280087	167596.339	5.07207269	1.42383036	25.127084	<0.31	1.184468	82327.0744
PM18AJ233	E19JN25a155.csv	<0.0393	<0.0371	132761.037	12.2132215	<0.00626	18.4730493	5.80525456	<0.0201	160511.389	4.32385502	1.24699771	33.3885572	<0.335	2.12035521	73840.6975
PM18AJ233	E19JN25a156.csv	<0.0344	<0.0324	130907.717	11.4078877	<0.00547	55.6252545	1.89984955	0.04086913	165720.307	21.0074102	1.26465807	11.8917833	<0.293	7.66253028	72883.6332
PM18AJ233	E19JN25a157.csv	<0.0334	<0.0315	125311.475	9.35466837	<0.00532	29.4183348	19.0903485	1.72499235	162912.572	62.5818576	2.6368696	0.83859974	0.4895238	2.84808738	86478.2713
PM18AJ233	E19JN25a158.csv	<0.0343	<0.0324	134497.102	23.1972819	<0.00547	45.0195208	2.74696138	0.10125175	165922.644	3.08772815	1.93904071	0.75272761	<0.294	1.25976077	69308.4572
PM18AJ233	E19JN25a159.csv	<0.0351	<0.0332	132985.494	19.4011584	<0.00558	35.6469535	3.15193161	0.08195566	164901.739	1.61443442	1.74124279	1.58969526	<0.301	0.64345158	70288.2405
PM18AJ233	E19JN25a160.csv	<0.0333	<0.0314	134364.092	14.0231952	<0.00531	26.531794	2.90098557	0.1209061	164200.532	0.2935004	1.43177408	<0.559	<0.285	0.10745567	71873.6541
PM18AJ233	E19JN25a161.csv	<0.0345	<0.0326	132833.019	9.05355424	<0.00551	31.4951463	13.1866595	0.07603462	163017.358	5.22860757	1.72923432	<0.581	<0.297	2.48816369	71007.5498
PM18AJ233	E19JN25a162.csv	<0.0425	<0.0401	130062.89	4.89444558	<0.00678	16.7808923	16.6869231	0.25646034	167989.646	37.6357202	2.27987911	0.78397696	<0.366	2.58737178	81686.7856
PM18AJ233	E19JN25a163.csv	<0.0344	<0.0325	131860.645	12.0928188	<0.00552	27.9740961	19.0309631	1.21439801	159546.647	82.1805059	2.02625036	1.30720965	<0.297	1.62138617	74834.1254
PM18AJ233	E19JN25a164.csv	<0.0344	<0.0325	128681.107	8.20500616	<0.00552	20.0798706	18.4056967	0.47326315	160876.214	34.505483	1.83165273	1.71685605	<0.297	1.30361396	81558.9497
PM18AJ233	E19JN25a165.csv	<0.0346	<0.0327	135225.799	30.2966342	<0.00556	50.017919	1.87461627	0.06807153	164252.446	4.58800351	2.29418351	17.4889716	<0.299	1.39849683	67852.9953
PM18AJ233	E19JN25a166.csv	<0.0387	<0.0366	134816.031	28.4507079	<0.00629	43.9897605	1.982473	0.1029406	167912.446	5.37377738	2.34625378	6.08899448	<0.337	1.64884093	70860.9723
PM18AJ233	E19JN25a167.csv	<0.0423	<0.0401	124379.51	13.5163432	<0.00684	17.9027919	2.07607802	0.10158999	160126.631	17.9792725	2.036292	3.64841002	<0.373	1.44462049	82062.097
PM18AJ238	E19JN26a129.csv	<0.0284	<0.0297	121790.861	10.3976923	<0.00514	12.4481475	3.61579215	2.23693247	164723.747	1.84821847	0.68118082	<0.519	<0.34	0.17482051	95737.079
PM18AJ238	E19JN26a130.csv	<0.0284	<0.0297	120304.01	20.5167724	<0.00517	12.7908173	24.7012988	9.3809381	163017.076	0.27954517	1.08800581	<0.522	<0.342	0.24170629	98739.0417
PM18AJ238	E19JN26a131.csv	<0.0288	<0.0302	131686.077	10.9896889	<0.00528	36.3314947	9.05808989	1.65874237	165620.071	1.5119335	1.41946054	<0.532	<0.349	0.40518821	77531.9472

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ238	E19JN26a132.csv	<0.0447	<0.0469	119431.949	12.7561478	<0.00826	15.5910477	10.816618	2.72476246	159456.835	1.12365257	1.77297435	<0.832	<0.547	0.40081363	93048.4205
PM18AJ238	E19JN26a134.csv	<0.0279	<0.0293	120889.031	27.5224126	<0.00515	34.6125646	14.235564	3.5750032	160168.18	873.702373	1.08208705	1.35814058	<0.343	12.5786397	97499.6469
PM18AJ238	E19JN26a135.csv	<0.043	<0.0453	121885.65	206.643545	<0.00794	269.083567	25.601332	20.902055	157523.615	203.014936	0.6087766	<0.812	<0.535	6.7368031	89334.182
PM18AJ238	E19JN26a136.csv	<0.0312	<0.0328	120873.547	27.0260528	<0.00585	12.9373044	20.745088	3.50935284	167622.405	1.10136907	1.19853642	<0.591	<0.389	0.47042262	99265.2789
PM18AJ238	E19JN26a143.csv	<0.0267	<0.0283	122908.194	8.92886967	<0.00515	10.8265163	20.0073779	6.09695055	162049.614	0.29233867	0.91383477	<0.516	<0.342	0.15610087	93829.6495
PM18AJ238	E19JN26a144.csv	<0.0299	<0.0314	128350.678	9.09226623	<0.00575	31.2156932	9.0957161	1.20784413	163054.884	11.5275375	1.20445586	5.38632882	<0.385	0.71656442	78213.826
PM18AJ238	E19JN26a145.csv	<0.0274	<0.0291	128205.698	7.95365614	<0.00533	10.6745977	17.1197781	4.14716198	157126.986	2.09908584	2.00564994	<0.534	<0.354	0.4603723	84135.4294
PM18AJ238	E19JN26a146.csv	<0.0324	<0.0344	122497.983	10.7168763	0.00703279	17.8211485	21.9629294	10.4851702	157587.642	1.34902502	1.54634208	<0.639	<0.424	0.19961245	93559.5621
PM18AJ238	E19JN26a147.csv	<0.0272	<0.0289	122255.258	35.379159	<0.00532	23.8422825	12.9152381	0.7533755	165494.687	0.1088267	1.6492321	<0.531	<0.353	0.64268223	93733.0239
PM18AJ238	E19JN26a148.csv	<0.0272	<0.029	128375.616	9.75239936	<0.00534	9.14917018	40.9167013	4.95475311	160011.856	5.70310808	1.91058188	0.66413449	<0.355	1.19814638	86763.1965
PM18AJ238	E19JN26a149.csv	<0.0285	<0.0304	129170.906	17.8731665	<0.00562	63.7814409	6.69998802	1.89557163	161934.616	5.69408012	1.14343528	0.98339307	<0.372	0.62976258	77239.4172
PM18AJ238	E19JN26a151.csv	<0.0256	<0.0274	115424.736	11.4409739	<0.00507	8.16922527	24.4008021	1.04181504	162194.078	0.23013966	1.13902686	<0.505	<0.336	0.34544034	105692.204
PM18AJ238	E19JN26a152.csv	<0.0281	<0.03	131697.119	10.8178506	<0.00553	19.2198994	14.8073105	1.39639834	160685.385	8.23674377	1.50231187	0.62329686	<0.369	0.80842657	76703.8094
PM18AJ238	E19JN26a153.csv	<0.0302	<0.0323	116802.061	103.619523	<0.00603	91.338226	7.30345369	4.3108306	162063.838	41.1347218	0.55592529	<0.598	<0.398	3.0290478	100166.145
PM18AJ238	E19JN26a154.csv	<0.0354	<0.0379	121150.153	19.0011569	<0.00708	27.7716556	47.8778551	5.84438098	157512.507	43.2691062	1.38561613	0.90511838	<0.469	2.81832856	97690.9072
PM18AJ238	E19JN26a155.csv	<0.0261	<0.028	123713.001	7.26802687	<0.0052	11.1472595	18.3172677	5.78649075	163089.74	2.10064233	1.11146988	<0.518	<0.345	0.24349084	91938.3805
PM18AJ238	E19JN26a156.csv	<0.0263	<0.0282	124714.402	7.94723101	<0.00525	18.2039598	11.8238869	2.71458294	161999.583	1.85935842	1.88720084	<0.522	<0.348	0.49386217	88587.7055
PM18AJ238	E19JN26a157.csv	<0.0264	<0.0282	127634.021	9.0653767	<0.00526	15.6209078	35.3653392	3.69396611	161191.717	6.28535104	1.62660613	1.31807764	<0.349	2.21011151	83781.4196
PM18AJ238	E19JN26a158.csv	<0.0257	<0.0276	117307.676	31.3144366	<0.00514	20.6972288	20.5823424	4.14246356	162219.873	2.50960023	2.43455149	<0.51	<0.341	1.32086513	102138.159
PM18AJ238	E19JN26a159.csv	<0.0265	<0.0284	127017.263	69.9467531	<0.00529	86.0313655	9.01646193	4.27789497	162790.348	5.02629272	1.80198942	<0.526	<0.351	1.25382644	86044.3273
PM18AJ242	E19JL11a070.csv	<0.0426	<0.0439	128777.016	3.46242374	<0.0058	161.226598	0.5013601	<0.0204	165948.987	2.72149536	0.66635921	<0.593	<0.251	0.34148802	80343.2591
PM18AJ242	E19JL11a071.csv	<0.0403	<0.0415	118380.844	2.44156158	<0.0055	55.342731	0.60979042	<0.0193	164617.757	2.72361228	0.58396074	<0.56	<0.238	0.61805118	98997.7086
PM18AJ242	E19JL11a072.csv	<0.0413	<0.0426	120312.5	14.111984	<0.00565	108.014285	2.55719843	0.03786296	164336.597	15.2054267	0.60433969	<0.574	<0.244	3.1494908	96670.7058
PM18AJ242	E19JL11a073.csv	<0.0463	<0.048	119044.858	4.72606035	0.00751618	27.1566288	0.4483941	<0.0225	163448.692	0.98611257	0.63535057	<0.644	<0.275	0.69459715	95295.0378
PM18AJ242	E19JL11a074.csv	<0.0605	<0.0632	129623.239	9.06880504	<0.00841	185.115497	7.17230956	<0.0296	159276.876	5.41678899	0.51795666	<0.857	<0.367	0.38217539	73186.0016
PM18AJ242	E19JL11a075.csv	<0.0395	<0.041	114894.38	3.31653779	<0.00546	87.2048657	1.35473441	<0.0191	164180.502	2.82416678	0.5704725	<0.552	<0.236	0.86981148	104291.73
PM18AJ242	E19JL11a076.csv	<0.0396	<0.0412	118101.591	<0.265	<0.00547	3.72864398	0.5033555	<0.0192	166042.436	0.88724799	0.17200086	<0.556	<0.237	0.28292063	99245.1419
PM18AJ242	E19JL11a077.csv	<0.0395	<0.0412	119247.183	0.78935536	<0.0055	29.7394577	0.97710131	<0.0192	165403.386	0.439566	0.18856584	<0.556	<0.237	0.19196351	99534.3885
PM18AJ242	E19JL11a078.csv	<0.0558	<0.0582	122095.779	1.45818859	<0.00763	27.1597402	0.395639	<0.0267	170651.998	3.97504766	0.46267392	<0.786	<0.337	0.36991936	95057.0064
PM18AJ242	E19JL11a079.csv	<0.0413	<0.0433	119023.322	2.35415412	<0.0058	45.5079119	2.29622455	<0.0202	166485.855	1.56464007	1.01203671	<0.585	<0.25	0.32498713	100000.002
PM18AJ242	E19JL11a080.csv	<0.0426	<0.0447	127445.122	8.30576279	<0.00603	171.505422	2.29528033	0.03248056	168464.148	11.8145267	0.68884324	<0.606	<0.259	0.67826707	84951.7411
PM18AJ242	E19JL11a081.csv	<0.0396	<0.0418	115899.19	1.14904625	0.00635115	25.2936535	1.61752073	<0.0194	165550.238	0.50320334	0.35606717	<0.563	<0.241	0.18613028	105641.164
PM18AJ242	E19JL11a082.csv	<0.0401	<0.0424	125030.269	1.90463827	<0.00572	107.14839	0.8204101	<0.0197	165073.188	0.37695267	0.5845267	<0.575	<0.246	0.10473385	86380.5732
PM18AJ242	E19JL11a083.csv	<0.0755	<0.0801	116830.839	4.37577883	<0.0103	76.3947903	3.81640678	<0.0357	161975.316	1.49164242	3.42721383	<1.04	<0.446	0.27938158	88863.8055
PM18AJ242	E19JL11a084.csv	<0.0405	<0.0431	132238.622	7.29747604	<0.00585	133.149109	4.98369753	<0.0201	163164.414	2.85886267	0.40463755	<0.587	<0.251	0.39645383	73698.0542
PM18AJ242	E19JL11a085.csv	<0.0427	<0.0456	125204.441	3.76852859	0.00670892	190.923114	5.10541553	<0.021	168401.315	0.07768347	0.77079825	<0.621	<0.267	0.17614482	86433.0823
PM18AJ242	E19JL11a086.csv	<0.0419	<0.0449	117642.913	4.5072024	<0.00616	74.52794	0.97535844	<0.021	165116.197	20.3441488	0.99725262	0.99832721	<0.265	1.47469446	97977.6877
PM18AJ242	E19JL11a087.csv	<0.0383	<0.0412	123044.32	5.34593883	<0.00564	101.714264	1.83603705	<0.0191	160971.468	13.5475128	1.50217037	<0.564	<0.242	1.46473237	89148.8576
PM18AJ242	E19JL11a088.csv	<0.0522	<0.0563	114192.758	15.6133606	<0.00753	74.3271539	3.14997465	<0.0254	166725.333	22.252739	1.36898107	<0.77	<0.331	1.29969936	106280.078
PM18AJ242	E19JL11a095.csv	<0.0372	<0.0413	124051.085	33.9840596	<0.00578	154.251394	9.45044449	0.05699217	160837.942	34.6013485	1.25614556	<0.578	<0.247	2.06044923	87310.447
PM18AJ242	E19JL11a096.csv	<0.0353	<0.0394	117173.59	1.95547478	<0.00557	80.2266407	1.47347125	<0.0179	164763.808	2.42534053	0.49807823	<0.558	<0.238	0.33689354	103112.773
PM18AJ242	E19JL11a097.csv	<0.0392	<0.0442	122120.866	4.70192052	<0.00626	91.3280053	0.69312493	<0.0198	169568.588	8.40711283	1.41381914	<0.619	<0.265	0.72653314	92878.4883
PM18AJ242	E19JL11a098.csv	<0.0369	<0.0416	128649.522	8.59249763	<0.00592	149.350626	3.6198108	<0.0187	165591.958	6.73330211	0.62216549	<0.588	<0.251	0.47084729	81109.1293
PM18AJ242	E19JL11a099.csv	<0.0362	<0.041	124018.407	3.83202325	<0.00585	245.497431	5.25279592	<0.0184	164116.777	0.43755071	1.19355497	<0.583	<0.249	0.19201529	88310.8508
PM18AJ249	E19JN25a225.csv	<0.025	<0.0264	119056.84	20.7340114	<0.00533	39.646137	1.07851705	0.32939377	162550.013	0.51201771	1.41038585	<0.525	<0.299	0.09601308	92210.7645
PM18AJ249	E19JN25a226.csv	<0.0245	<0.0258	117688.853	2.13653646	<0.00522	11.7557309	1.4834468	0.13830528	162893.83	0.12301087	1.05976756	<0.513	<0.293	0.25352919	98707.8007
PM18AJ249	E19JN25a227.csv	<0.0241	<0.0255	120014.211	11.3411386	<0.00515	39.360883	1.7367484	0.28940851	160970.423	1.51496106	1.78237834	<0.505	<0.289	0.54902353	93027.59
PM18AJ249	E19JN25a228.csv	<0.0254	<0.0268	114362.719	8.41503796	<0.00543	18.5253911	7.94878108	0.22824653	160366.68	148.542283	1.02809884	<0.536	<0.307	4.62172829	102469.902
PM18AJ249	E19JN25a229.csv	<0.0253	<0.0267	116828.578	1.33041913	<0.00541	1.75954728	1.94194929	0.09892355	164361.099	0.10165812	0.67602744	<0.528	<0.303	0.32989176	104456.579
PM18AJ249	E19JN25a230.csv	<0.0276	<0.0291	118236.83	5.62648131	<0.00592	11.985711	3.89891952	0.21496401	165755.947	12.3067616	0.90041771	<0.575	<0.33	1.83546713	99349.9456
PM18AJ249	E19JN25a237.csv	<0.0253	<0.0265	120326.035	31.479782	<0.0053	38.83803	22.5757709	0.172397	160486.354	12.2102514	0.28295534	0.85363216	<0.299	0.94727135	95807.6998
PM18AJ249	E19JN25a238.csv	<0.0322	<0.0337	114841.811	8.11528886	<0.00674	16.2193531	1.60446038	0.19532912	156699.771	0.39450697	0.54041683	<0.645	<0.379	0.29046929	102130.376

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ249	E19JN25a239.csv	<0.0271	<0.0283	121836.897	6.621656	<0.00567	34.5422041	0.74998279	0.22491384	165118.991	0.0132796	0.61400087	<0.542	<0.318	0.06740447	94740.5448
PM18AJ249	E19JN25a240.csv	<0.0261	<0.0272	120442.41	14.9127479	<0.0054	18.8852731	1.26346752	0.1925571	162691.216	8.83445717	0.28866677	<0.516	<0.305	0.92867544	95294.3997
PM18AJ249	E19JN25a241.csv	<0.0257	<0.0267	118807.881	2.61606273	<0.00529	7.67307511	4.84947357	0.05963628	163285.128	0.68512838	1.12846293	<0.505	<0.298	0.71004435	96943.3505
PM18AJ249	E19JN25a242.csv	<0.026	<0.0269	115467.837	6.50567149	<0.00531	4.96017571	3.39488777	0.05090417	162526.377	17.3228631	0.56793023	<0.506	<0.3	1.83826326	103037.227
PM18AJ249	E19JN25a243.csv	<0.0264	<0.0272	120329.428	25.0221565	<0.00537	59.1531764	1.6388936	0.28666852	161938.277	11.2726102	0.64538311	1.80540907	<0.303	1.80527345	94811.0981
PM18AJ249	E19JN25a244.csv	<0.0254	<0.0261	111088.627	2.29414573	<0.00513	4.5077087	2.76639559	0.05008017	161304.759	1.15939966	0.86159079	<0.487	<0.29	0.49609499	111788.74
PM18AJ249	E19JN25a245.csv	<0.0302	<0.031	114967.556	14.636437	<0.00607	24.4875683	11.6733776	0.09442684	157263.296	8.40450111	0.31619914	1.61560524	<0.342	0.64458703	98790.431
PM18AJ249	E19JN25a246.csv	<0.0269	0.02900932	112857.537	10.4947037	<0.00536	16.8582885	8.84753182	0.11053519	159818.635	16.5617817	2.29694977	<0.506	<0.302	1.87350105	100530.589
PM18AJ249	E19JN25a247.csv	<0.0271	<0.0276	116588.578	1.50687034	<0.00537	3.5775409	2.32178186	0.21842134	162330.681	0.23570516	0.98055125	<0.506	<0.303	0.03734103	100387.504
PM18AJ249	E19JN25a248.csv	<0.0269	<0.0272	119075.103	29.9213696	<0.00528	28.2657336	1.75745145	0.12732709	162665.024	2.90299329	0.57831405	<0.497	1.00192011	0.74091071	95383.0955
PM18AJ249	E19JN25a249.csv	<0.0301	<0.0304	120575.773	41.5319448	<0.00589	59.4176053	1.09566348	0.35826714	161383.124	10.4416749	0.64317189	<0.557	<0.333	2.41204008	91700.775
PM18AJ249	E19JN25a250.csv	<0.0282	<0.0284	122458.389	44.9591203	<0.00545	92.3289561	1.4590636	0.18710527	161025.802	6.55118995	0.74611853	8.18859557	<0.308	4.37300008	89160.2877
PM18AJ249	E19JN25a251.csv	<0.0332	<0.0332	119192.621	9.00144192	<0.00647	18.3639006	2.8763685	0.20597469	161892.582	11.5112478	0.82811275	32.688676	<0.364	2.1659843	99169.0721
PM18AJ249	E19JN25a252.csv	<0.0278	<0.0277	113919.001	6.98659852	<0.00529	15.5758446	6.93675923	0.3293513	161738.755	3.86941642	0.98365108	<0.495	<0.298	0.83831232	102136.296
PM18AJ249	E19JN25a253.csv	<0.0432	<0.0428	111711.426	8.14636471	<0.00814	12.8911721	4.45948743	0.11948363	155286.216	133.098772	0.89049685	31.2331364	6.58885869	4.77170456	104715.654
PM18AJ249	E19JN25a254.csv	<0.0284	<0.0281	113431.526	2.99146944	<0.00531	5.01673916	4.6562146	0.29715073	160463.849	9.36624871	0.59095629	<0.496	0.39858257	3.05069803	104445.334
PM18AJ249	E19JN25a255.csv	<0.0281	<0.0276	114524.142	8.79493888	<0.00521	16.5100387	5.38718072	0.19195293	160465.584	47.560321	0.34846467	39.1578406	0.32703638	4.50409146	104379.796
PM18AJ252	E19JL11a007.csv	<0.138	<0.134	118790.655	14.2026549	<0.00913	25.8113641	3.19344547	<0.0593	161840.006	154.334402	0.40912229	<1.36	0.66982128	13.704889	94732.9588
PM18AJ252	E19JL11a009.csv	<0.128	<0.129	126087.522	228.468116	<0.00921	462.100343	2.66846766	0.23754592	160920.192	142.554922	0.56254985	<1.39	<0.5	6.90492433	80621.7488
PM18AJ252	E19JL11a011.csv	<0.129	<0.135	117362.662	1.57170871	<0.0103	35.799072	1.03355865	<0.0522	163056.315	8.43512599	0.2232615	<1.55	<0.562	1.82093444	100604.445
PM18AJ252	E19JL11a012.csv	<0.14	<0.148	98977.4005	1.40731858	<0.0117	16.7942975	2.1531451	<0.0556	158026.54	20.9305494	0.3874048	<1.76	<0.633	3.68792701	128828.288
PM18AJ252	E19JL11a013.csv	<0.187	<0.2	114779.052	4.32914505	<0.016	37.1846449	11.1788301	<0.0716	162732.489	88.0677349	0.48939689	18.2232102	<0.858	4.00683043	94446.2745
PM18AJ252	E19JL11a015.csv	<0.102	<0.112	109922.33	6.40118049	<0.00955	38.9426227	0.57295937	0.05087416	161413.376	16.9846053	0.46532421	<1.40	<0.503	1.26904769	110576.471
PM18AJ252	E19JL11a235.csv	<0.0577	<0.0498	117356.603	5.90783762	<0.0108	49.9178252	5.89293524	0.05691297	162345.284	24.5123691	0.55440529	<1.09	<0.496	1.09665368	96959.2785
PM18AJ252	E19JL11a236.csv	<0.0452	<0.041	116001.451	7.95370554	<0.00891	37.061498	10.2827345	0.05461516	157815.455	9.32018228	0.98098009	<0.854	0.43093741	1.26310568	104509.204
PM18AJ252	E19JL11a238.csv	<0.0434	0.0398689	120757.009	2.98313848	0.01300875	30.8641573	6.01616328	0.04197539	171372.234	10.200803	0.49835726	<0.805	<0.367	1.04998635	98493.7187
PM18AJ252	E19JL11a239.csv	<0.0336	<0.0306	126820.798	5.10695728	<0.00672	91.6034037	2.09908023	0.15402882	165937.812	17.4523418	0.26149024	1.25837073	<0.291	1.63299346	88765.7917
PM18AJ252	E19JL11a240.csv	<0.0299	<0.0273	121773.943	13.9749629	<0.00597	136.445011	8.40696584	0.59090635	160237.386	16.4405411	0.37855152	<0.573	<0.259	2.21644506	95007.0664
PM18AJ252	E19JL11a241.csv	<0.0395	<0.0362	116242.286	6.97462349	<0.00793	26.8411969	13.4418272	0.0518418	159684.979	12.0426691	1.02629758	8.98616286	<0.343	1.08535961	99946.7131
PM18AJ252	E19JL11a243.csv	<0.0289	<0.0267	113316.867	8.65366117	<0.0058	49.9692846	13.8671762	0.23184033	160457.292	176.214107	0.77714675	1.03259029	<0.252	15.3634592	106343.297
PM18AJ252	E19JL11a244.csv	<0.0371	<0.0342	117313.764	6.5862327	<0.00767	30.5580458	8.6583913	0.44535535	162069.098	15.8817081	0.39955327	1.37423262	<0.323	6.3525565	101369.64
PM18AJ252	E19JL11a245.csv	<0.0402	<0.0381	118455.707	7.48332948	<0.00836	34.103317	8.67169008	0.03999327	167071.32	60.7413458	0.35144481	4.02988118	<0.352	4.0898978	100008.316
PM18AJ264	E19JL11a022.csv	<0.0824	<0.0959	113244.32	21.9555357	<0.00945	96.6915298	2.51387027	<0.0287	161521.193	3.58612106	1.07172464	<1.35	<0.484	2.38067459	103102.496
PM18AJ264	E19JL11a023.csv	<0.085	<0.0994	117886.095	18.9361302	0.01242952	37.3586069	1.77796373	0.0339478	162897.016	10.2308895	0.66620422	<1.43	<0.507	1.34821817	99025.9146
PM18AJ264	E19JL11a024.csv	<0.0813	<0.0953	117806.614	6.07599854	<0.00968	3.58904535	13.5434994	<0.0282	166257.783	2.29327118	0.3424968	<1.36	<0.491	1.69306821	99720.2585
PM18AJ264	E19JL11a025.csv	<0.0871	<0.102	118227.095	19.3778483	<0.0104	49.489232	4.09091885	<0.0301	164915.975	33.5495293	0.71134297	<1.48	<0.534	3.11208747	95908.2633
PM18AJ264	E19JL11a026.csv	<0.0872	<0.103	125296.382	15.5458586	<0.0107	37.8733987	7.3735404	<0.0302	167363.484	13.0317499	0.58207911	<1.49	<0.54	2.36694332	88360.8232
PM18AJ264	E19JL11a027.csv	<0.0958	<0.113	116232.251	14.1618731	<0.0118	19.9051286	8.85963059	<0.0334	158156.741	22.232531	0.61430638	<1.66	<0.599	1.22242942	97384.6667
PM18AJ264	E19JL11a028.csv	<0.0886	<0.104	118632.714	11.1078446	<0.0112	19.7193112	16.3392857	<0.0306	171301.007	14.2010582	1.74662456	<1.51	<0.55	1.99251538	102796.589
PM18AJ264	E19JL11a029.csv	<0.0885	<0.104	116591.953	5.36769936	<0.0111	7.163204	11.4925904	<0.0312	159776.793	15.0094704	0.38051882	<1.54	<0.561	1.65841258	95893.7007
PM18AJ264	E19JL11a030.csv	<0.0742	<0.087	115639.852	20.2610632	<0.0094	29.4312857	11.8419651	0.04555908	160698.039	30.6114901	1.09925615	<1.30	<0.472	2.1407175	97568.0512
PM18AJ264	E19JL11a031.csv	<0.0781	<0.0915	129685.467	7.93460484	<0.0101	18.8523233	15.5504716	<0.0284	165436.25	37.3877621	0.32337707	<1.37	<0.498	8.58357196	81140.6085
PM18AJ264	E19JL11a032.csv	<0.104	<0.122	127509.647	7.3871577	<0.0135	7.03150114	21.8240623	<0.0366	174180.414	39.6630269	0.57505862	<1.77	<0.646	3.90680093	88831.1186
PM18AJ264	E19JL11a033.csv	<0.0954	<0.111	130586.855	12.6621787	<0.0124	32.0491826	8.74376233	<0.0342	172472.466	11.7676813	0.60383318	<1.64	<0.6	4.11284008	81459.319
PM18AJ264	E19JL11a034.csv	<0.0761	<0.0881	123919.629	44.2589392	<0.00994	74.0166517	8.09161536	0.0298007	160115.21	30.3510637	0.56432214	<1.33	<0.487	3.24610205	88456.0795
PM18AJ264	E19JL11a035.csv	<0.0922	<0.106	135912.481	28.3070306	<0.0123	43.2343721	11.6320501	<0.0343	169937.101	55.0683947	0.53426069	<1.60	<0.59	7.28848981	76090.6826
PM18AJ264	E19JL11a036.csv	<0.0752	<0.0862	117459.666	6.96035843	<0.00986	8.81272304	16.6205995	<0.0286	159537.728	22.2312956	2.59479997	<1.30	0.59457958	3.30329783	97483.1536
PM18AJ264	E19JL11a038.csv	<0.0841	<0.0958	118696.216	19.6527516	<0.0109	34.2040602	9.8116839	<0.0322	159672.965	11.3122428	0.55206176	<1.44	<0.534	2.0960451	94590.7459
PM18AJ264	E19JL11a040.csv	<0.0801	<0.0902	129664.486	12.915647	<0.0105	59.8752545	6.59496416	<0.0313	168954.574	42.5201838	0.61729819	<1.35	<0.505	7.77173074	80710.7631
PM18AJ264	E19JL11a041.csv	<0.078	<0.0874	125762.93	33.3891092	<0.0102	63.9062765	6.33962033	<0.0309	161513.446	37.6389965	0.61391607	<1.31	<0.489	5.15992699	87122.4903
PM18AJ267	E19JL11a140.csv	<0.0341	<0.0418	126283.929	4.21787593	<0.00717	135.938541	1.40013828	0.10309129	163970.326	4.33573482	0.11181886	<0.687	<0.283	0.34427074	80926.24
PM18AJ267	E19JL11a141.csv	<0.0472	<0.0576	130807.074	1.11724152	<0.00985	5.99412631	0.22971683	0.07432621	172872.338	1.28535589	0.08933997	<0.952	<0.394	0.58523927	82736.5782

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ267	E19JL11a142.csv	<0.0323	<0.0393	132344.806	3.44220825	<0.00677	55.9727098	1.61169127	0.11869459	170091.844	5.26963221	0.06192754	<0.647	<0.267	0.41310147	76965.6043
PM18AJ267	E19JL11a149.csv	<0.0494	<0.0586	129316.941	5.58441809	<0.0106	96.4407596	12.2122887	0.2574432	160308.889	4.48938908	0.09344883	<1.03	<0.424	0.50356101	77505.9893
PM18AJ267	E19JL11a150.csv	<0.0352	<0.0416	125513.422	1.41218654	<0.00741	19.7835449	2.22457459	0.07908624	166508.754	1.21936039	0.05310608	<0.707	<0.292	0.35408485	89807.0285
PM18AJ267	E19JL11a152.csv	<0.0334	<0.0392	129878.801	19.2975185	<0.00694	46.8399177	0.96865234	0.29168496	170197.591	15.3706126	0.0627961	<0.667	<0.277	1.89726669	80390.6579
PM18AJ267	E19JL11a154.csv	<0.0323	<0.0378	129000.443	5.07370835	<0.00681	97.1538366	2.06013548	0.25513895	167102.963	609.713628	0.1334752	1.29865218	<0.268	38.4917706	81534.6739
PM18AJ267	E19JL11a155.csv	<0.0299	<0.0346	129156.455	2.99094133	<0.00627	57.980773	0.68242681	0.10364416	163794.312	5.20960376	0.0772506	<0.601	<0.247	0.70139705	79627.1099
PM18AJ267	E19JL11a156.csv	<0.0446	<0.0514	129927.446	2.01165317	<0.00958	31.0185649	1.12896939	0.11589536	171988.341	0.65633454	0.1037726	<0.894	<0.369	0.3386227	82922.5518
PM18AJ267	E19JL11a157.csv	<0.0379	<0.0435	131950.369	2.31464866	<0.0079	26.1793223	1.34697854	0.05747358	169801.912	33.1083063	0.08677395	12.6861138	<0.313	1.66292637	78931.4623
PM18AJ267	E19JL11a158.csv	<0.0425	<0.0485	120566.781	2.68062764	<0.00862	79.4323731	2.42058034	0.1717597	163146.931	0.53661728	0.16137664	5.66633012	<0.35	0.19689928	94993.635
PM18AJ267	E19JL11a159.csv	<0.0492	<0.0565	120432.886	4.3626138	<0.0104	38.8790057	10.5996592	0.06592357	171947.904	20.1811641	1.07390946	<0.976	<0.404	0.7846255	83016.6381
PM18AJ267	E19JL11a160.csv	<0.042	<0.0477	124877.537	2.97800195	<0.00879	43.4345381	1.07112897	0.10676111	159870.438	11.3794609	0.07067534	<0.834	<0.345	0.97880215	83576.22
PM18AJ267	E19JL11a161.csv	<0.0391	<0.0439	126917.598	1.70285805	<0.0081	30.2465863	1.55097511	0.06963798	162091.028	1.19292004	0.04083297	<0.78	<0.32	0.27605962	81425.2902
PM18AJ267	E19JL11a162.csv	<0.0334	<0.0373	126373.18	0.84214613	<0.00684	21.0345233	0.50101642	0.023911	169433.166	1.09595271	0.0595117	<0.661	<0.273	0.09713067	88665.672
PM18AJ267	E19JL11a163.csv	<0.0467	<0.0519	134069.077	2.77258523	<0.0099	62.2578789	3.38816508	0.07023353	169598.822	0.85101259	0.17328585	1.38280638	<0.383	0.06651982	79936.7559
PM18AJ267	E19JL11a164.csv	<0.058	<0.0641	126042.906	3.99667447	0.02121454	139.207149	2.34426015	0.3815049	159508.08	12.6499355	0.06008403	<1.14	<0.473	0.88242941	83271.1707
PM18AJ267	E19JL11a165.csv	<0.0407	<0.0447	120824.764	2.19494441	<0.00836	71.1466828	3.42237324	0.14759266	162197.389	0.67267846	0.04432983	1.42709323	<0.331	0.22897247	91484.8416
PM18AJ270	E19JN26a185.csv	<0.0256	<0.0274	124997.096	3.91894445	<0.005	4.50643393	2.56463741	8.04298554	160713.036	0.35882689	0.42790145	<0.491	<0.33	0.53025733	91985.799
PM18AJ270	E19JN26a186.csv	<0.0256	<0.0273	120280.726	3.77624524	<0.00499	6.68525963	4.07797837	13.771555	159865.003	3.38870934	0.48865727	<0.49	<0.329	1.90659245	96700.3905
PM18AJ270	E19JN26a187.csv	<0.0257	<0.0274	122492.615	3.72895926	<0.00499	7.90703152	4.51110913	22.1395781	157780.762	6.03770549	0.72973022	<0.49	<0.329	1.55094379	95258.4756
PM18AJ270	E19JN26a188.csv	<0.0279	<0.0297	139430.343	3.03401188	<0.0054	18.2139712	6.90743675	0.34052962	165153.011	0.11178557	0.83211818	<0.531	<0.356	0.53434331	62666.471
PM18AJ270	E19JN26a189.csv	<0.0258	<0.0274	123644.28	3.80945542	<0.00498	9.09140389	2.87521825	5.04431472	162935.292	0.38706482	0.44208688	<0.489	<0.329	0.83039997	90628.1269
PM18AJ270	E19JN26a190.csv	<0.0277	<0.0294	136756.657	3.12059677	<0.00533	7.59399827	6.45115831	1.0615442	162605.517	<0.00202	0.68347523	<0.523	<0.352	0.06925261	67069.2311
PM18AJ270	E19JN26a191.csv	<0.028	<0.0298	136360.526	3.36130137	<0.00536	15.2833884	6.53989656	0.40520176	162556.226	17.0916931	1.04661183	<0.529	<0.355	4.06052368	67196.9011
PM18AJ270	E19JN26a192.csv	<0.028	<0.0297	131438.215	2.74697125	<0.00537	13.3286662	8.93206121	2.49970187	162129.078	29.4170571	0.68895234	<0.526	<0.353	4.435758	75119.1193
PM18AJ270	E19JN26a193.csv	<0.0278	<0.0295	135105.403	3.29496693	<0.00532	8.98512974	6.19527094	3.42677834	163363.758	17.8612719	0.73592493	<0.522	<0.35	3.94568346	67209.8311
PM18AJ270	E19JN26a194.csv	<0.0259	<0.0275	121388.701	3.57436402	<0.00496	4.43268325	1.6647987	13.6537706	163498.07	14.5414604	0.86687132	<0.486	<0.326	1.29979575	94273.8411
PM18AJ270	E19JN26a196.csv	<0.0283	<0.0299	123838.32	7.92539595	<0.00539	9.43034689	11.5824149	1.59865284	166702.898	0.0076223	1.05640262	<0.526	<0.355	0.14557467	90097.7184
PM18AJ270	E19JN26a197.csv	<0.0275	<0.029	129432.576	2.82667787	<0.00522	18.9424779	9.18383303	13.2087136	161519.486	3.90125442	0.32587703	<0.511	<0.343	3.99322358	81085.9661
PM18AJ270	E19JN26a198.csv	<0.0267	<0.0282	121518.846	1.83382686	<0.00507	5.586859	6.64187816	51.3273392	152955.017	3.19853257	0.59396579	<0.496	<0.333	2.2659502	97619.5436
PM18AJ270	E19JN26a199.csv	<0.0273	<0.0288	133284.805	2.76241643	<0.00516	2.19231195	2.52382249	1.28429492	162958.462	0.08567052	0.31350565	<0.505	<0.339	1.91471588	74764.8603
PM18AJ270	E19JN26a200.csv	<0.0287	<0.0302	140912.053	5.82103706	<0.00541	13.0790754	0.61419308	0.95929025	165064.714	0.00252973	0.9367716	<0.529	<0.355	0.05811735	59660.2894
PM18AJ270	E19JN26a201.csv	<0.0269	<0.0283	126184.158	3.23719948	<0.00506	3.00323524	8.90833694	0.82743703	161134.669	<0.00191	0.39361936	<0.494	<0.332	0.16969523	88722.2698
PM18AJ270	E19JN26a202.csv	<0.0262	<0.0276	120885.203	2.4198735	<0.00493	3.87561097	3.2287502	11.100044	161121.26	1.07839514	0.61903031	<0.482	<0.323	1.08194127	97637.8503
PM18AJ270	E19JN26a209.csv	<0.0276	<0.0287	130376.017	2.62075978	<0.00512	3.61245631	6.83113673	0.28576868	161968.777	0.01720634	0.35056828	<0.499	<0.335	0.41949063	78319.3238
PM18AJ270	E19JN26a210.csv	<0.0289	<0.0301	139659.127	3.2480127	<0.00535	12.9625335	0.66068113	0.0272634	164800.595	4.18987601	0.60013173	<0.522	<0.35	1.14184575	60688.8147
PM18AJ270	E19JN26a211.csv	<0.0302	<0.0313	141399.862	5.27615018	<0.00556	11.6512152	4.78431646	0.40498453	163229.348	35.0114432	0.95369958	1.38090277	<0.365	3.17869064	60426.2176
PM18AJ270	E19JN26a212.csv	<0.0291	<0.0301	135510.682	4.96202516	<0.00536	7.63719781	1.49631107	0.05273256	165421.863	<0.00203	0.47154727	<0.522	<0.35	0.16471805	69530.9377
PM18AJ270	E19JN26a214.csv	<0.0275	<0.0283	121813.288	5.26738822	<0.00504	12.2657047	4.23270584	11.7324464	163085.848	25.9543431	0.85702685	<0.491	<0.329	2.14558853	91929.1839
PM18AJ274	E19JN25a198.csv	<0.0292	<0.0291	119662.452	8.7544973	<0.00546	22.0865293	5.0617619	53.1276202	158670.122	13.4402515	1.39013468	<0.565	<0.301	39.369047	92466.4384
PM18AJ274	E19JN25a199.csv	<0.0298	<0.0297	130300.161	13.3049315	<0.00558	39.7244747	5.11206321	19.5207797	159548.273	2.62996114	0.67350554	<0.581	<0.309	0.92989872	75556.5048
PM18AJ274	E19JN25a200.csv	<0.0287	<0.0287	121205.116	7.44518593	<0.00541	20.2182906	8.11427728	33.0653867	160224.951	12.6272032	1.88295298	<0.559	<0.299	2.22162728	94960.6823
PM18AJ274	E19JN25a201.csv	<0.0287	<0.0288	118743.67	7.91494086	<0.00545	43.6732325	6.85199034	8.96409399	159272.365	35.6452225	3.84355795	<0.562	1.28953986	5.37258718	102303.098
PM18AJ274	E19JN25a202.csv	<0.0273	<0.0274	113451.55	5.44907476	<0.00523	7.08429808	2.04770526	6.78809687	162709.08	30.2876601	1.28183093	<0.538	<0.289	2.49330732	108855.445
PM18AJ274	E19JN25a203.csv	<0.0277	<0.0279	120849.966	9.30795641	<0.00533	39.6670058	7.31994173	13.9659026	163502.164	31.0756397	3.51772843	<0.548	1.01824865	3.8839841	95607.364
PM18AJ274	E19JN25a204.csv	<0.0273	<0.0276	119134.547	11.5330422	0.00563991	40.0324652	6.44606827	19.3824785	162125.046	29.2543661	1.47907601	<0.543	0.37031493	1.03097622	97816.4212
PM18AJ274	E19JN25a205.csv	<0.0275	<0.0279	121301.037	7.48666272	<0.00537	42.9310415	5.63314663	20.498281	158427.092	28.8895412	1.54581336	<0.55	0.41431965	22.6237331	96646.9941
PM18AJ274	E19JN25a206.csv	<0.033	<0.0334	129992.565	14.5417212	<0.00644	34.5061557	7.73948352	30.0892825	165775.18	12.2422534	0.4436485	<0.669	<0.361	0.64930593	83055.111
PM18AJ274	E19JN25a208.csv	<0.0266	<0.0271	117670.944	3.10179721	<0.00527	14.6777337	6.99790313	9.65548213	159281.092	303.598804	1.00205703	5.63533736	<0.293	7.84318726	99476.5077
PM18AJ274	E19JN25a209.csv	<0.0259	<0.0265	119877.706	8.58420325	<0.00516	35.0504955	6.84236805	10.1568327	161924.973	66.6752851	1.68443927	1.32245155	1.21156568	1.12243367	96338.3854
PM18AJ274	E19JN25a210.csv	<0.0316	<0.0324	124942.929	11.3646638	<0.00634	25.9797042	7.31821776	12.1083034	165542.804	3.03752357	1.45629079	<0.641	<0.35	0.61229452	93569.0028
PM18AJ274	E19JN25a211.csv	<0.0259	<0.0266	117968.441	5.10289908	<0.00523	39.009093	1.53982612	2.81342891	163673.283	3.37136616	1.27850459	<0.531	0.55486305	1.25657037	98566.3183
PM18AJ274	E19JN25a212.csv	<0.0262	<0.027	123654.959	7.59208214	<0.00532	15.3600585	2.23359935	12.8352335	162059.623	1.04310359	0.74277137	<0.538	<0.296	0.43643498	92838.1206

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ274	E19JN25a213.csv	<0.0256	<0.0264	119693.457	8.22693604	<0.00522	26.0622327	3.9851321	10.2909318	163701.465	1.43393208	1.82915763	<0.527	<0.291	0.41529397	97377.3608
PM18AJ274	E19JN25a214.csv	<0.0324	<0.0336	115503.927	9.26693825	<0.00666	36.1078362	2.18831933	4.83406907	159892.801	1.97387733	1.5780643	<0.672	<0.371	0.34847833	101209.699
PM18AJ274	E19JN25a215.csv	<0.0255	<0.0265	122769.72	8.61322169	<0.00525	121.274738	5.68900878	10.2754344	162193.59	13.2378536	2.5306504	<0.53	0.92748728	2.48341154	92791.6825
PM18AJ274	E19JN25a216.csv	<0.025	<0.026	113341.188	6.59906522	<0.00518	30.7601217	5.99334931	5.45511712	162872.561	5.58678626	1.99770226	3.14613143	0.36202915	0.36617786	106920.978
PM18AJ274	E19JN25a217.csv	<0.0258	<0.0269	125002.991	12.37672	<0.00536	44.296322	5.85699404	11.6540935	162063.442	197.331393	3.52679552	<0.538	<0.3	5.11216534	89703.2436
PM18AJ274	E19JN25a218.csv	<0.0254	<0.0265	120502.951	11.101825	<0.0053	25.2494932	7.32461517	34.6285187	160643.74	2.28535393	1.07193948	<0.531	0.33938518	0.70563174	99835.412
PM18AJ274	E19JN25a219.csv	<0.0258	<0.027	123750.394	8.69448636	<0.00542	152.103268	7.52093095	12.8914218	160773.949	133.046314	2.14585085	<0.541	0.53525782	5.41912677	91027.0001
PM18AJ274	E19JN25a220.csv	<0.026	<0.0272	118599.841	11.8005508	<0.00548	34.2926926	8.01074399	26.9963518	160956.248	1013.7776	1.45420947	<0.548	0.34161891	7.32054129	97302.0365
PM18AJ275	E19JN26a428.csv	<0.0219	<0.0208	119761.168	6.08344147	<0.00492	5.46806471	0.48742851	0.1689912	163158.802	11.9660747	1.11549499	<0.45	<0.294	0.48963327	93678.5969
PM18AJ275	E19JN26a429.csv	<0.0231	<0.0218	126918.648	7.37826241	<0.00513	11.7597264	0.24951818	0.42429712	163320.627	6.12353613	0.99190738	<0.469	<0.307	0.30171547	81279.6802
PM18AJ275	E19JN26a430.csv	<0.0231	<0.0216	123526.737	5.1948722	<0.00506	4.38174966	0.12201618	0.69923453	163028.763	0.00675957	0.59086441	<0.463	<0.303	0.01206263	89577.51
PM18AJ275	E19JN26a431.csv	<0.0231	<0.0215	121944.589	10.0365504	<0.00499	10.1493557	0.06941139	0.24666954	164369.422	0.17454817	1.33118442	<0.457	<0.299	0.02928539	89770.2097
PM18AJ275	E19JN26a432.csv	<0.0237	<0.0219	124100.741	11.5372608	<0.00505	56.8128025	0.63754221	0.13171005	165147.108	8.24268641	2.3901952	69.9604534	<0.303	1.3171849	86645.2781
PM18AJ275	E19JN26a433.csv	<0.0237	<0.0218	123941.399	13.9735232	<0.00494	15.7339294	1.81971083	1.17386967	158438.126	4.74572161	1.23223373	4.51075969	<0.297	0.51173013	87945.9353
PM18AJ275	E19JN26a434.csv	<0.0246	<0.0225	124379.546	21.388836	<0.00504	23.8511507	0.53303754	1.41280633	160172.8	2.60673946	0.8379541	0.53139568	<0.303	0.56069012	88287.148
PM18AJ275	E19JN26a436.csv	<0.0258	<0.0234	124718.114	10.0710555	<0.00504	10.1189068	0.29292859	0.38140325	163953.82	0.12879872	0.76697516	<0.465	<0.306	0.03389319	87867.372
PM18AJ275	E19JN26a437.csv	<0.0346	<0.0314	126694.054	6.50572189	<0.00663	5.57928025	0.23726804	0.1090932	171817.504	<0.00256	0.66014912	<0.602	<0.404	<0.00355	87684.8815
PM18AJ275	E19JN26a438.csv	<0.0263	<0.0238	116903.216	15.9279125	<0.00485	19.0916087	2.09013475	0.56705661	164225.918	1.87725938	1.2066532	1.72655126	<0.297	0.91384099	97338.1258
PM18AJ275	E19JN26a439.csv	<0.044	<0.0397	131710.113	11.466741	<0.00779	40.7938899	1.19715077	1.27062193	167561.184	13.1960071	1.05993395	1.21296173	<0.489	0.9374672	81056.9559
PM18AJ275	E19JN26a440.csv	<0.0292	<0.0263	126890.654	5.55207915	<0.00509	10.4008377	0.26059793	0.79888537	155681.607	25.0527485	0.83057885	12.7232302	<0.312	0.57379668	86232.5573
PM18AJ275	E19JN26a442.csv	<0.0307	<0.0277	122568.73	16.4598276	<0.00499	12.2201971	0.32312903	0.76460723	163100.68	6.27298874	0.94995693	9.79568305	<0.31	1.00461986	92571.8284
PM18AJ275	E19JN26a443.csv	<0.0369	<0.0333	127251.937	5.81153749	<0.00583	4.96160705	0.25284239	0.31367298	169251.565	7.44527534	0.60381462	<0.541	<0.364	0.43480932	90633.6853
PM18AJ275	E19JN26a444.csv	<0.0339	<0.0306	128149.905	25.2610538	0.00571002	28.1236766	0.69455397	0.69143965	158957.703	22.3290514	1.00451774	7.9080703	<0.321	3.05136875	82424.8249
PM18AJ275	E19JN26a445.csv	<0.0614	<0.0558	120082.758	26.0937778	<0.00888	34.1756136	0.32736174	0.74347376	159499.826	11.5821235	0.95592981	9.33621861	<0.562	1.45055122	89961.727
PM18AJ275	E19JN26a446.csv	<0.0393	<0.0358	129129.04	9.71106238	<0.0055	19.6542495	0.91937241	0.75939439	168181.114	0.55022371	0.60286673	2.27603021	<0.351	0.14941482	82123.6708
PM18AJ275	E19JN26a447.csv	<0.0375	<0.0342	122467.065	41.2470583	<0.00498	60.8268424	0.65244499	1.04397941	163435.881	30.8124806	2.2146823	200.978076	<0.321	2.39012937	89463.6187
PM18AJ275	E19JN26a448.csv	<0.0388	<0.0355	120568.221	6.99489466	<0.00495	16.8941036	1.17140616	1.52767101	164244.608	2.61390994	1.08650836	1.19130538	<0.321	0.40678288	94930.4875
PM18AJ275	E19JN26a449.csv	<0.0429	<0.0395	124546.532	6.7037889	0.00619646	14.6872231	0.52721361	2.1243779	167073.442	0.20998623	1.94715604	0.93969599	<0.343	0.03765719	88081.7697
PM18AJ275	E19JN26a450.csv	<0.0429	<0.0397	119097.921	6.23555384	<0.005	11.1654171	0.98008551	0.5147011	162332.431	0.4150867	1.35918206	0.65037243	<0.331	0.03475405	96317.5478
PM18AJ279	E19JN26a241.csv	<0.0269	<0.0265	113904.105	25.034526	<0.00489	49.2957753	4.83083611	0.04637161	163870.519	1.87520089	1.02049697	<0.471	<0.317	1.33133945	106403.822
PM18AJ279	E19JN26a242.csv	<0.0268	<0.0264	117001.322	23.6267943	<0.00488	22.2593776	3.24453583	0.0421541	162181.925	0.10079128	1.16225939	<0.47	<0.316	0.62079462	101901.741
PM18AJ279	E19JN26a243.csv	<0.0427	<0.042	110374.043	7.66576443	<0.00781	11.4940642	0.45461071	<0.0241	157252.129	0.04374914	0.95087134	<0.768	<0.505	<0.00405	108950.893
PM18AJ279	E19JN26a244.csv	<0.0269	<0.0264	119223.995	24.4492711	<0.0049	32.6875698	2.28883031	0.15756203	160885.616	0.1011374	0.77979041	<0.472	<0.317	0.3282029	100972.643
PM18AJ279	E19JN26a245.csv	<0.0264	<0.0259	111368.29	9.54581093	<0.00482	6.6615792	0.82638444	0.0178843	164740.045	0.15705367	0.630351	<0.464	<0.312	0.29310162	111421.913
PM18AJ279	E19JN26a246.csv	<0.0278	<0.0272	119340.789	40.5234587	0.00527205	41.5928536	8.16795788	0.02451682	162598.816	32.9436552	0.71330335	1.31184253	<0.329	3.71189496	98625.9655
PM18AJ279	E19JN26a247.csv	<0.0276	<0.027	118977.841	32.1133637	<0.00506	47.3455061	9.20358077	<0.0151	162139.27	30.5799462	0.76028598	0.89150637	<0.327	3.68203908	95632.6567
PM18AJ279	E19JN26a248.csv	<0.0294	<0.0286	128406.429	55.4977384	<0.00538	72.2691631	10.2955831	0.03978275	164142.703	59.1799782	0.81751011	1.07126329	<0.349	4.94625247	85087.0206
PM18AJ279	E19JN26a249.csv	<0.0263	<0.0256	110399.747	21.4143934	<0.00483	9.58967706	4.56477156	<0.0143	162736.182	0.67183117	0.61162387	<0.464	<0.312	0.63152597	111379.056
PM18AJ279	E19JN26a250.csv	<0.0294	<0.0286	130289.376	26.8174086	<0.00541	72.5204558	7.3347475	<0.016	165658.019	4.9069099	0.70137324	0.67591161	0.35123024	3.06735678	80099.5626
PM18AJ279	E19JN26a251.csv	<0.0343	<0.0333	116938.617	46.7791274	<0.00626	28.5171018	4.25524331	0.02301353	154951.854	1.16961703	0.9223653	<0.606	<0.409	0.97222355	98614.0177
PM18AJ279	E19JN26a252.csv	<0.0285	<0.0276	118001.648	22.8337031	<0.00527	18.6260012	0.47604319	0.0800918	164377.232	0.02168075	0.54701436	<0.508	<0.342	0.10538299	102563.528
PM18AJ279	E19JN26a253.csv	<0.0275	<0.0266	118231.082	13.9656629	<0.00507	27.2461705	1.05612994	0.08974828	161997.37	0.14977248	0.60239492	<0.487	<0.328	0.61901469	101115.481
PM18AJ279	E19JN26a254.csv	<0.0279	<0.0269	123389.549	13.896223	<0.00516	42.757126	2.9628922	0.02894034	161912.091	0.42125519	0.89223032	<0.495	<0.334	1.02795162	92928.3049
PM18AJ279	E19JN26a255.csv	<0.0287	<0.0277	119925.353	13.7505397	<0.00534	20.000959	2.89698437	0.02592899	162143.138	0.72319358	1.04386429	<0.511	<0.345	0.69329702	99953.0956
PM18AJ279	E19JN26a256.csv	<0.0267	<0.0257	116350.974	14.4793463	<0.00497	14.0245565	0.99421486	0.02129519	162439.022	0.12066607	0.46466727	<0.476	0.3309418	0.03937681	104481.972
PM18AJ279	E19JN26a257.csv	<0.0279	<0.0268	110054.259	14.9674492	<0.00514	4.99847574	1.82795677	<0.0149	162038.117	0.02890294	0.88388038	<0.496	<0.335	0.17987004	110699.406
PM18AJ279	E19JN26a258.csv	<0.0344	<0.0333	125163.218	32.0147956	<0.00637	30.0187558	5.858079	0.03648264	155248.125	0.13274111	0.86595763	<0.615	<0.415	0.61933959	88416.347
PM18AJ279	E19JN26a259.csv	<0.0346	<0.0331	116397.885	14.9218111	<0.00642	35.9454798	1.49201809	<0.0184	158114.037	0.12556004	1.13183576	<0.619	<0.419	0.12675368	101223.913
PM18AJ279	E19JN26a260.csv	<0.0288	<0.0276	109717.271	29.1568199	<0.00541	42.5906501	4.5959615	<0.0154	159818.382	7.14764307	1.01908102	<0.516	5.7404534	1.38531297	111574.574
PM18AJ279	E19JN26a261.csv	<0.0267	<0.0255	114638.883	18.4169406	<0.005	16.0165903	3.18842491	0.04867759	162749.925	0.0310749	0.91757125	<0.478	0.7451585	0.18709313	106544.877
PM18AJ279	E19JN26a262.csv	<0.0272	<0.0259	122003.409	17.1705894	<0.00511	38.2257684	3.28750844	0.01794135	161614.007	0.61229867	1.10546135	<0.489	<0.33	0.39168927	94469.6946
PM18AJ279	E19JN26a263.csv	<0.0285	<0.0271	119678.66	9.33599976	<0.00536	14.5148335	2.02717504	<0.0151	165188.575	0.06713698	1.55573763	0.85403347	0.42827531	0.13670535	101936.479

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ279	E19JN26a265.csv	<0.0267	<0.0253	119099.877	24.1883444	<0.00504	34.9761696	3.76940124	0.02337385	162830.707	0.7966938	0.71482964	<0.482	<0.326	1.0150365	99693.1391
PM18AJ281	E19JL11a020.csv	<0.0877	<0.101	119466.917	0.71273961	0.01029974	3.88488825	1.08580161	0.06888463	163823.157	0.93083583	0.15335966	<1.38	<0.495	0.23573597	95537.0388
PM18AJ281	E19JL11a021.csv	<0.0872	<0.101	128143.237	2.58287462	<0.00968	13.3894044	0.31405308	0.1127211	162857.026	2.86182656	0.19017176	<1.40	<0.503	0.39655297	80989.4071
PM18AJ281	E19JL11a052.csv	<0.0399	<0.0419	121181.865	10.8736851	<0.00549	27.7692943	4.2853567	0.52940903	161950.169	142.319738	1.07908802	34.5041628	0.25512814	6.24833675	94428.1143
PM18AJ281	E19JL11a053.csv	<0.0424	<0.0444	115157.876	11.2135245	<0.00585	10.8686484	1.33153243	0.20863865	165549.775	7.83315724	0.19963126	10.3011014	<0.255	0.54084456	105048.654
PM18AJ281	E19JL11a054.csv	<0.0503	<0.0525	118413.58	11.3099724	<0.00688	14.9825384	6.32213095	0.06360142	163629.94	5.50986595	0.18460911	0.88847104	<0.301	0.34915119	98400.1023
PM18AJ281	E19JL11a055.csv	<0.0419	<0.0436	121778.552	8.02268958	<0.00568	28.2901902	4.03088999	0.32029874	164244.872	156.3365	0.52611549	3.13357915	0.72841232	4.40388255	91748.7624
PM18AJ281	E19JL11a056.csv	<0.0626	<0.065	119109.049	5.25030175	<0.00851	18.6687007	0.4707067	0.12265534	163283.778	0.55325801	0.18095953	<0.917	<0.372	0.0507301	95111.9639
PM18AJ281	E19JL11a058.csv	<0.0407	<0.042	115101.961	1.28630149	<0.00549	2.04963806	0.99134591	0.04332059	163651.217	1.26528084	0.06934246	<0.578	<0.24	0.17833571	103890.648
PM18AJ281	E19JL11a059.csv	<0.0517	<0.0533	116534.269	1.80922387	<0.00711	1.00612607	0.21990561	0.02669747	171318.766	0.72273469	0.06907051	<0.731	<0.306	0.15875168	103840.841
PM18AJ281	E19JL11a060.csv	<0.0418	<0.043	123806.726	6.09628666	<0.00562	16.6222479	1.1359945	0.48008472	162065.462	59.684087	0.26264905	4.62472168	0.72625965	2.86694149	89299.7038
PM18AJ281	E19JL11a061.csv	<0.0571	<0.0588	135800.775	1.77076745	<0.0077	22.3663039	0.20462649	0.11334533	176884.986	0.1009457	0.46840904	<0.802	<0.337	0.05537133	72707.868
PM18AJ281	E19JL11a062.csv	<0.0427	<0.0439	122631.027	1.61032279	<0.00578	3.7994373	0.14848048	0.03951374	165831.403	2.72251635	0.25792755	0.670135	<0.251	0.32427071	91300.8197
PM18AJ281	E19JL11a063.csv	<0.0402	<0.0413	111597.888	1.28587876	<0.00543	3.68183744	0.43791066	<0.0186	167702.22	0.44317204	0.11027133	<0.562	0.28599041	0.1933276	109470.193
PM18AJ281	E19JL11a064.csv	<0.0408	<0.042	114919.327	1.15627811	<0.00552	1.37708222	0.77903736	0.04335799	164239.838	1.49666135	0.1386817	<0.57	<0.24	0.17591425	104514.595
PM18AJ281	E19JL11a065.csv	<0.0438	<0.045	133164.132	0.83939545	<0.00592	1.75769057	0.58665226	<0.0205	164672.207	0.06419466	0.22321094	<0.61	<0.257	0.01121694	72960.764
PM18AJ281	E19JL11a066.csv	<0.0447	<0.0459	129716.037	38.2737158	<0.00606	20.4046453	0.71098724	0.3449523	166387.686	94.2141256	0.16218076	<0.622	<0.263	5.21350421	78535.9658
PM18AJ281	E19JL11a067.csv	<0.0418	<0.0429	124944.834	38.6725551	<0.00566	20.5706183	2.30525802	0.52307351	166434.426	229.719226	0.18198149	2.31089898	<0.245	9.29333447	86463.6212
PM18AJ281	E19JL11a069.csv	<0.0424	<0.0437	123254.645	14.828692	<0.00573	18.6116094	2.51270977	0.22709166	162751.341	339.042214	0.19169047	<0.589	<0.25	8.10058953	91527.2656
PM18AJ282	E19JN26a102.csv	<0.0342	<0.0348	107775.294	2.71426715	<0.00527	1.69572518	0.41367639	<0.0169	167445.275	0.03585103	0.16561728	<0.536	<0.342	0.0700178	123187.312
PM18AJ282	E19JN26a103.csv	<0.0508	<0.0517	104309.52	2.47182859	<0.0079	2.11618217	1.04930945	<0.0254	159719.188	0.06447086	0.28198117	<0.82	<0.524	0.16011095	122144.235
PM18AJ282	E19JN26a104.csv	<0.0359	<0.0366	114486.673	3.94356729	<0.00563	11.5993992	2.27051688	<0.0179	168713.569	0.12840335	0.44300063	<0.57	<0.364	0.25346243	111368.036
PM18AJ282	E19JN26a105.csv	<0.049	<0.05	104036.426	2.35191587	<0.00765	13.9578454	1.84984849	<0.0244	161402.441	8.32345629	0.642619	<0.783	<0.501	0.33552012	121338.174
PM18AJ282	E19JN26a106.csv	<0.0354	<0.0361	110441.054	4.14384251	<0.00559	22.9640218	1.96228153	<0.0177	161480.745	1.9694324	0.49862218	<0.572	<0.367	0.68809704	114041.952
PM18AJ282	E19JN26a107.csv	<0.0339	<0.0347	112688.473	4.86662937	<0.00538	36.3800654	1.57850004	<0.0168	165654.308	0.74633107	0.43313051	<0.547	<0.351	0.35329316	112592.71
PM18AJ282	E19JN26a108.csv	<0.0359	<0.0367	135520.473	1.46808234	<0.00573	2.59060473	0.78939343	<0.0178	166118.856	2.16879516	0.5606646	<0.581	<0.373	0.30155746	66147.524
PM18AJ282	E19JN26a109.csv	<0.0317	<0.0325	112095.577	4.00224315	<0.00507	17.1511213	2.39691562	<0.0158	164505.101	5.24947116	0.48973635	<0.517	<0.333	0.53578112	112798.894
PM18AJ282	E19JN26a110.csv	<0.0314	<0.0322	111780.903	4.95487918	<0.00508	17.2539485	2.04805559	0.01925118	163405.88	4.80874903	0.82639061	<0.515	<0.332	0.33564428	112861.748
PM18AJ282	E19JN26a111.csv	<0.0309	<0.0317	113372.451	6.99115345	<0.00502	12.847832	4.01621788	0.0343918	162398.411	19.7755268	0.63739633	<0.51	<0.329	0.87811622	110239.858
PM18AJ282	E19JN26a112.csv	<0.0301	<0.0309	107838.12	2.70693479	<0.00493	1.31856825	0.46480402	<0.015	166247.589	2.57528471	0.11307252	<0.5	<0.323	0.33024758	120059.224
PM18AJ282	E19JN26a113.csv	<0.0319	<0.0327	115408.823	12.1969667	<0.00524	99.8871115	4.93856816	0.07591082	162300.849	12.6615173	0.70190664	<0.532	0.55912391	1.32470929	104558.552
PM18AJ282	E19JN26a114.csv	<0.0291	<0.03	104231.694	2.68849361	<0.00483	6.33979487	1.296335	<0.0145	161389.981	0.94927216	0.20479697	<0.49	<0.317	0.76685097	128186.939
PM18AJ282	E19JN26a115.csv	<0.0302	<0.0311	109836.532	3.16913998	<0.00503	6.21877523	0.99373997	<0.0151	163555.739	0.01447371	0.48093886	<0.51	<0.33	0.17164525	116027.358
PM18AJ282	E19JN26a116.csv	<0.0297	<0.0307	109878.36	3.74504911	<0.00499	4.91741995	2.23700488	<0.0149	163777.598	0.53279909	0.33601295	<0.506	<0.328	0.15170151	114508.386
PM18AJ282	E19JN26a117.csv	<0.0326	<0.0336	106129.03	3.8179912	<0.00544	61.9823292	3.23913882	0.01984145	165567.655	10.6032324	0.67287902	1.04592295	<0.362	1.72229566	126160.12
PM18AJ282	E19JN26a118.csv	<0.0301	<0.0311	113808.346	12.4869514	<0.00513	74.994049	4.43109343	0.07516885	158501.461	108.774573	2.51452599	2.53058541	1.10473798	3.50888007	108022.358
PM18AJ282	E19JN26a119.csv	<0.0301	<0.0312	118680.689	5.73740864	<0.00515	30.1565605	2.74837517	<0.0151	163763.718	4.11590431	1.09860733	<0.522	<0.339	0.46087529	99298.6963
PM18AJ282	E19JN26a120.csv	<0.0409	<0.0423	111290.598	3.21351026	<0.00701	4.21894879	4.14318935	<0.0205	158307.067	1.04979693	0.60476846	<0.714	<0.464	0.23595453	111070.681
PM18AJ282	E19JN26a121.csv	<0.03	<0.0311	116043.039	7.21350342	<0.00518	39.8745647	2.93669676	0.05969986	159967.15	7.90343491	0.45549816	<0.525	<0.342	1.48689161	106622.192
PM18AJ282	E19JN26a122.csv	<0.0279	<0.029	105161.556	8.82846703	<0.00487	48.638049	1.99440519	<0.0141	160617.237	1.2645769	1.06614284	2.37158173	1.97946567	0.66247231	125398.305
PM18AJ282	E19JN26a123.csv	<0.0281	<0.0292	108713.461	12.922571	<0.00493	88.9568724	2.39259677	0.0246644	159916.604	0.71034738	1.48150018	2.65253122	2.88491042	0.58658697	119449.036
PM18AJ282	E19JN26a124.csv	<0.0289	<0.0301	113725.74	9.1038238	<0.0051	53.867698	2.77345594	0.07631677	160317.802	13.6294663	0.46600592	<0.515	<0.336	1.31947245	110548.39
PM18AJ282	E19JN26a125.csv	<0.0283	<0.0294	110825.804	6.84478515	<0.00501	28.5180832	3.22713949	0.04333918	161970.603	14.0522877	0.43796411	<0.506	<0.331	0.95827064	115042.297
PM18AJ283	C19AU08C309.csv	<0.032	<0.0363	121055.834	5.85895073	<0.00912	16.1119705	0.57243115	0.56478567	163405.827	1.63111969	0.46916103	<0.697	<0.286	0.69883911	94304.8911
PM18AJ283	C19AU08C310.csv	<0.0328	<0.0371	121819.829	10.9746627	<0.00937	23.0456102	0.64388971	0.44117669	163486.073	3.00488528	0.40358576	0.91447743	<0.296	0.88270624	92500.124
PM18AJ283	C19AU08C317.csv	<0.0328	<0.0359	124924.631	18.9829845	<0.00951	38.2009996	1.47047863	0.70083287	161466.212	6.16406646	0.59109597	<0.703	<0.306	1.34890714	87720.3479
PM18AJ283	C19AU08C320.csv	<0.0352	<0.0379	123619.437	8.24134077	<0.0103	21.8968606	0.82316458	1.88807561	159912.597	58.5021382	0.61233324	5.26389104	<0.332	3.00438801	91108.1042
PM18AJ283	C19AU08C321.csv	<0.0321	<0.0344	128558.986	9.11873775	<0.00941	31.1220032	1.03542236	1.49178471	162766.757	5.6886604	0.37992705	1.26224289	<0.304	3.48852276	81355.3341
PM18AJ283	C19AU08C287.csv	<0.0344	<0.0374	120845.004	5.1928134	<0.00925	10.4957994	0.4140728	0.1821253	161782.047	0.03421075	0.47088582	<0.8	<0.28	0.17183946	95235.9518
PM18AJ283	C19AU08C288.csv	<0.0339	<0.0371	118557.715	3.82516223	<0.00914	6.25312489	0.16792643	0.1580034	163954.787	0.11970089	0.20926094	<0.788	<0.277	0.23039369	99367.563
PM18AJ283	C19AU08C289.csv	<0.0333	<0.0365	116121.336	8.2751504	<0.00899	6.44953909	0.72112156	0.03161418	165947.392	0.02033964	0.30491699	<0.771	<0.272	0.20546485	100864.895
PM18AJ283	C19AU08C290.csv	<0.0397	<0.0438	120948.891	12.7638399	0.01358701	26.2790567	0.26143821	0.27333032	160870.541	0.78212812	0.48798883	<0.918	<0.325	0.56560934	93284.273

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ283	C19AU08C291.csv	<0.0339	<0.0375	121637.252	10.4831571	<0.00922	18.6094527	0.11503693	0.23955511	165019.831	0.77745726	0.38603509	<0.783	<0.278	0.47343061	93971.6964
PM18AJ283	C19AU08C292.csv	<0.0326	<0.0363	118304.587	10.4223637	<0.0089	7.61287892	0.6613932	0.43654161	163075.166	0.71205043	0.43159669	<0.751	<0.269	0.6097717	97791.2363
PM18AJ283	C19AU08C293.csv	<0.0345	<0.0386	124424.65	14.8815248	<0.00947	22.4780805	1.37214481	0.24492077	159779.077	0.3567837	0.64197107	<0.794	<0.285	0.72582939	86096.1411
PM18AJ283	C19AU08C294.csv	<0.0338	<0.0379	122055.422	10.7428001	<0.00929	15.6147608	0.08843266	0.2642073	162844.311	0.37064814	0.40995219	1.04013695	<0.28	0.6369289	93108.3612
PM18AJ283	C19AU08C295.csv	<0.0333	<0.0375	119673.932	4.77914005	<0.00917	5.84895576	0.0332182	0.60771773	164959.251	0.07393306	0.41727913	<0.762	<0.277	0.32642874	96097.3458
PM18AJ283	C19AU08C296.csv	<0.0356	<0.0402	119896.246	4.58978857	<0.00982	4.71624955	0.10996264	0.54599258	166143.32	0.08226133	0.34394117	<0.813	<0.298	0.28608924	98743.9809
PM18AJ283	C19AU08C297.csv	<0.0327	<0.0371	119738.347	14.3193671	<0.00909	26.7007802	0.99795216	0.34306088	164579.566	3.71190891	0.48134674	<0.746	<0.275	0.73906611	95161.7277
PM18AJ283	C19AU08C298.csv	<0.0341	<0.0388	124663.874	7.42166287	<0.00949	21.0191408	1.49018881	0.48933262	162603.832	0.24845539	0.58618074	<0.774	<0.288	0.9500389	87989.229
PM18AJ283	C19AU08C299.csv	<0.0521	<0.0594	116786.325	4.72225341	<0.0146	7.73680834	0.29097538	0.16956392	161066.455	0.0614315	0.34564658	<1.18	<0.442	0.22072078	100401.074
PM18AJ283	C19AU08C300.csv	<0.0321	<0.0367	118262.219	9.12608236	<0.00899	10.0016131	1.57249671	0.0745116	159929.769	0.11822419	0.32175174	<0.724	<0.274	0.10619535	100624.087
PM18AJ283	C19AU08C301.csv	<0.032	<0.0366	120522.612	5.94034392	<0.00896	10.9858275	0.24414196	0.15448579	164152.027	0.28402804	0.30909339	<0.718	<0.274	0.31499816	97351.511
PM18AJ283	C19AU08C302.csv	0.06206279	<0.0374	120361.64	9.07186973	<0.00918	15.8569447	0.33136582	0.19551188	164160.392	0.39757819	0.44168226	3.66260647	<0.281	0.38582731	95952.2634
PM18AJ283	C19AU08C303.csv	<0.0325	<0.0372	125562.58	31.06332	<0.00915	57.1227354	0.62833405	0.22265617	161142.636	2.88508619	0.48873415	17.0680703	<0.281	0.91634936	88769.5874
PM18AJ283	C19AU08C304.csv	<0.0374	<0.0428	126172.132	6.21660497	<0.0105	10.4176958	0.69618336	0.53279263	166071.096	5.23184693	0.82440756	39.3731348	<0.325	1.30392539	88125.1208
PM18AJ283	C19AU08C305.csv	<0.0331	<0.0379	122894.478	20.1844258	<0.00937	34.037358	0.11647429	0.52630009	162342.856	1.867331	0.51622624	2.26098075	<0.29	0.93562185	91344.3091
PM18AJ283	C19AU08C306.csv	<0.038	<0.0434	130294.48	10.0648822	<0.0107	33.0851189	0.67015344	0.4972303	169810.972	3.69903981	0.51679274	<0.84	<0.335	1.00658551	84183.0526
PM18AJ283	C19AU08C307.csv	<0.0335	<0.0382	128557.174	22.2346694	<0.00952	45.9191311	1.04876498	0.4190055	161502.963	2.35729614	0.58320633	1.31159052	<0.297	1.69233164	80281.1544
PM18AJ283	C19AU08C308.csv	<0.0314	<0.0357	117308.68	39.6642604	<0.00895	14.2711558	4.13910296	0.06392935	165639.026	0.07241005	0.56334218	<0.688	<0.28	0.23665587	98582.1966
PM18AJ285	E19JL11a167.csv	<0.0313	<0.034	136970.942	57.3776902	<0.00639	125.562451	3.54354772	2.36789512	168621.023	0.01156353	0.57359726	<0.613	<0.254	0.06128044	65148.5587
PM18AJ285	E19JL11a168.csv	<0.0319	<0.0345	142071.791	54.1141047	<0.0065	138.974438	8.35733869	0.70209961	168228.683	0.01640597	0.80223334	<0.624	<0.259	0.04094225	53849.7415
PM18AJ285	E19JL11a169.csv	<0.0304	<0.0327	134098.999	45.1496971	<0.00618	31.6649759	2.32245727	1.00206939	164796.98	0.45052728	0.4086103	<0.596	<0.246	0.78641358	70184.3086
PM18AJ285	E19JL11a170.csv	<0.0428	<0.0458	141403.887	31.0700155	<0.0087	10.5641231	1.38310775	0.34300964	169166.532	0.08364205	0.44255593	<0.835	<0.348	1.17539309	57030.3465
PM18AJ285	E19JL11a171.csv	<0.0315	<0.0334	136850.121	39.3260123	<0.00635	99.6813449	7.43663854	1.80181502	167959.742	0.02514296	1.06393283	<0.61	<0.254	0.04329232	62187.2676
PM18AJ285	E19JL11a172.csv	<0.0304	<0.0321	128206.878	3.23380623	<0.00609	2.08394305	0.45981133	0.10792765	164175.353	0.00240951	0.22694422	<0.588	<0.245	0.26737237	81097.9886
PM18AJ285	E19JL11a173.csv	<0.0315	<0.0331	132770.232	11.0322593	<0.00631	5.6456747	0.39675797	0.30792413	165306.201	1.40085894	0.37732527	<0.607	<0.253	3.90803788	71260.0551
PM18AJ285	E19JL11a174.csv	<0.0305	<0.0319	125921.503	3.29378014	<0.0061	2.80799423	0.226886	0.08845987	165560.349	0.14246681	0.17045344	11.7930209	<0.245	1.02509286	83576.849
PM18AJ285	E19JL11a175.csv	<0.0528	<0.0549	137132.629	17.2240077	<0.0105	14.2327865	2.28234766	0.21270861	169519.893	0.07892852	0.26880097	<1.01	<0.423	0.65216707	64837.2174
PM18AJ285	E19JL11a176.csv	<0.0331	<0.0342	134353.227	13.3598422	<0.00658	8.13275295	5.74398457	0.20402625	162776.833	0.08407606	0.26136226	<0.637	<0.265	0.36529479	68791.7429
PM18AJ285	E19JL11a177.csv	<0.0304	<0.0312	129593.073	5.2307735	<0.00602	4.06929869	0.22460095	0.1184176	166029.025	0.0131636	0.19474125	<0.583	<0.243	0.37353983	77417.4521
PM18AJ285	E19JL11a178.csv	<0.0318	<0.0325	137111.632	30.8248717	<0.00628	17.0963297	2.19992453	0.40072247	165391.232	0.05677009	0.47882776	<0.608	<0.254	0.60370396	63865.8881
PM18AJ285	E19JL11a179.csv	<0.0324	<0.0329	140873.255	39.8334943	<0.00638	29.9156461	1.88885204	0.42788394	165840.242	0.58283456	0.57693512	1.36818727	<0.258	2.55310593	57167.597
PM18AJ285	E19JL11a180.csv	<0.0318	<0.0321	139314.954	19.491949	<0.00624	14.0410616	2.02960869	0.25402355	165382.971	0.09715762	0.37357145	<0.603	<0.253	0.64610261	60899.5606
PM18AJ285	E19JL11a181.csv	<0.0318	<0.032	138149.429	33.6773383	<0.00623	10.9303126	1.92109423	0.32608936	166201.002	0.34744239	0.45196014	<0.603	0.26124341	1.45835177	62567.8631
PM18AJ285	E19JL11a182.csv	<0.0442	<0.0441	133967.227	24.3256699	<0.00844	18.4433278	6.21050767	0.3760338	165693.666	21.1464489	0.31823439	<0.817	<0.346	2.30119554	70228.4189
PM18AJ285	E19JL11a183.csv	<0.0327	<0.0326	140020.265	123.570288	<0.00635	351.826211	8.65455538	3.18923306	167142.984	0.03994634	0.90845832	<0.616	<0.26	0.05121126	59286.4362
PM18AJ285	E19JL11a184.csv	<0.0375	<0.037	135560.367	16.3685404	<0.00726	9.62644619	2.29887548	0.17024237	166281.495	0.1281119	0.26338769	<0.696	<0.295	0.14319758	68683.5096
PM18AJ285	E19JL11a185.csv	<0.0319	<0.0314	134332.764	21.8679395	<0.00618	12.1989729	1.35743311	0.37980799	165124.266	0.15724638	0.3282957	<0.601	<0.255	0.12865356	70275.661
PM18AJ285	E19JL11a186.csv	<0.0462	<0.0453	138707.369	48.1319481	<0.00872	27.3711883	29.2596028	0.60189933	169478.17	0.10204055	0.56573238	<0.864	<0.368	0.0700695	65917.4849
PM18AJ285	E19JL11a188.csv	<0.0369	<0.0358	137044.746	12.0332729	<0.00702	14.3206103	0.70718459	0.52551419	172279.787	0.32882134	0.50192654	0.80380679	0.46501615	0.90836238	65075.0224
PM18AJ286	E19JL11a016.csv	<0.0939	<0.104	110447.425	12.8590271	<0.009	43.9895378	1.54241211	0.10550053	162459.471	1.5168318	0.43052243	<1.33	1.15549506	0.47573909	111342.546
PM18AJ286	E19JL11a017.csv	<0.0902	<0.101	111908.455	20.6282673	<0.00902	45.2803426	5.19617407	1.37009022	160801.141	0.00489741	0.64313563	<1.32	<0.472	0.0928823	107290.256
PM18AJ286	E19JL11a215.csv	<0.0314	<0.0281	128230.531	26.8907332	<0.0059	103.790785	11.4266621	2.97443978	164234.356	32.494097	0.32045065	3.94282202	15.4643713	3.96388079	82086.0981
PM18AJ286	E19JL11a216.csv	<0.0314	<0.0281	128550.014	27.2792573	<0.0059	101.107868	10.6671219	2.86894628	165312.229	28.2027223	0.29525039	4.74485387	7.71307722	3.92358959	81600.2662
PM18AJ286	E19JL11a217.csv	0.04622808	0.06789963	124734.1	26.022192	<0.00586	95.3938155	13.5496847	3.49988848	164483.891	47.8218928	0.26737026	2.26528138	7.58478339	4.71423604	86998.8456
PM18AJ286	E19JL11a218.csv	<0.0373	<0.0332	130335.913	31.3573994	<0.007	126.643729	7.99551829	2.99414636	168516.739	17.6899781	0.40556825	<0.688	<0.308	2.52413366	83450.2023
PM18AJ286	E19JL11a219.csv	<0.0304	<0.0271	114154.726	9.6274357	<0.00573	58.8369454	2.42478935	0.32139347	164014.769	5.68091663	0.18466245	<0.565	1.19208975	1.56181301	107096.958
PM18AJ286	E19JL11a220.csv	<0.0312	<0.0278	119593.081	13.2649839	<0.00589	83.7783044	3.49804307	0.24594396	163667.027	15.0385481	0.20287667	1.69927438	3.92016215	2.56455679	96851.119
PM18AJ286	E19JL11a221.csv	<0.0313	<0.0279	119212.493	13.406602	<0.00592	86.3036269	3.9682505	0.14492982	161567.878	10.7504647	0.49833657	<0.58	1.51870348	1.13672118	98418.8951
PM18AJ286	E19JL11a222.csv	<0.0361	<0.0322	118975.128	11.7293501	<0.00684	65.0164707	6.77037272	0.05094685	164705.445	28.4574231	0.39123229	<0.669	<0.301	3.62411743	94099.7441
PM18AJ286	E19JL11a224.csv	<0.0304	<0.0271	122939.676	0.77413346	<0.00579	4.25571593	1.08521266	<0.0153	165302.901	0.22118349	0.41404407	<0.566	<0.255	0.23017613	90656.4287
PM18AJ286	E19JL11a225.csv	0.04684562	0.03391707	119745.382	21.0575699	<0.00579	111.342552	9.88437265	0.23062529	165647.928	24.1001898	1.07272795	44.4868186	7.68119525	2.99677075	96742.609
PM18AJ286	E19JL11a226.csv	<0.0307	<0.0275	122054.123	17.4834674	<0.00588	44.0481658	3.70408872	<0.0153	165419.579	2.1648851	0.9945868	<0.574	1.34585148	0.12282923	92057.3718

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ286	E19JL11a227.csv	<0.0345	0.03865325	125716.625	32.9181258	<0.00661	111.452591	18.678597	7.72682102	165183.428	54.9911644	0.2965282	5.00472626	6.87272819	6.34293604	85804.2007
PM18AJ286	E19JL11a228.csv	<0.0293	<0.0263	114632.579	17.1109574	<0.00564	49.2778279	3.44944313	0.21370632	166801.206	20.768372	0.93330164	1.5995436	0.9257416	1.6143521	103684.965
PM18AJ286	E19JL11a229.csv	<0.0359	<0.0323	117413.022	17.4335807	<0.00696	51.4370466	3.70407704	0.02579641	163008.775	1.74709563	1.04435334	<0.681	1.45725401	0.12450786	97956.0188
PM18AJ286	E19JL11a230.csv	<0.0285	<0.0256	111976.703	19.9813287	<0.00552	65.43272	7.33568056	0.81935864	165772.818	1.61920722	0.52707622	<0.536	1.85243091	0.80856565	109908.956
PM18AJ286	E19JL11a231.csv	<0.0295	<0.0265	117366.788	16.8177727	<0.00568	73.0801216	15.2743256	0.89460434	161321.574	23.7999609	2.06963982	26.6439969	15.7331217	2.67750314	98242.1037
PM18AJ286	E19JL11a232.csv	0.08336964	0.09808196	118183.448	23.3320023	<0.00574	96.3703588	20.3534718	1.76036752	161785.618	46.9920307	0.82311443	23.8720524	8.92495291	4.4045875	94096.1662
PM18AJ286	E19JL11a233.csv	<0.0389	<0.0351	119352.962	12.0539108	<0.00759	74.8584842	10.1241256	0.05666214	160692.476	8.36721787	0.27757358	<0.733	<0.333	1.91356723	93849.566
PM18AJ289	E19JN26a216.csv	<0.0296	0.03352584	141412.985	12.8249721	<0.0054	17.2895162	3.34763794	11.6698929	165783.146	91.4636585	1.79097311	<0.527	<0.354	9.2154171	55052.1596
PM18AJ289	E19JN26a218.csv	<0.0294	<0.0301	131396.996	33.6555052	<0.00536	49.0174936	0.74168783	6.75341442	166015.635	35.043206	1.90161127	<0.522	<0.35	1.35399715	73787.437
PM18AJ289	E19JN26a219.csv	<0.0294	<0.0302	134741.579	13.6544931	<0.00537	4.48302313	15.8853023	13.4410159	164072.251	21.7527421	1.37777399	<0.522	<0.351	4.67798143	70167.9954
PM18AJ289	E19JN26a220.csv	<0.0299	<0.0306	140078.895	51.5340732	<0.00544	61.1694626	4.25683558	13.9766641	165616.013	37.0431979	1.70404456	<0.529	<0.355	1.49028689	59289.9478
PM18AJ289	E19JN26a221.csv	<0.0285	<0.0291	129251.105	7.56462277	<0.00518	6.23410367	5.492313	6.25836425	164235.216	28.7410852	2.11405257	<0.503	<0.338	1.445117	81347.4762
PM18AJ289	E19JN26a222.csv	<0.0283	<0.0289	132791.172	15.9992403	<0.00515	23.6381967	2.15001007	4.33622645	166301.801	22.6813714	1.38923494	<0.5	<0.336	1.9459344	72781.8554
PM18AJ289	E19JN26a223.csv	<0.0296	<0.0302	134108.995	10.8094837	<0.00539	38.1645976	3.69396588	5.96528815	163246.403	203.815107	0.79240067	<0.523	<0.351	23.0915079	66812.2269
PM18AJ289	E19JN26a226.csv	<0.03	<0.0304	138279.565	12.9332503	<0.00545	25.4279695	1.69674323	7.7209698	165404.778	42.2083285	1.0688069	<0.529	<0.355	6.51402935	62330.3551
PM18AJ289	E19JN26a227.csv	<0.03	<0.0303	138842.401	10.9352744	0.00561842	36.1872591	2.67726611	11.3513684	165499.575	40.9729144	0.8051052	<0.527	<0.353	4.89042147	58884.9182
PM18AJ289	E19JN26a228.csv	<0.0302	<0.0305	142100.545	24.7475414	<0.00546	73.8298242	2.20173544	27.7385382	164599.817	34.571637	0.77333614	<0.531	<0.356	2.7041014	53996.3842
PM18AJ289	E19JN26a229.csv	<0.0295	<0.0297	140992.231	16.378623	<0.00534	37.7704957	6.63191179	22.4340873	161850.103	80.1098477	1.17259061	<0.517	<0.347	6.29993311	56707.463
PM18AJ289	E19JN26a230.csv	<0.0311	<0.0313	131701.226	12.0800398	0.00687823	20.698412	0.89552205	6.00225372	166543.252	11.2233084	0.41999689	<0.543	<0.365	2.14670064	74315.8397
PM18AJ289	E19JN26a231.csv	<0.0303	<0.0304	141458.634	51.1535624	<0.00549	16.3864416	9.54430478	10.3144115	163620.294	21.4326704	1.26389851	<0.533	<0.358	1.05046084	58716.8729
PM18AJ289	E19JN26a232.csv	<0.0324	<0.0327	140268.877	14.7434845	<0.00591	30.3140358	1.90604528	6.2201756	167969.395	23.801785	0.49228216	<0.57	<0.382	1.22305101	57939.3209
PM18AJ289	E19JN26a233.csv	<0.0315	<0.0315	141976.586	12.6114909	<0.00571	27.2301473	3.4940268	10.1753876	165681.962	35.5407502	0.99323356	<0.552	<0.371	6.77561385	53427.6539
PM18AJ289	E19JN26a235.csv	1.45496186	1.55513399	141187.693	14.6453679	0.10752705	32.8068846	10.7851881	13.0939654	161177.964	9.23563989	1.31903008	<0.539	1.054407	5.8648889	54885.3007
PM18AJ289	E19JN26a236.csv	<0.0295	<0.0294	135984.946	16.8677215	<0.00535	43.2747957	2.84118723	3.2912503	166318.171	10.7305824	1.33543638	<0.517	<0.347	1.01797167	64804.7712
PM18AJ289	E19JN26a237.csv	<0.03	<0.0298	135598.151	36.18668	<0.00543	26.5044276	5.71176615	19.4682314	163315.678	23.8812107	1.87570467	<0.525	<0.353	0.75245909	68658.0711
PM18AJ289	E19JN26a238.csv	<0.0285	<0.0283	133955.044	10.0141331	<0.00518	62.2060183	9.2141299	29.5058296	161757.526	41.085399	0.88617825	<0.5	<0.336	6.96155024	70652.7753
PM18AJ289	E19JN26a240.csv	<0.03	<0.0296	139294.847	28.8096457	<0.00544	81.713212	3.28055384	70.2182636	163409.362	49.4185194	0.63900183	<0.525	<0.353	2.76397404	60322.8382
PM18AJ290	E19JL11a100.csv	<0.0366	<0.0419	107244.873	27.5578806	<0.00604	118.236231	5.63007437	0.05492803	161547.323	73.755997	2.63795411	<0.59	<0.252	2.63698625	112782.976
PM18AJ290	E19JL11a101.csv	<0.04	<0.0456	114551.847	12.7135916	<0.00655	75.1369997	4.91473459	0.02479998	168324.832	18.3783484	1.73063984	1.85376161	<0.277	1.75251539	107224.883
PM18AJ290	E19JL11a102.csv	<0.0421	<0.0486	104454.601	1.71173283	<0.00703	7.10419429	0.68243482	<0.0217	159380.903	0.52995583	1.5875945	13.4742915	<0.294	0.87227555	122800.08
PM18AJ290	E19JL11a104.csv	<0.0331	<0.0383	108847.5	20.7612941	<0.00558	106.412933	10.4374591	0.02317426	162775.616	57.0278789	1.62382126	<0.551	<0.234	2.13274132	113672.658
PM18AJ290	E19JL11a105.csv	<0.0449	<0.052	117013.654	11.2124033	<0.00746	5.47500292	1.78330681	0.02513401	164929.828	3.40428051	1.68097466	1.15742533	<0.315	1.87446325	100037.389
PM18AJ290	E19JL11a106.csv	<0.035	<0.0409	123417.47	14.2073107	<0.00601	49.0943593	4.07205839	0.04022626	161840.239	12.8738835	0.60766166	<0.593	<0.252	4.52081	88390.202
PM18AJ290	E19JL11a107.csv	<0.0363	<0.0424	128037.042	22.3587909	<0.00621	19.0805229	3.50501945	<0.0185	165817.651	11.9758532	0.42935013	<0.617	<0.262	7.98774897	83711.2147
PM18AJ290	E19JL11a108.csv	<0.0401	<0.0473	117266.158	43.3380359	<0.00703	51.2404375	2.75271001	0.21283185	160519	9.99483783	0.54865095	<0.689	<0.292	6.79034499	98330.2271
PM18AJ290	E19JL11a109.csv	<0.0533	<0.0628	117836.379	38.4989807	<0.00906	31.2808617	3.03386757	0.04234371	160853.029	10.3693992	0.9893036	0.92394387	<0.39	3.02196592	101739.218
PM18AJ290	E19JL11a110.csv	<0.0321	<0.038	113083.943	10.0572678	<0.00569	78.6528325	17.0041861	0.08364694	160176.042	14.4453801	1.07160227	<0.56	<0.237	1.2869127	106674.056
PM18AJ290	E19JL11a111.csv	<0.0522	<0.063	107022.338	10.2395883	<0.00948	66.0123882	9.54364499	<0.0275	155088.268	84.1324685	2.56954534	<0.934	<0.388	2.26598374	109339.24
PM18AJ290	E19JL11a112.csv	<0.0352	<0.042	113619.83	8.76974345	<0.00628	29.0847174	4.21564599	0.14994581	156913.114	8.49830951	2.36358152	5.57161796	<0.263	4.5802268	101678.881
PM18AJ290	E19JL11a113.csv	<0.0485	<0.0579	123089.229	15.7401127	<0.00874	30.4186205	2.24584152	0.12694479	173367.756	53.3573233	0.38618475	<0.863	<0.365	6.54195489	93464.1963
PM18AJ290	E19JL11a117.csv	<0.0561	<0.068	111860.15	18.2211789	<0.0105	138.10668	12.3897995	0.15734072	163176.795	1.69411877	0.47835253	<0.994	<0.419	0.97132297	110089.535
PM18AJ290	E19JL11a118.csv	<0.0336	<0.0408	112274.997	5.80910604	<0.0063	39.2092517	9.86371254	0.04200645	161514.377	57.7210531	1.55512387	<0.62	<0.26	3.17766846	107657.694
PM18AJ290	E19JL11a119.csv	<0.0566	<0.0688	110231.589	32.9089421	<0.0107	169.249632	10.452494	0.08183073	158529.136	31.5301229	0.84730401	<1.05	<0.44	1.70366683	108774.441
PM18AJ290	E19JL11a120.csv	<0.0432	<0.0527	111818.563	13.0998188	<0.00827	42.1509971	13.2695455	0.03380312	158959.448	86.433941	1.75582543	<0.803	<0.338	5.66502969	103783.958
PM18AJ297	E19JL11a189.csv	<0.0532	<0.05	109196.69	9.86028429	<0.00994	18.3842022	0.55704701	<0.0282	160816.993	2.32398785	<0.0281	<0.968	<0.421	0.44708467	110245.788
PM18AJ297	E19JL11a190.csv	<0.0353	<0.0339	123733.523	15.5149885	<0.00674	70.8096963	0.95435828	0.11289182	171060.256	22.5394607	<0.0188	<0.649	<0.277	3.32465511	92181.1418
PM18AJ297	E19JL11a191.csv	<0.0311	<0.0297	114980.378	15.4255232	<0.00589	43.4918252	0.62570105	0.02328647	164233.652	56.6218781	0.03589637	<0.576	<0.246	0.68060125	104198.822
PM18AJ297	E19JL11a192.csv	<0.0346	<0.0329	114240.033	16.7117734	<0.00663	39.001993	4.00513374	0.0346162	165215.652	1.25463282	<0.0185	<0.648	<0.275	0.86933623	103394.697
PM18AJ297	E19JL11a193.csv	<0.0322	<0.0305	125125.47	60.6408287	<0.00612	146.842781	0.72268245	0.24804133	165224.291	1.14790956	<0.0172	<0.595	<0.256	1.69766329	88986.1212
PM18AJ297	E19JL11a194.csv	<0.0308	<0.029	114701.151	6.79988062	<0.00584	16.8801318	0.30832115	0.07379829	168040.022	14.3114781	0.02078778	<0.572	<0.246	0.82561547	106373.228
PM18AJ297	E19JL11a195.csv	<0.053	<0.0499	133977.582	32.7646419	<0.00999	169.298913	1.77266594	<0.0277	174372.469	0.16939577	<0.0284	<0.978	<0.422	2.90189954	80190.6581
PM18AJ297	E19JL11a196.csv	<0.039	<0.0365	121632.636	19.1157878	<0.00736	73.3790938	1.02154317	0.18008409	172776.074	37.8639348	0.04110151	<0.707	<0.306	3.41421639	97207.3024

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ297	E19JL11a197.csv	<0.0397	<0.037	123004.621	19.3103437	<0.0076	56.7962498	0.71730545	0.28466065	173151.666	24.0398926	0.03692518	<0.73	<0.316	3.26644406	95209.4323
PM18AJ297	E19JL11a198.csv	<0.0413	<0.0386	110087.442	6.20318727	0.00921513	10.5950422	0.2387293	<0.0219	162334.323	0.50191384	<0.022	<0.757	<0.328	0.30447199	111487.44
PM18AJ297	E19JL11a199.csv	<0.0362	<0.0336	119582.318	28.8223871	<0.00683	94.6090674	4.78269172	0.17450681	161737.198	7.47271089	<0.0192	<0.664	<0.288	2.77768559	94328.8244
PM18AJ297	E19JL11a200.csv	<0.0325	<0.0301	125640.689	12.1210883	<0.00608	29.7336355	2.02581416	0.49910214	166422.911	46.8442199	0.02867633	<0.598	<0.26	6.04341679	84828.2563
PM18AJ297	E19JL11a201.csv	<0.0487	<0.0448	134852.975	19.2684985	<0.00911	49.5432226	0.87623693	0.64314184	175419.867	55.3189682	0.02552567	<0.872	<0.38	5.74603187	77121.7784
PM18AJ297	E19JL11a202.csv	<0.0345	<0.0316	127065.083	20.7034063	<0.00646	75.8886127	7.60565521	0.11769956	165060.08	20.1160383	<0.0183	<0.63	0.31921548	3.9521164	87085.9863
PM18AJ297	E19JL11a203.csv	<0.0332	<0.0304	129568.783	12.3966938	<0.00622	54.7833296	1.10310211	0.25914764	166388.585	43.9038119	<0.0177	<0.61	<0.266	13.3044597	76870.2314
PM18AJ297	E19JL11a204.csv	<0.0362	<0.033	118070.1	9.64823658	<0.00681	31.495666	0.47965552	<0.0192	164089.882	0.62666528	<0.0193	<0.662	<0.29	0.37177014	99395.9218
PM18AJ297	E19JL11a205.csv	<0.0445	<0.0405	120231.268	16.883111	<0.00819	76.375269	7.69872572	0.10425979	159864.691	15.7677432	0.02650065	<0.814	<0.358	1.0754354	91839.4515
PM18AJ297	E19JL11a207.csv	<0.0314	<0.0285	120966.757	16.1502626	<0.00588	78.9769619	1.27216874	0.0244853	167170.497	9.12635811	<0.0168	<0.577	<0.253	4.22577456	94327.9788
PM18AJ297	E19JL11a208.csv	<0.0441	<0.0399	117464.665	15.701711	<0.0082	76.1789227	0.91227527	0.09682058	164194.632	1.63008528	<0.0236	<0.807	<0.356	0.3717851	98304.3955
PM18AJ299	E19JL11a246.csv	<0.0454	<0.0427	123187.684	13.5577213	<0.00921	24.487724	2.63335834	1.7864206	159744.919	2.49803477	0.23367488	<0.87	0.54494481	0.24614536	84617.4666
PM18AJ299	E19JL11a247.csv	<0.0314	<0.0293	126162.364	9.04523226	<0.00644	20.1477786	118.253711	0.30433895	161996.07	18.4527315	0.38697092	<0.608	0.70474799	1.8187349	81215.7781
PM18AJ299	E19JL11a248.csv	<0.0395	<0.0368	130122.371	4.96591992	<0.00807	13.2664913	9.33066017	0.36486143	168724.545	11.4090342	0.29689512	<0.754	3.14509217	0.44393976	80127.4095
PM18AJ299	E19JL11a250.csv	<0.0324	<0.0304	126459.656	8.36019403	<0.00663	13.0358745	5.33179076	0.1822157	167358.7	2.4314335	0.28632209	<0.619	1.40069168	0.25565073	86663.9033
PM18AJ299	E19JL11a251.csv	<0.0379	<0.0358	120816.272	5.15797554	<0.0079	8.1408636	2.73658477	0.48100688	158117.487	0.52285016	0.28306331	0.89075194	1.46160176	0.08024527	90987.0477
PM18AJ299	E19JL11a252.csv	<0.0332	<0.0313	132413.301	4.28367652	<0.00695	15.2782787	2.05962088	0.18301583	165025.587	0.69426694	2.16183012	<0.641	0.87710453	0.17478396	77422.3222
PM18AJ299	E19JL11a253.csv	<0.0301	<0.0285	126571.523	3.86252093	<0.00629	7.93612533	2.20716211	0.13608259	164896.472	0.83792772	0.24586059	<0.58	<0.264	0.10062288	85369.9272
PM18AJ299	E19JL11a254.csv	<0.0334	<0.0316	128089.218	4.20222473	<0.00692	11.7011487	3.59330784	0.16842557	164596.311	0.74568134	0.26966947	<0.639	<0.291	0.10490154	80585.919
PM18AJ299	E19JL11a255.csv	<0.0364	<0.035	130727.541	4.12445831	<0.00772	13.1489443	3.45871229	0.13883301	170389.33	1.954945	0.35901386	<0.701	<0.319	0.24938053	79778.8664
PM18AJ299	E19JL11a257.csv	<0.0328	<0.0313	127520.803	25.6530219	<0.00693	51.540733	8.03712347	1.70329937	166355.599	14.1250694	0.41384687	<0.632	0.29638874	3.68868413	82986.69
PM18AJ299	E19JL11a258.csv	<0.0305	<0.0292	128972.934	4.13927091	<0.00647	11.4903327	3.64607661	0.15038901	164797.439	1.22640628	0.53904814	<0.591	0.84427398	0.17848203	78547.9149
PM18AJ299	E19JL11a259.csv	<0.0359	<0.0345	124826.921	4.46655881	<0.0076	15.7130872	2.2547493	0.41813909	160829.802	1.2229127	0.28357812	<0.691	0.72342672	0.16121876	85839.4554
PM18AJ299	E19JL11a260.csv	<0.0504	<0.0484	132922.636	11.3490671	<0.0107	26.6529248	9.21141507	1.20649036	168467.023	17.9210242	0.33107366	<0.935	<0.441	9.5139213	75427.4478
PM18AJ299	E19JL11a261.csv	<0.043	<0.0415	130274.93	5.77872612	<0.00924	18.6365863	52.6246063	0.88899143	165378.555	17.5412014	0.41288937	<0.815	0.44809671	1.46540925	78237.7237
PM18AJ299	E19JL11a262.csv	<0.0403	0.04451973	125439.06	6.21562679	<0.00871	33.571966	10.932451	0.19728204	159712.492	5.12925501	0.30252446	<0.772	1.0792564	0.77629444	80474.8132
PM18AJ299	E19JL11a263.csv	<0.0305	<0.0296	126834.661	11.0101676	<0.00657	35.1873685	16.4767586	1.66535273	161341.57	61.4305127	0.63853623	0.73593073	0.86570894	5.61074753	81801.5903
PM18AJ302	E19JL15a007.csv	<0.119	<0.134	126640.398	11.4025775	<0.0118	55.9862337	3.82063372	<0.0516	165392.215	88.4282691	0.12523589	<1.08	<0.547	10.6728071	81820.7144
PM18AJ302	E19JL15a009.csv	<0.112	<0.125	127093.878	17.130149	<0.0121	55.9100606	3.40056249	<0.0454	162654.723	43.3245497	0.34410685	<1.09	<0.565	17.0318119	86944.8436
PM18AJ302	E19JL15a011.csv	<0.0987	<0.111	123647.919	4.81786356	<0.0118	20.4331415	19.8763695	<0.0374	163594.384	9.11988229	0.33049868	<1.04	<0.55	10.1668483	88783.3401
PM18AJ302	E19JL15a012.csv	<0.093	<0.105	118077.945	3.33255255	<0.0116	20.0488215	20.5494954	<0.0342	164731.395	5.05998844	0.30711672	<1.01	<0.541	4.90853145	94943.9905
PM18AJ302	E19JL15a013.csv	<0.134	<0.151	117208.796	12.4009501	<0.017	42.0013874	9.44689923	<0.0467	161806.735	14.9425496	0.38921902	<1.50	<0.811	6.15182341	94846.0142
PM18AJ302	E19JL15a014.csv	<0.0975	<0.11	122087.495	11.7414683	<0.013	39.605279	1.37949201	<0.0337	174699.845	70.9101997	0.22446282	<1.12	<0.612	5.62995853	94219.1977
PM18AJ302	E19JL15a015.csv	<0.0827	<0.0932	117638.259	12.3800916	<0.0115	44.8131349	1.47488514	0.05629504	165150.073	22.3517315	0.25805022	<0.978	<0.538	4.12427337	99987.338
PM18AJ302	E19JL15a016.csv	<0.0917	<0.103	134519.346	27.7550942	<0.0129	81.3584354	3.56801502	0.04291892	166717.143	88.7902656	0.28940451	<1.11	<0.616	27.8603783	76696.5459
PM18AJ302	E19JL15a018.csv	<0.0806	<0.0902	129074.207	52.4245769	<0.0121	44.3991489	3.56928898	0.21375674	161532.546	48.909748	0.40598053	<1.02	<0.571	10.6509126	80626.6295
PM18AJ302	E19JL15a019.csv	<0.0781	<0.0872	126846.465	5.22178776	<0.0119	18.9068719	1.68425336	2.71257262	161428.672	140.50659	0.33816665	<1.00	<0.567	29.2302789	86485.5607
PM18AJ302	E19JL15a020.csv	<0.0758	<0.0844	123694.167	4.3902296	<0.0118	5.90810062	0.16077863	0.59632006	164414.301	31.948763	0.41070542	<0.99	<0.562	7.46811787	95442.5571
PM18AJ302	E19JL15a021.csv	<0.0903	<0.1	137163.992	55.2598386	<0.0142	129.389862	4.51860979	0.06105778	161335.991	1188.09577	0.42304401	<1.20	<0.682	13.7949869	75479.1129
PM18AJ302	E19JL15a022.csv	<0.073	<0.0807	120579.14	35.5366643	<0.0117	65.926237	3.94405844	0.06067788	164354.661	272.406008	0.28501141	0.97807434	<0.559	22.2434836	94645.8639
PM18AJ302	E19JL15a023.csv	<0.0751	<0.0827	132001.816	11.7925763	<0.0121	93.4843798	4.21518748	0.03205082	161596.719	83.1897496	0.20665696	<1.01	<0.583	20.46547	76322.5109
PM18AJ302	E19JL15a024.csv	<0.0759	<0.0832	134751.355	7.79877681	<0.0122	56.9274882	1.78841887	0.02851044	160555.526	25.4269627	0.14871876	1.0750153	<0.594	8.99264811	73349.1738
PM18AJ304	E19JN25a061.csv	<0.0494	<0.0429	135961.447	12.8087471	<0.00605	27.2511385	4.63239249	0.08214794	163904.416	42.8033412	0.03582135	<0.735	<0.368	2.32215344	69336.5909
PM18AJ304	E19JN25a062.csv	<0.045	<0.0389	135940.991	4.20624589	<0.00551	17.5371252	1.05888495	<0.0204	164439.319	10.341759	0.30946558	<0.666	<0.334	0.54215982	67339.7508
PM18AJ304	E19JN25a063.csv	<0.0437	<0.0378	125093.49	6.27866574	<0.00536	24.2431966	0.26357922	0.07799945	164030.393	11.0263999	0.31873277	<0.647	<0.324	1.53972121	86360.0068
PM18AJ304	E19JN25a064.csv	<0.0434	<0.0375	126305.206	9.17475637	<0.0053	35.5592506	1.37552444	0.05033655	164056.035	29.3605613	0.23505414	0.88533019	<0.322	3.28561614	82891.4144
PM18AJ304	E19JN25a079.csv	<0.0415	<0.0357	125450.842	8.06054253	<0.00534	28.913783	1.00432494	0.23752407	160745.2	21.8219057	0.22536323	<0.628	<0.314	2.81219732	84112.841
PM18AJ304	E19JN25a083.csv	<0.0424	<0.0367	129849.523	8.80135851	<0.00557	46.7186592	0.70366762	0.08077105	164219.366	27.0846771	0.27796381	<0.648	<0.324	3.84640743	76583.6265
PM18AJ304	E19JN25a084.csv	<0.0412	<0.0357	124259.468	6.85489291	<0.00544	23.4849342	0.48234592	0.15942849	164590.468	20.6090952	0.28925915	<0.631	<0.316	2.26773843	87460.7024
PM18AJ304	E19JN25a085.csv	<0.0471	<0.0408	126766.286	6.42556498	<0.00625	15.0512328	0.70992503	0.3078047	164914.652	33.2972033	0.21468882	<0.726	<0.362	4.46706879	85047.0478
PM18AJ304	E19JN25a106.csv	<0.0404	<0.0367	125060.551	4.86577241	<0.00605	13.4976513	3.20023612	<0.0174	161891.739	27.433828	0.60968143	1.28211555	<0.335	1.44367226	84567.0307
PM18AJ304	E19JN25a107.csv	<0.0364	<0.0332	130059.73	6.78936952	<0.00548	31.6777064	4.43714333	0.03748003	162383.02	117.567707	0.05256708	<0.603	<0.305	3.65111274	73287.8164

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ304	E19JN25a108.csv	<0.0358	<0.0326	132622.109	6.32973899	<0.0054	28.3507216	2.5591534	<0.0154	164376.735	56.909887	0.129714	<0.59	<0.299	4.21043709	71758.4356
PM18AJ304	E19JN25a109.csv	<0.035	<0.032	121285.629	5.45451002	<0.00531	11.1186064	0.52866664	0.16170522	163935.121	33.9260871	0.36463613	<0.582	<0.295	3.17150454	90584.4601
PM18AJ304	E19JN25a110.csv	<0.0444	<0.0407	119402.108	15.4534672	<0.00666	26.6524745	2.93312704	<0.0191	161588.612	3.32708639	0.04948349	<0.737	<0.372	1.04693997	91620.2195
PM18AJ304	E19JN25a114.csv	<0.0338	<0.0312	119457.573	6.88865164	<0.00519	9.27084161	0.13895901	0.49995428	163410.081	12.3799541	0.38943455	<0.563	<0.286	1.28196449	95906.482
PM18AJ304	E19JN25a115.csv	<0.0381	<0.0352	130884.679	9.62864056	<0.00593	46.4197729	1.91211492	0.09540298	164808.313	45.7681079	0.29837448	<0.637	<0.323	3.9209819	77048.2544
PM18AJ304	E19JN25a116.csv	<0.0449	<0.0416	128185.465	12.5272668	<0.00697	35.1261965	2.02520672	<0.0195	170959.881	91.830084	0.0726489	0.94148417	<0.381	7.81974114	81930.6867
PM18AJ309	E19JL15a288.csv	<0.0315	<0.0305	113948.853	0.26387202	<0.00565	5.2582327	3.30992251	0.01451184	166834.49	0.00250388	1.9132247	<0.423	<0.291	0.02446031	105066.402
PM18AJ309	E19JL15a290.csv	<0.0326	<0.0318	122831.661	1.79152682	<0.00602	24.1621015	4.47326384	<0.0135	167751.495	0.07677445	1.07260384	0.5324022	<0.311	0.11895852	90717.3257
PM18AJ309	E19JL15a291.csv	<0.0295	<0.029	110356.222	3.81156137	0.00705487	28.931066	11.9517181	0.02467545	163771.208	0.04107932	1.69629054	<0.412	<0.286	0.07104291	111962.729
PM18AJ309	E19JL15a292.csv	<0.029	<0.0286	112725.211	3.47895824	<0.00556	10.0419012	38.1674714	<0.0121	162877.696	0.00676772	1.9101426	<0.411	<0.287	0.03472236	109263.538
PM18AJ309	E19JL15a293.csv	<0.0278	<0.0275	106688.263	2.57507408	<0.00541	18.6940467	21.4630696	0.01912929	164254.425	0.31227823	1.12003912	1.92557781	<0.28	0.4095574	119511.968
PM18AJ309	E19JL15a294.csv	<0.0279	<0.0278	111310.544	2.63144117	<0.00556	28.5982702	8.45227905	<0.0118	164476.687	0.12087958	0.95165035	<0.409	<0.288	1.00663793	111692.686
PM18AJ309	E19JL15a295.csv	<0.0271	<0.0272	109657.226	3.23179694	<0.00552	46.8990923	14.7042192	0.0188654	165055.89	0.04520163	1.73267411	0.91184894	<0.286	0.32290008	113149.753
PM18AJ309	E19JL15a296.csv	<0.0295	<0.0298	114745.371	1.63767594	<0.00618	15.417209	16.9982689	<0.0127	165619.901	7.87837333	2.02776395	183.459787	<0.319	1.3196755	106170.704
PM18AJ309	E19JL15a297.csv	<0.0274	<0.0279	123354.969	1.79604751	<0.00585	44.5701952	5.33401673	0.01352891	164800.22	0.50356441	1.35367617	<0.427	<0.303	2.53163958	87215.7634
PM18AJ309	E19JL15a298.csv	<0.0272	<0.0278	128993.15	1.9684792	<0.00594	20.4530709	17.7356461	<0.0118	166283.868	0.06802643	1.92924399	<0.433	<0.308	0.32774107	77221.511
PM18AJ309	E19JL15a299.csv	0.04542361	0.04682966	114332.044	3.55557331	<0.00563	57.2073532	13.9287832	0.01240877	164215.856	1.40744635	0.80773768	5.74409958	<0.292	0.93370388	104210.371
PM18AJ309	E19JL15a300.csv	<0.0247	<0.0257	116593.47	2.65336825	<0.0057	76.2128684	18.5613209	<0.011	162701.153	2.06847731	0.96575253	1.54664351	0.53795074	0.90079648	100632.834
PM18AJ309	E19JL15a301.csv	<0.0255	<0.0267	131901.943	0.91147345	<0.00606	19.475003	7.49999148	0.01267167	166177.142	0.21911767	2.1121345	2.06431133	<0.314	0.37367629	72258.6132
PM18AJ309	E19JL15a302.csv	<0.0231	<0.0244	120585.588	0.48775147	<0.00565	4.86070425	5.16597108	<0.0105	166618.498	0.00911898	1.5411474	0.53085524	<0.293	0.20447725	93037.0722
PM18AJ309	E19JL15a303.csv	<0.0227	<0.0243	116521.66	1.39479372	<0.00574	15.0998858	16.1069244	0.0131919	163073.57	0.11920612	0.81392884	<0.416	<0.299	0.35335017	101763.373
PM18AJ309	E19JL15a304.csv	<0.0218	<0.0235	113407.311	1.80731185	0.00652154	54.1616169	7.97936582	<0.0101	164845.182	0.19996128	0.76626338	<0.408	0.43904795	0.72101209	106278.647
PM18AJ309	E19JL15a305.csv	<0.0211	<0.0231	120204.247	1.94860422	<0.0057	43.3879276	31.4660478	<0.01	164220.88	0.10573059	0.94923626	0.7833372	0.54030293	0.76152987	95374.7034
PM18AJ309	E19JL15a306.csv	<0.0219	<0.0242	132996.012	0.28701992	<0.00605	5.88799012	2.08605552	<0.0105	166745.985	0.1410424	0.27405251	<0.435	<0.314	1.61312408	71100.5761
PM18AJ309	E19JL15a307.csv	<0.0201	<0.0225	121849.572	9.48097888	<0.00579	24.9503078	60.4497929	0.02295289	163382.67	0.04886331	1.59507136	<0.413	<0.298	0.13352691	92131.1523

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ209	E19JN26a350.csv	0.21424139	0.05564992	20.4113075	0.74586294	1.41830957	0.01128462	1340.31427	1761.43653	714.430323	0.01593693	2.19940683	39.6182047	40.1518176	40.8764314	48.7880775
PM18AJ209	E19JN26a351.csv	0.05299811	0.09411328	<3.34	0.65326571	0.13039217	0.01399519	384.154561	784.511284	9.23378316	0.00353672	0.38233827	11.5255637	11.400492	11.6139651	3.53311261
PM18AJ209	E19JN26a352.csv	0.75800677	0.21498678	9.96570488	1.10759291	0.5078156	0.10256307	887.078348	2503.62161	366.212065	0.04022996	0.69833569	65.2895011	68.1422843	66.2075341	54.7125953
PM18AJ209	E19JN26a353.csv	0.22529022	2.4754271	<3.77	0.50705247	0.24657214	0.16569599	561.478622	2052.96433	21.8792054	0.08849639	0.43035507	54.8361895	55.8761309	56.2278536	78.1998034
PM18AJ209	E19JN26a355.csv	0.16269846	2.61047803	<3.44	0.24745778	0.1106708	0.18430672	669.47833	1418.20896	11.6546656	0.01121574	0.9532995	26.1518659	27.8277303	27.0652482	18.4967985
PM18AJ209	E19JN26a356.csv	0.15682384	0.11007844	<3.84	0.71507717	0.14773389	0.02576694	368.057623	1971.62218	20.561807	0.04599624	<0.0708	67.4825301	69.1410303	67.7606226	39.6398377
PM18AJ209	E19JN26a359.csv	0.59407987	0.02476884	<3.31	1.83961817	0.11008969	0.07213464	515.305737	3619.19583	37.4649775	0.03454552	0.4722134	7.52743719	8.30346193	7.70507671	8.8320872
PM18AJ209	E19JN26a361.csv	4.66497805	0.09798614	26.4675819	11.4758227	1.0490018	0.46823192	1546.00187	2313.99413	1248.51126	0.04492869	1.47119037	10.4891368	11.1716673	10.721192	11.847962
PM18AJ209	E19JN26a362.csv	31.4888726	0.04881304	6.60354645	142.999761	0.58417061	0.54051858	270.998223	2159.79288	81.8254968	0.09674237	0.25229166	10.7841823	10.3034146	10.101747	4.15397199
PM18AJ209	E19JN26a363.csv	0.36974445	1.41854487	6.08874392	0.6037151	0.66036374	0.07066749	887.778415	2708.8202	71.1170871	0.14377783	0.59996858	39.3663387	40.6216488	40.1343145	35.1263032
PM18AJ209	E19JN26a364.csv	0.11674575	0.00907643	5.63290692	0.53807522	0.42428876	0.01453929	2425.19705	2038.70991	71.7318945	0.24612531	5.6617408	40.5817812	42.1295757	40.8105117	22.7078707
PM18AJ209	E19JN26a366.csv	3.7404921	0.08188964	61.4624413	8.21655495	1.25819584	0.24155291	1454.30971	2282.19838	1360.8352	0.02315639	1.64046931	44.5346611	46.3001877	44.9274811	47.0221181
PM18AJ209	E19JN26a367.csv	0.70691876	0.22283478	13.6208821	2.00732734	<0.16	0.19206066	159.91319	1933.27942	43.5000405	0.07902543	<0.0909	31.2172476	31.7137894	31.7276968	22.3819049
PM18AJ209	E19JN26a370.csv	2.68596155	0.19535625	<3.04	8.7366344	0.3790756	0.24497982	590.19534	1900.11967	71.6193895	0.04191234	0.3308062	10.7399513	10.9826566	10.7014673	11.3274848
PM18AJ209	E19JN26a371.csv	0.74978743	0.01436289	4.70444875	1.86465317	0.15614735	0.08739669	931.233528	1406.64122	35.9567319	0.05028496	0.43067352	7.82253334	8.15223123	8.08699721	4.50905734
PM18AJ212	C19AU08C322.csv	3.16027547	0.05801495	40.0664919	9.12861239	0.44098218	0.30461222	769.31431	5573.56527	9.25594457	<0.00236	0.38429988	5.03394951	0.13627781	0.08224818	0.30614769
PM18AJ212	C19AU08C323.csv	8.27366466	0.03447741	32.7468155	61.590273	0.58395017	0.05443914	425.904238	2807.57096	367.475163	0.04386645	0.31336438	9.77387472	0.03422958	0.02649581	1.91468681
PM18AJ212	C19AU08C325.csv	14.5608716	1.17893099	29.8866539	156.22335	<0.173	0.36062942	1765.41051	2657.69733	265.333522	0.05191091	1.19151871	32.0923974	0.41012911	2.71035976	2.7986911
PM18AJ212	C19AU08C326.csv	3.12502434	0.01543654	155.288509	17.7614199	0.32387536	0.06749421	574.659297	4902.03878	1165.22396	0.05616615	0.36136423	13.0834738	0.01903271	0.14980903	1.75751628
PM18AJ212	C19AU08C327.csv	2.04538268	<0.00412	61.3762279	8.49460318	<0.195	0.11026213	481.728867	3290.78729	14.4966614	0.01603263	0.60312302	4.24558195	0.05376283	0.14315379	<0.117
PM18AJ212	C19AU08C328.csv	2.46197778	0.05943014	49.4353317	4.60424164	0.55070789	0.48992114	168.519971	6364.77099	331.831124	0.07325231	<0.155	35.8649966	0.21011424	<0.00407	29.2255158
PM18AJ212	C19AU08C329.csv	0.09187346	<0.00581	387.647244	3.30267678	0.28896871	0.00321767	551.504259	2213.07596	584.655855	0.03853434	0.48923573	7.14441425	<0.0162	<0.00403	0.98901806
PM18AJ212	C19AU08C330.csv	0.3626575	<0.00392	<3.27	1.92124919	<0.181	0.01701227	291.801606	5389.23774	<5.85	0.03052346	<0.106	2.75945892	0.03439672	0.01186724	<0.11
PM18AJ212	C19AU08C331.csv	1.49623093	<0.00713	214.729721	6.07928285	0.63521171	0.07024188	3063.49883	2761.03624	650.472536	0.27697735	1.12086302	7.02982721	0.11670111	0.19280529	0.36280397
PM18AJ212	C19AU08C332.csv	0.86905535	<0.00427	5.08013787	5.13938747	<0.196	0.02766187	339.337859	1997.56423	44.0086242	0.02476068	<0.115	7.21603496	0.15590648	0.00570911	0.5977955
PM18AJ212	C19AU08C333.csv	0.11372943	<0.00377	4.83881257	2.50661305	<0.172	0.0079313	242.501566	1462.30348	46.5300907	0.00907177	<0.102	29.0688557	0.31153257	<0.00262	1.48712953
PM18AJ212	C19AU08C334.csv	0.29122743	0.02852644	76.9300222	3.76707428	0.51889138	0.0243653	458.145624	2144.55558	1124.93125	0.05605519	0.41136698	16.0337033	0.13667073	0.00477371	1.33336692
PM18AJ212	C19AU08C335.csv	0.16062261	<0.00362	144.899685	3.05024149	0.69812109	0.00612606	316.351966	4841.68869	1968.89333	0.00882452	<0.0986	4.14009048	0.08063958	<0.00253	0.15854546
PM18AJ212	C19AU08C336.csv	10.8160601	0.06231971	47.3051407	104.197142	1.02328388	0.12030898	389.850988	1910.65454	860.499959	0.01821494	0.46586254	8.46648231	0.03150715	2.36964755	0.90417698
PM18AJ212	C19AU08C337.csv	19.6949143	0.4092969	45.9301675	204.207229	1.60297778	0.60038418	1362.33907	2369.55857	658.007425	0.33366168	0.57324813	19.9440178	0.26391136	0.90172946	1.95898306
PM18AJ212	C19AU08C338.csv	0.29822743	<0.00515	12.791301	3.56744702	0.43387573	0.00350238	640.509352	1233.96056	74.6479741	<0.00179	1.34055122	11.3074231	<0.0102	0.06040521	1.99492169
PM18AJ212	C19AU08C342.csv	2.91813864	0.46862818	60.7803053	24.2551729	0.63909515	0.06033742	528.607301	2527.63285	629.923189	0.43011631	0.26382473	5.55501178	0.08822209	1.84825155	0.35710016
PM18AJ212	C19AU08C344.csv	0.48170325	<0.00381	164.292552	8.02764099	0.44468258	0.06349386	484.954637	2384.96925	1625.10292	0.11125053	0.18723401	2.97680902	0.13683371	0.06015199	<0.11
PM18AJ212	C19AU08C345.csv	1.62379772	0.01692157	95.4633093	16.8554223	0.27577204	0.09165782	458.246849	3026.94377	860.902551	0.01094895	0.11489806	9.27370468	0.12434468	0.14223054	0.49351223
PM18AJ212	C19AU08C346.csv	15.1555489	<0.00444	11.9974542	75.2364931	0.26470219	0.11085419	417.445144	4181.93838	74.6812418	0.02450883	0.30815449	12.6473118	0.07978739	<0.00318	0.50517517
PM18AJ215	E19JN26a373.csv	0.17912637	0.01241551	<3.49	7.4170313	<0.113	0.00901649	313.578092	790.497791	157.124276	0.04125724	0.20159618	21.5913111	22.0779308	21.9065093	3.62158301
PM18AJ215	E19JN26a374.csv	1.59647254	0.08010725	5.67120224	5.16585142	0.21531523	0.06825437	254.282162	907.261355	30.3320873	0.23624961	0.44822625	35.3359292	37.381348	36.5858164	5.16473943
PM18AJ215	E19JN26a375.csv	0.78287323	0.56305865	<3.22	2.2141271	0.22071531	0.0775435	322.730566	701.820945	39.3166584	0.05804601	0.2342695	18.9922034	19.4202721	18.9210165	8.25016334
PM18AJ215	E19JN26a376.csv	<0.0114	<0.00631	<3.15	0.15804926	<0.102	<0.00177	183.139965	459.645373	7.57439262	0.02932795	0.1984608	10.009892	9.95217371	9.87965072	0.45493157
PM18AJ215	E19JN26a377.csv	<0.0111	<0.00615	<3.07	0.22130217	<0.0998	<0.00173	251.152452	804.674693	<7.11	0.01830892	0.48933101	11.2316041	11.3835313	11.6322626	0.06582294
PM18AJ215	E19JN26a378.csv	0.19139307	<0.00628	<3.13	3.56865836	<0.102	0.00799034	265.805095	457.062524	34.6906279	0.31523544	0.21301091	11.3679077	11.4934527	11.5307669	0.18957444
PM18AJ215	E19JN26a379.csv	0.01165099	<0.00631	11.8247277	0.41400543	0.39676921	<0.00177	265.182401	630.262631	271.460057	<0.00241	0.32563002	15.5500682	17.1477766	16.6146342	3.86274641
PM18AJ215	E19JN26a380.csv	0.09671371	<0.0102	<5.05	0.16153931	<0.165	<0.00286	207.936149	1070.4065	17.2863923	0.08104337	0.25088208	21.872864	23.2623451	22.1276117	1.657904
PM18AJ215	E19JN26a381.csv	11.0778646	0.0243313	12.1435999	111.68994	0.22293676	0.27189706	229.134477	987.014588	105.668959	0.01521396	0.85039918	19.5626569	20.4219198	19.7364222	3.6378155
PM18AJ215	E19JN26a382.csv	0.09249303	0.01453478	<3.20	0.41555493	0.17418592	0.00588937	316.789614	596.691522	87.3220276	0.22275899	0.3807231	18.1055394	18.5139558	18.5800704	2.13213716
PM18AJ215	E19JN26a383.csv	0.18278959	0.09423521	8.74004469	1.23546255	1.08437074	0.02398758	1041.28502	630.726259	69.7858963	0.02086535	1.71033166	6.16075901	6.53964512	6.26049181	1.10889275
PM18AJ215	E19JN26a384.csv	0.12897876	<0.00811	5.27606333	0.8168315	<0.13	<0.00228	104.048892	775.86401	333.817534	0.11013596	0.25972955	5.51459593	5.24206771	5.5155529	0.54877749
PM18AJ215	E19JN26a385.csv	6.81604466	0.01929718	<3.10	68.1975585	0.11049816	0.10483315	218.921062	1029.46048	42.0838351	0.05447376	0.16970356	21.1614319	21.7968226	21.6642608	2.47976508
PM18AJ215	E19JN26a386.csv	0.02706716	0.01089982	8.5690101	0.2536	<0.17	0.00851691	195.731642	1289.00563	551.900715	0.1928364	0.58021302	13.4020754	14.0739405	14.1506894	2.16995704
PM18AJ215	E19JN26a387.csv	0.03998348	0.02808106	12.4936985	0.26397919	<0.12	<0.00209	165.757812	664.814328	31.1764079	0.00541466	0.35557165	5.50760785	5.32311321	5.55286098	0.74305487
PM18AJ215	E19JN26a394.csv	0.36119525	0.43111284	16.9035098	2.45380777	<0.105	0.07658839	241.588491	478.820073	268.780429	0.17248045	0.6303744	7.24211998	7.45437464	7.2299749	1.40244806
PM18AJ215	E19JN26a395.csv	1.29112921	0.45587789	12.088004	10.2836929	0.22427212	0.20240837	295.142897	901.243959	29.9963538	0.08408064	0.35785667	15.9822826	16.7291205	16.2918508	1.97049137

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ215	E19JN26a396.csv	0.10227012	<0.00636	7.77853499	1.93858365	0.78145398	0.01104108	307.90398	767.430582	219.802541	0.03282696	0.47021455	33.1154206	33.7302567	33.4338208	8.9466849
PM18AJ215	E19JN26a397.csv	0.32744384	0.03231409	158.429139	11.4651552	2.04411153	0.0291876	2026.44677	818.493271	216.571575	0.77135976	2.3429805	32.0413121	33.4623821	33.2546207	5.72703149
PM18AJ215	E19JN26a398.csv	0.05667516	0.02432853	4.75996559	0.92783848	0.16569424	0.01322438	363.874741	745.147759	27.2211649	0.16491358	0.51493054	31.8507565	33.289898	32.5185985	6.21420916
PM18AJ215	E19JN26a400.csv	1.84900075	0.0352515	<3.50	17.1774393	0.6857219	0.30962961	279.224213	1519.65808	16.0417892	0.12686483	<0.0649	52.1191251	53.3002577	53.0033047	29.4493533
PM18AJ215	E19JN26a401.csv	0.26826211	0.05658839	<3.85	2.3197531	0.13725381	0.04152952	203.137953	740.608799	143.017304	0.06972839	0.30349625	13.7496832	13.6130744	13.7706169	3.97427482
PM18AJ215	E19JN26a402.csv	0.09822092	0.01058713	98.3792307	0.4738581	0.70130078	0.00558245	490.399059	847.648223	1083.83013	0.05956517	0.6115808	42.2644893	42.1025271	42.2469377	11.2775123
PM18AJ219	E19JN26a296.csv	0.1622616	0.05675621	<3.22	0.63515258	0.15190164	0.02139737	209.281618	3850.94818	9.92602797	0.04776103	1.3744983	18.2901229	18.754646	18.7595628	21.5509526
PM18AJ219	E19JN26a297.csv	0.30163014	0.04977447	<3.11	0.67950599	0.31029325	0.04146739	398.905888	5048.23618	7.67545557	0.26756919	0.6832806	20.046383	19.912766	20.1334758	5.50201994
PM18AJ219	E19JN26a299.csv	0.18642783	0.01498147	<3.24	1.05943449	0.16937897	0.03854002	305.943639	4584.56985	12.1654153	0.16707856	0.54826577	19.7769767	20.1760531	19.835852	13.8374955
PM18AJ219	E19JN26a300.csv	0.9310891	0.61593563	<3.38	3.70144084	0.44820071	0.1600395	265.322792	4744.10477	8.594742	0.044525	2.39004923	27.4355042	28.1201922	27.6705301	30.853989
PM18AJ219	E19JN26a301.csv	0.31566972	0.00976384	<3.26	0.91624688	0.22430246	0.04495855	259.845878	5335.44177	<7.53	0.10274524	0.78218737	18.0158628	19.354848	19.0248286	18.5160133
PM18AJ219	E19JN26a302.csv	0.44979585	0.13144148	<3.26	1.7123983	0.33694106	0.05973095	312.840268	4640.6827	9.95665681	0.22245229	0.27104746	20.9355547	22.3428547	21.3365217	14.8753638
PM18AJ219	E19JN26a303.csv	0.400864	0.08044992	<3.33	1.65993088	0.21175388	0.04366197	296.493999	4861.78659	14.222783	0.09401841	0.42887269	22.2464102	23.7895236	22.7363584	15.5661939
PM18AJ219	E19JN26a304.csv	0.68172446	0.31074474	<3.31	2.61784974	0.3501917	0.08671234	274.469366	5568.49203	<7.64	0.01967734	1.51552276	20.3302398	20.6953236	20.7777189	19.4832123
PM18AJ219	E19JN26a305.csv	0.49737791	0.05217449	<3.27	1.55173395	0.13677623	0.03647596	275.457207	4148.15699	<7.55	0.07762056	0.65260922	20.2564423	20.702538	20.4888474	15.6560953
PM18AJ219	E19JN26a306.csv	0.52127244	0.12257983	<3.30	2.32721975	0.33701922	0.0527062	253.456213	7059.56244	10.5326072	0.03439945	1.34767811	20.56474	20.4917916	20.7242504	15.0482793
PM18AJ219	E19JN26a307.csv	1.56403559	0.79184312	<3.33	4.80019377	0.36503335	0.12351883	254.035954	4792.74738	17.8895288	0.02717087	1.75475807	25.3745652	26.3004747	26.3594781	16.656008
PM18AJ219	E19JN26a309.csv	0.19765604	0.29345983	<3.24	0.80309775	0.22611184	0.03230777	347.780763	3751.69336	8.95667572	0.17804044	0.51602806	17.8104198	18.7100978	18.175375	9.46433788
PM18AJ219	E19JN26a310.csv	0.38027835	0.07445932	<3.32	1.75549818	0.41816814	0.0417749	269.336414	6106.86862	<7.65	0.0567208	1.58926094	21.4474208	22.1829371	21.7409186	15.3193998
PM18AJ219	E19JN26a311.csv	0.09777631	0.06653453	<3.21	0.68963377	0.26759677	0.01890391	222.958018	3623.81893	<7.40	0.04393481	1.37661667	18.1247481	19.2315995	18.7704022	20.9161041
PM18AJ219	E19JN26a312.csv	0.24205174	0.05254749	<3.29	0.79638507	0.39758085	0.03204744	278.854706	5855.29239	12.1414134	0.03796154	2.07886252	19.04332	20.2765283	19.2291053	15.8253367
PM18AJ219	E19JN26a313.csv	0.4873444	0.14102301	<3.24	1.34186233	0.33785975	0.03926628	272.750485	5038.00613	8.41436512	0.0337747	2.42694591	23.4814924	23.8865231	23.5062503	22.5476319
PM18AJ219	E19JN26a314.csv	0.44931289	0.17720517	<3.14	0.95190187	0.24661051	0.09637379	461.461824	3154.50863	<7.23	0.44560741	0.22982091	14.4869668	15.23942	15.2779598	3.48870157
PM18AJ219	E19JN26a315.csv	0.36094195	0.05185316	<3.25	1.47063807	0.32587954	0.02620842	271.515669	4975.3987	16.9590909	0.17170045	1.19602573	16.3109239	16.3304228	16.3985954	14.4446917
PM18AJ219	E19JN26a316.csv	0.64250388	0.32545288	<3.36	1.93816312	0.43503052	0.04866018	322.649099	7421.90341	<7.74	0.05372982	1.40633033	20.4767784	20.6897981	20.3839056	12.5965589
PM18AJ219	E19JN26a317.csv	0.852044	0.71258936	<3.28	3.24218374	0.32894021	0.09699862	317.530015	5799.26889	8.05792335	0.1882477	0.39108605	19.3780246	20.3694184	20.4737269	10.4091131
PM18AJ220	E19JN25a281.csv	1.09948779	<0.00674	81.7636991	3.21651734	0.16283052	0.15908741	292.918685	1062.66713	55.0441948	0.02647686	0.65551287	5.06592071	5.16150583	5.15874307	3.43012052
PM18AJ220	E19JN25a282.csv	4.80293335	0.17147211	104.651586	5.18128269	0.16549943	0.27402178	2647.60021	1390.2885	725.471644	0.01753052	3.46295814	9.28100124	9.46243415	8.95727021	7.87106063
PM18AJ220	E19JN25a283.csv	0.30710143	0.01541564	9.7190827	3.15956445	<0.137	0.02287578	653.871837	1214.86202	32.3504641	0.04911208	2.91878245	10.4553285	11.2891555	11.2927729	0.28155908
PM18AJ220	E19JN25a284.csv	0.05211433	0.02824762	22.9160232	0.11497812	0.12546934	0.03025683	3210.53075	1126.65964	46.0366197	0.21868919	8.06681964	12.2697887	13.0344219	12.9141611	0.37366466
PM18AJ220	E19JN25a285.csv	0.51864524	0.04969398	32.5252597	1.53571791	<0.195	0.04839981	1462.47141	1267.14651	56.3270225	0.16848021	14.7042102	3.51946314	3.52602026	3.69966061	0.2687924
PM18AJ220	E19JN25a286.csv	7.16676388	0.02695847	60.699137	35.3245184	<0.0984	0.21222818	716.637192	2215.84372	16.8807356	0.05377333	4.12443841	10.4493819	11.2075279	10.6479194	0.15879317
PM18AJ220	E19JN25a293.csv	12.8252545	0.16044185	337.494692	59.4675761	0.77736796	0.7144856	814.048317	1895.47317	1069.22405	0.04445971	2.55861976	4.06891953	4.48892919	4.07932454	0.70608839
PM18AJ220	E19JN25a294.csv	3.85672849	0.36260703	17.4798473	4.95742295	<0.128	0.58068032	363.742805	1337.95678	278.940755	0.20444969	2.06264228	11.8151922	12.394967	12.1245246	2.30739112
PM18AJ220	E19JN25a295.csv	1.39873355	0.39769674	16.6284286	3.76167936	0.46677238	0.1771984	592.498965	1290.26021	521.360592	0.05068942	1.74152839	11.9345537	12.7660126	12.4616771	1.3993225
PM18AJ220	E19JN25a297.csv	0.40965372	<0.00911	89.5362269	1.92581503	0.19579073	0.02370309	1853.94015	1616.11206	27.4719371	0.00502959	3.93278303	5.64071588	5.80409283	6.06306208	0.19555347
PM18AJ220	E19JN25a298.csv	<0.0114	<0.00645	16.9145969	0.01163748	0.19102883	0.00296053	1113.77298	964.603497	20.0822106	0.05098429	5.68580484	11.0610243	11.5042424	11.2844743	0.44296634
PM18AJ220	E19JN25a300.csv	4.76438052	0.02785256	38.7227708	40.264884	0.09407641	0.10086297	1726.80409	1491.74469	38.1203644	0.0069405	5.73909461	5.7718124	5.36989604	5.48596516	0.14782984
PM18AJ220	E19JN25a302.csv	1.03939444	<0.0062	8.67247827	8.5715364	<0.0915	0.08947301	383.165689	1178.96274	25.9894802	0.17203333	0.94180031	9.68907387	10.283812	10.2280704	0.64514939
PM18AJ220	E19JN25a303.csv	<0.0116	<0.00661	7.14420828	0.00713084	0.19535786	0.00222735	1085.84768	1884.64607	29.608197	0.12296343	4.23404675	18.2124274	18.6756197	18.5269478	0.13593773
PM18AJ220	E19JN25a304.csv	1.33564414	0.0336964	23.1110371	6.46737855	0.16714072	0.0949879	689.47205	974.807429	44.4475605	0.01720789	3.25768899	5.35401314	5.83401578	5.67286224	0.21470099
PM18AJ220	E19JN25a305.csv	0.67563912	<0.00656	122.891636	2.51947574	0.11583304	0.081376	950.853108	1175.78661	21.5852169	0.01469778	6.15641682	5.96214719	6.11667934	6.28349043	0.65607542
PM18AJ220	E19JN25a307.csv	0.65699139	0.21691689	34.1837559	1.05187706	<0.136	0.1301977	2565.50198	1087.68113	66.3112601	0.06367889	5.17282716	8.83475668	8.85817712	9.09082832	0.53994613
PM18AJ220	E19JN25a308.csv	1.45658982	0.43392421	3.33007747	3.32720769	0.18723571	0.24948966	305.783885	1368.75465	35.4384138	0.08875656	1.56356633	19.6266213	19.8930281	19.8097674	0.69170803
PM18AJ220	E19JN25a309.csv	1.19945706	<0.00692	13.3901321	3.48109049	<0.102	0.06838754	362.508451	1181.90196	20.001395	<0.0033	4.22159049	5.50450598	6.21045142	5.66591529	0.17811014
PM18AJ220	E19JN25a310.csv	2.66053862	0.42845877	51.2755506	8.38255258	0.43707061	0.33220958	722.493944	1143.03852	421.839707	0.07978	5.93225704	11.4635069	11.9920196	11.8675829	0.88031184
PM18AJ225	E19JN25a322.csv	0.01638655	<0.0064	<3.08	0.04619485	0.2818667	0.00273603	752.346622	609.016233	48.1416196	0.00381112	2.09681364	4.4930455	4.64044581	4.4465588	0.26343291
PM18AJ225	E19JN25a323.csv	0.02132001	<0.00625	12.0728658	0.15702679	0.34763282	<0.00165	362.896509	1016.50529	180.571767	0.01679805	2.04704651	3.70445432	3.92452783	3.77005866	0.16414283
PM18AJ225	E19JN25a324.csv	0.12540066	<0.00698	22.259268	0.31145369	0.46626228	0.0074606	480.734516	1052.31977	797.951301	0.10181372	2.43677851	4.99194238	5.5612842	5.13742178	0.2713935
PM18AJ225	E19JN25a325.csv	0.04419762	<0.0065	<3.12	0.07843942	<0.0934	0.00276792	222.603847	845.034255	19.6180817	0.01742362	1.9453594	3.6044339	3.75089479	3.64724266	0.15011855
PM18AJ225	E19JN25a326.csv	0.0483358	<0.00632	941.30964	0.39431041	2.64848732	0.01278803	808.605994	815.923171	371.144802	0.01693654	3.01295839	4.00391983	4.11614364	3.93169452	0.22350319
PM18AJ225	E19JN25a327.csv	0.0487654	<0.00951	5.46978748	0.30027443	0.2282029	0.00837282	624.919986	626.861046	14.9090431	0.16484879	5.18171872	2.24958204	2.04800214	2.23017746	0.29568006

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ225	E19JN25a328.csv	0.02680793	<0.00632	<3.03	0.11715732	<0.0905	<0.00166	125.713728	493.050721	<6.57	0.02680283	5.78602496	2.26313564	2.28469356	2.36289107	0.07512702
PM18AJ225	E19JN25a330.csv	0.01688589	<0.00665	93.7462435	0.22858175	0.65250984	0.00206268	229.014786	622.172818	303.678655	0.01085535	1.71164151	3.18895958	3.50590199	3.48112645	0.18760522
PM18AJ225	E19JN25a331.csv	0.01155742	<0.00666	20.2921592	0.11146935	0.40867273	<0.00175	535.214757	725.892297	923.756475	0.01803004	1.55631599	4.99570372	5.2315135	5.23184793	0.29727405
PM18AJ225	E19JN25a332.csv	0.03296416	<0.0065	811.785457	0.46476942	0.31009922	0.01308391	164.070933	548.548218	96.6409287	0.00384335	1.96608087	4.46214935	4.46772011	4.42895793	0.38152414
PM18AJ225	E19JN25a333.csv	<0.012	<0.00695	<3.32	0.03181016	<0.0985	<0.00182	147.159708	759.748072	<7.21	0.01132603	0.4784794	8.75097272	8.97397321	9.04565393	1.25408433
PM18AJ225	E19JN25a334.csv	0.03854002	<0.00652	<3.12	0.54802728	0.14385232	0.02050695	273.082345	1249.97598	14.0373008	0.0106266	2.38493069	7.00420548	7.37149402	7.2060754	0.1723785
PM18AJ225	E19JN25a335.csv	0.13517566	<0.00641	40.7731406	0.44684129	1.83516962	0.02157964	4798.68035	941.651777	60.2938615	0.07354151	19.1168028	4.37482044	4.27899582	4.20342217	0.14037469
PM18AJ225	E19JN25a336.csv	4.5890999	0.00868243	295.344081	4.32062815	0.45374287	0.40653374	1922.1637	3722.51704	15.8507273	0.0038365	4.76989984	3.7721106	3.98107471	3.77262306	0.8535524
PM18AJ225	E19JN25a337.csv	3.78425714	0.01365856	304.661385	4.27536858	0.46559928	0.27803109	2223.59829	3610.62334	13.729668	0.00383438	5.81110047	4.58312029	4.78050822	4.64945011	0.73357268
PM18AJ225	E19JN25a338.csv	20.5083501	0.84084445	5.1958113	46.3766489	0.18042396	0.89389514	852.875063	889.246678	13.0219105	0.05698968	2.26720121	2.97573252	2.85335294	2.73992883	0.71449048
PM18AJ225	E19JN25a339.csv	4.38347035	0.06445318	247.459252	5.06379916	0.38310764	0.37902587	1985.05375	1654.32389	10.9805919	0.01072352	5.87466677	4.93326179	4.89377648	5.18514684	1.73398533
PM18AJ225	E19JN25a340.csv	0.06224031	0.01580926	<3.27	0.2607833	0.27161046	<0.0018	609.778514	2207.60447	27.6638879	0.06484403	2.81448769	5.58312906	5.71828599	5.50853819	<0.059
PM18AJ225	E19JN25a341.csv	0.02250684	<0.00645	<3.09	0.0938468	0.14124477	<0.00169	275.875073	3514.9696	8.09766079	0.00738853	0.27523937	4.22289555	4.49434942	4.4286307	<0.0581
PM18AJ225	E19JN25a342.csv	0.03710689	<0.0065	320.680132	0.2693329	0.52982656	<0.0017	413.073716	844.895286	200.130578	0.01807788	1.69146495	3.81909357	3.84643759	3.89898013	0.21049657
PM18AJ225	E19JN25a343.csv	<0.011	0.00840807	<3.04	0.21500483	0.18239468	<0.00167	312.88723	1150.01876	42.8491451	<0.00294	1.36536124	4.1964958	4.19380742	4.06047433	0.07886872
PM18AJ225	E19JN25a344.csv	27.4272957	0.3858975	7.29744763	100.069527	0.42315145	0.94636741	1101.95336	492.194157	37.6485497	0.21067261	3.24420803	2.78042646	2.58277893	2.69095488	0.09919071
PM18AJ225	E19JN25a345.csv	5.45743196	0.05774596	9.02078277	12.8888309	0.32803363	0.21146967	773.989446	561.643446	29.9971853	0.12847286	2.59862741	2.628205	2.81413107	2.96174566	<0.118
PM18AJ225	E19JN25a346.csv	1.69653718	0.00852688	273.025153	1.4328959	0.71336882	0.21927013	2424.24259	1982.59533	18.7274624	<0.00299	6.61217447	5.19543968	5.28293785	5.31894604	2.88080212
PM18AJ228	E19JL11a018.csv	0.20576767	0.13424842	<7.59	10.5212769	0.51605233	0.0410567	79.4702547	6454.26211	<13.2	0.36282682	<0.119	77.2458752	79.0474342	77.6760537	39.4358796
PM18AJ228	E19JL11a019.csv	1.05417365	0.32224377	<7.33	1.78186839	0.39244283	0.1283128	115.515275	3135.33804	13.3614496	0.6302421	0.12015782	8.42794005	8.54797411	8.91505781	12.9339801
PM18AJ228	E19JL11a121.csv	1.57970431	0.11415604	<3.58	1.31057955	0.30421699	0.17071586	195.491906	6057.02015	15.6690303	3.66056362	<0.0545	19.9568887	20.4301383	20.579033	10.4487918
PM18AJ228	E19JL11a122.csv	0.59182724	0.10032686	<4.14	2.27823792	0.90235911	0.09379675	163.204779	13627.2512	13.5349818	0.28223516	<0.0628	35.137412	36.9275424	36.7849242	4.54294552
PM18AJ228	E19JL11a123.csv	0.88201269	0.14126477	<4.40	2.72736438	<0.111	0.03142297	59.5462858	1281.37366	<7.26	0.12440445	<0.0673	16.2910587	15.7757065	16.6624973	11.8160629
PM18AJ228	E19JL11a124.csv	0.31279649	0.17489454	<3.63	9.25469142	0.13756493	0.02635687	67.0401624	3093.44083	<5.99	0.3492686	<0.0555	60.03971	61.3048083	60.6023084	16.047478
PM18AJ228	E19JL11a125.csv	1.81987494	0.60246	<3.64	38.3385124	0.19160155	0.10135372	103.985272	1730.16467	<6.02	0.34405308	0.07266411	16.0279053	16.8709538	16.1539557	13.3106265
PM18AJ228	E19JL11a126.csv	1.84345829	0.2720111	<4.11	13.1153181	0.3215125	0.31101735	102.810159	9269.34822	<6.79	1.06808388	<0.0633	41.0512149	43.5333391	42.0339041	10.7335734
PM18AJ228	E19JL11a127.csv	1.33537228	0.48875449	<3.65	7.19562607	0.24975802	0.19854417	113.699272	7859.63537	9.17333525	1.56897314	<0.0558	40.9111872	41.6254908	40.6778087	13.7826713
PM18AJ228	E19JL11a128.csv	3.67203786	0.42265276	<4.68	43.2840982	0.91606928	0.21936661	135.522744	14997.5422	10.8981002	0.44353881	<0.0708	52.0229833	54.0420694	52.3960806	14.348225
PM18AJ228	E19JL11a129.csv	12.2015354	1.8295402	<3.63	47.0081404	0.21052713	0.80478624	125.337138	3645.24324	<5.99	0.3457558	0.09079586	39.2770008	39.7090658	39.8055738	5.92898714
PM18AJ228	E19JL11a130.csv	1.60502912	0.235987	<3.57	1.6170765	0.33142691	0.14260978	126.027606	2432.20904	11.6924011	0.91763907	<0.0546	17.7636671	17.3882303	17.6283748	18.3070105
PM18AJ228	E19JL11a131.csv	0.68752686	0.19002427	4.56423074	1.24759957	0.38547877	0.06817149	113.482784	7595.56987	13.9167489	2.53656137	<0.055	56.0353205	56.8139946	56.7594721	26.8483301
PM18AJ228	E19JL11a132.csv	2.35830398	0.80217876	<3.81	64.407257	0.1040702	0.14019695	142.506822	1500.21152	<6.30	0.20222154	0.11522914	8.24778138	8.5229403	8.26809859	4.4716894
PM18AJ228	E19JL11a133.csv	3.58661155	0.10513527	<3.64	8.90887699	1.05717264	0.28373371	174.928605	8891.12191	9.92100972	0.08768625	<0.0557	22.0518653	21.8663866	22.3815378	8.45400489
PM18AJ228	E19JL11a134.csv	<0.0158	<0.00854	<4.41	0.08230355	0.166098	<0.00258	444.019891	2042.23137	<7.28	0.10017922	0.30441013	31.1739083	33.0313835	31.8119031	5.88046646
PM18AJ228	E19JL11a135.csv	0.29543003	<0.00955	<4.95	12.9022318	0.22016718	0.00887829	411.413399	3498.93242	<8.18	0.54282621	0.08976344	35.4471434	37.0021981	36.8190085	23.0640639
PM18AJ228	E19JL11a136.csv	0.02713878	<0.00772	<3.96	0.57170355	<0.102	<0.00233	553.14795	1941.19739	8.38867414	0.08260957	0.08674693	27.4315921	29.384439	28.8751449	4.69592464
PM18AJ228	E19JL11a137.csv	1.03881929	0.19658763	38.0302699	14.1853372	1.02018146	0.07747458	202.648475	13149.9051	44.6659569	0.5322974	4.11814683	48.5367832	48.2094383	49.2106376	9.75570406
PM18AJ228	E19JL11a138.csv	1.12059527	0.73509184	90.3753521	3.19015403	0.26635918	0.04178263	74.5312041	5716.07451	26.1815368	0.15473199	0.06115658	69.3513305	71.2519815	71.4607593	29.6581742
PM18AJ228	E19JL11a139.csv	0.2723767	0.03427818	<4.49	0.98296386	0.95890616	0.05393416	138.991425	16873.5932	14.0618839	0.081826	<0.0686	43.0259728	44.2344956	44.9507337	8.65015411
PM18AJ229	E19JN25a012.csv	1.63389702	0.1128743	8.57045685	1.87685475	0.28106642	0.06026065	1548.20665	1764.55133	29.8951064	0.02599676	2.29130144	27.0468316	27.3227754	27.4334877	4.98883497
PM18AJ229	E19JN25a013.csv	1.78110807	0.03178174	13.4586129	2.73182063	0.28771374	0.05044949	2219.20668	949.055639	42.0836747	0.19065318	1.88489638	21.5395368	22.1545398	21.931032	4.21151416
PM18AJ229	E19JN25a014.csv	1.02973809	<0.00521	5.96140805	2.9240609	0.31355995	0.00815863	901.726495	839.19387	14.328658	0.03687616	1.345329	17.4342435	18.4803477	18.1136273	6.31215321
PM18AJ229	E19JN25a015.csv	0.52898694	<0.0052	7.69672641	1.93566264	0.39771435	0.02182119	1645.30242	1297.71154	35.4859377	0.18381222	1.95010146	30.4528429	31.5493082	31.0520902	4.64801514
PM18AJ229	E19JN25a016.csv	1.90496396	0.37845554	25.4916535	1.72904447	0.35142017	0.09428404	2974.29686	976.989985	83.2757395	0.11024337	2.03502923	20.9017779	22.2472407	21.4074948	7.08465712
PM18AJ229	E19JN25a027.csv	3.14303098	0.00982813	66.6009343	1.26592619	0.54208481	0.1674383	3386.9841	696.14676	176.396556	0.01190663	3.95307128	14.1917628	14.5574855	14.1964131	13.283312
PM18AJ229	E19JN25a028.csv	1.75644466	0.22620696	8.95976778	1.10238617	0.19862038	0.10912257	1074.37051	1280.90762	26.4842962	0.07329365	1.04220578	30.8056463	32.5826059	32.392566	5.30718769
PM18AJ229	E19JN25a029.csv	2.9255812	0.49106212	4.97418208	2.66061385	0.16795346	0.13690935	1076.63385	701.824759	20.7753763	0.10436472	0.74076869	11.5374436	11.9262997	11.9018976	4.47988809
PM18AJ229	E19JN25a030.csv	2.38066867	0.1252922	9.46350966	4.7939933	0.34836403	0.08864629	1508.57316	731.469381	43.5429264	0.18346674	1.26401998	8.20551864	8.51652883	8.50998199	4.77518985
PM18AJ229	E19JN25a031.csv	0.04347194	0.01940219	<4.42	0.29963777	0.19945257	0.01278205	1317.42108	843.872312	19.6120918	0.15636758	0.94448887	15.0010513	15.0474485	14.4911897	2.62398577
PM18AJ229	E19JN25a032.csv	1.0098829	0.01527675	<3.70	2.73093311	0.18002512	0.04101777	953.435744	767.289161	15.6615044	0.14086869	0.88044382	10.1006066	10.7720795	10.4911216	3.96798134
PM18AJ229	E19JN25a044.csv	32.3392974	0.01963774	55.4673218	51.6308085	0.63177122	0.77834566	3745.58195	942.814113	183.747396	0.06950055	7.08376267	16.4998226	17.2709152	16.3475087	12.1418858
PM18AJ229	E19JN25a045.csv	1.37745912	0.26941512	22.7523337	1.45587655	0.46883649	0.03759879	2436.93259	1087.14624	87.5503912	0.10413676	2.08461335	27.2600363	27.6990213	27.1193166	7.71492884

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ229	E19JN25a046.csv	1.45409316	0.01064947	25.7174031	3.62643546	0.39002903	0.05031748	3036.20645	890.239889	89.0910843	0.10655437	2.32881876	19.0863287	19.7698858	19.0683969	9.83415211
PM18AJ229	E19JN25a047.csv	1.96341773	0.01104324	4.31834326	2.54410035	0.45071445	0.03935143	1257.55853	1627.05875	13.4734981	0.09956409	2.36898214	27.9522227	28.6929028	28.6122017	3.19499028
PM18AJ229	E19JN25a048.csv	1.47926897	0.22182026	7.98892792	2.95380688	0.27855812	0.0371866	1231.53612	665.244033	36.328988	0.07800313	1.0562785	11.8388033	11.719603	11.5174522	5.83338678
PM18AJ229	E19JN25a049.csv	0.94640172	0.03186046	10.8435352	2.15962368	0.45942221	0.02896456	2107.13669	664.946252	25.7407036	0.07566066	2.58688215	13.7528641	14.0589451	13.8384132	7.72411301
PM18AJ229	E19JN25a050.csv	0.61515482	0.0213428	<3.60	1.417577	0.22616896	0.02039125	1074.42376	1136.27022	23.2694976	0.09017596	1.25490686	31.06366	32.8702622	32.1659744	8.15126069
PM18AJ229	E19JN25a051.csv	0.57508183	0.04463111	<3.57	1.04737935	0.3446169	0.02953709	884.072195	961.411811	13.677113	0.06432335	1.95945357	16.9841752	17.1514225	17.0530304	4.0562531
PM18AJ229	E19JN25a052.csv	0.22121007	<0.00618	48.0408673	0.71348459	0.21529948	0.01005388	2652.83901	741.13098	175.795275	0.02648315	6.0479854	14.3581002	14.8748911	14.8241667	10.8962813
PM18AJ229	E19JN25a053.csv	0.57339372	<0.0052	14.4672752	1.43200951	0.36461577	0.02169123	2567.77808	956.547883	70.8680002	0.04306942	2.425897	22.0115712	23.1615837	22.1525519	10.0183731
PM18AJ229	E19JN25a060.csv	0.73740855	0.01617921	<3.59	2.01169765	0.31549186	0.07648112	1250.58464	957.967546	26.894877	0.13435366	1.1137946	20.2979199	22.0150411	20.7488582	5.86220678
PM18AJ231	E19JL15a026.csv	0.44741138	0.56318387	40.632393	7.05294433	<0.269	0.0356264	218.74528	477.19462	74.4152328	0.8328262	0.68805889	13.7546652	13.6846057	13.1186876	0.85868606
PM18AJ231	E19JL15a027.csv	<0.032	0.1304156	<9.41	3.33782872	<0.286	<0.00626	103.645004	606.364003	<18.3	0.06753147	0.25852466	9.92242419	11.1094979	10.3730696	3.54630256
PM18AJ231	E19JL15a028.csv	1.26808358	0.22963082	27.3986928	16.8119826	0.57127338	0.04715967	241.201781	781.32558	18.6162403	0.59156544	<0.127	12.3794835	11.4195812	12.5494147	1.72211504
PM18AJ231	E19JL15a030.csv	0.13078461	0.12973944	<6.79	3.56287609	<0.207	<0.00456	285.344489	639.278262	16.5416649	1.24259123	0.181783	6.64106673	6.76205924	6.31914013	1.03658274
PM18AJ231	E19JL15a031.csv	0.36106177	<0.0137	<6.65	1.7911459	0.75310022	0.05020865	382.971216	2362.64217	16.8951274	0.31436426	0.11584229	49.7289114	51.4907849	50.0343096	11.6536129
PM18AJ231	E19JL15a033.csv	0.16551721	1.39605446	<7.28	0.64243444	0.51479827	0.10858191	359.993432	494.436621	<14.4	0.39988927	<0.114	30.3475194	31.3598731	29.6907212	2.74851298
PM18AJ231	E19JL15a034.csv	1.1785763	0.90472456	<6.98	3.79036455	0.43265892	0.19185584	454.036549	1998.71868	13.6776729	0.45908713	0.34206675	32.2849695	33.2061469	33.0733731	11.2248994
PM18AJ231	E19JL15a035.csv	0.05331644	1.76397704	<9.32	0.33194583	<0.286	0.01684345	182.959073	656.05416	<18.1	0.12110771	0.21055017	27.4557977	27.0443831	27.8076796	18.9965185
PM18AJ231	E19JL15a037.csv	0.49758621	0.56436268	<7.95	1.60232477	<0.244	0.06746002	299.367431	345.178667	<15.5	0.20760956	<0.124	7.89648275	8.01262841	7.94403077	1.44470269
PM18AJ231	E19JL15a038.csv	<0.0231	0.1912612	<6.67	0.68853666	0.6547582	0.01321801	220.201533	2161.42038	<13.0	0.22477207	<0.104	11.2019097	11.9308193	11.0316928	10.0442224
PM18AJ231	E19JL15a039.csv	0.7037834	<0.0143	698.644018	15.7772345	0.6652908	0.03547099	328.9672	3305.3746	316.230078	0.06541282	0.34050564	10.2262084	10.8144387	10.2351446	10.2070854
PM18AJ231	E19JL15a041.csv	1.72150719	0.17752422	<7.24	75.9163493	0.50711511	0.03645313	248.501606	599.961852	133.728652	0.29484605	0.15531908	41.1156604	41.7211415	40.5565339	12.9175071
PM18AJ231	E19JL15a042.csv	1.95334976	0.15675784	<7.07	24.3600538	0.97838712	0.05488012	317.95942	961.998276	110.185686	1.63169167	0.12201078	27.3134427	27.1855192	27.207566	1.69785395
PM18AJ231	E19JL15a043.csv	4.01506308	0.32320286	135.883105	24.5881321	0.38120045	0.12849639	354.194935	716.667928	1188.29698	0.34285049	<0.119	18.4153855	17.4754794	17.5810322	7.40635622
PM18AJ231	E19JL15a044.csv	0.63633545	0.33342742	7.97381641	7.30033492	0.33008619	0.05551362	254.163707	459.044008	260.882233	<0.00573	0.21422404	37.8276655	39.1298594	38.0205842	6.55430638
PM18AJ231	E19JL15a045.csv	4.45631195	0.29634233	28.4444896	50.6314598	0.28486005	0.22836872	301.418302	989.326727	<17.6	0.12697481	<0.139	52.9117369	56.4325844	54.1376558	10.109576
PM18AJ231	E19JL15a046.csv	0.07877555	0.11480276	<7.53	0.09414143	<0.233	0.03083548	231.133967	511.587315	<14.6	0.43738934	<0.119	8.47153899	8.3852644	8.17534477	2.17427037
PM18AJ233	E19JN25a145.csv	2.47868426	0.22303764	<3.35	37.9719645	0.75971157	0.16724164	316.729819	1659.77307	18.9269439	0.02441578	3.37154905	61.4901597	61.8075594	60.8975694	51.527809
PM18AJ233	E19JN25a146.csv	1.41516967	0.07093967	<3.49	31.3244726	0.6637849	0.0880005	143.469964	1966.85783	19.6921988	0.03072371	2.28260563	68.395782	70.1030662	68.929648	61.9038654
PM18AJ233	E19JN25a147.csv	4.79567042	0.15216182	<3.47	67.1476213	0.77497569	0.30307659	171.650103	1901.24969	24.9034326	0.06424504	1.02780756	55.5381399	56.8692817	55.2041476	44.0384611
PM18AJ233	E19JN25a148.csv	3.27101857	0.10363843	4.09821136	46.3492557	0.58557435	0.34592118	182.437096	1936.89496	25.491844	0.10922945	1.26567156	72.8370197	72.2809594	72.4353913	24.8558358
PM18AJ233	E19JN25a149.csv	0.42632434	0.05454184	<3.88	2.2855124	0.40372605	0.07193583	219.978818	1706.24706	22.2548154	0.28927644	3.98279832	40.2824909	40.8742598	41.0746331	31.992995
PM18AJ233	E19JN25a150.csv	0.20220678	<0.00563	<3.36	1.65760009	0.20622534	0.04175574	155.69387	1248.50064	11.5817131	0.03580356	3.4739909	26.867421	27.7293725	27.60084	34.6092357
PM18AJ233	E19JN25a151.csv	0.85291009	0.45879998	<3.49	2.16851409	0.34784952	0.07188122	160.709999	1434.36094	31.4253489	0.01170269	5.90050521	37.9465604	38.4172476	37.7400379	60.1794565
PM18AJ233	E19JN25a152.csv	0.43387535	0.14820002	<3.37	0.58916156	0.17886766	0.06808822	329.001803	568.128898	25.6642867	0.56598658	4.79542424	36.7366759	37.7309935	37.4423001	7.48383893
PM18AJ233	E19JN25a153.csv	0.36319707	0.02542027	<3.39	0.75755263	0.16046406	0.07693114	152.440639	1144.14706	14.9629264	0.05601761	2.79717163	29.6508041	30.6114755	30.1274933	23.5424498
PM18AJ233	E19JN25a154.csv	0.94749127	0.07267545	<3.67	2.23246019	0.25478231	0.14006416	154.765094	1553.28506	17.4946628	0.01335585	4.33070832	30.1986134	32.0779983	31.1246603	44.050701
PM18AJ233	E19JN25a155.csv	1.19440775	0.20184789	78.155658	2.07856236	0.42644668	0.17089541	175.847079	2701.04941	45.4616246	0.04343372	2.40049869	53.8323689	55.4912272	54.4232333	19.9331099
PM18AJ233	E19JN25a156.csv	10.9787614	0.47947842	<3.46	8.64852692	0.22786182	1.06826207	190.504548	609.359039	71.3989818	0.12826962	2.1291442	27.6677763	28.4961527	27.6894087	63.0791725
PM18AJ233	E19JN25a157.csv	1.92260484	1.32303215	<3.37	44.4344513	0.58011454	0.15011701	235.401886	1604.0529	40.2682953	0.045371	1.98220522	49.252988	50.6257579	49.6220832	18.3288197
PM18AJ233	E19JN25a158.csv	0.54001594	0.03126035	3.75655337	1.99397089	0.81338904	0.02411033	196.812096	1670.38412	52.433631	0.06085189	3.33514917	34.2920587	35.8191273	35.7822114	60.4633367
PM18AJ233	E19JN25a159.csv	0.39568778	0.02688279	<3.54	0.77367864	0.66082855	0.01120979	190.963749	1731.43464	29.6702617	0.03784409	3.43475074	37.9312865	38.2638667	38.2960852	47.616578
PM18AJ233	E19JN25a160.csv	0.03456081	<0.00569	4.45391235	0.57221862	0.49444141	0.00219271	170.315149	1680.02548	53.0274643	0.04872073	2.54078433	31.6613095	32.9331624	32.2219068	44.0860017
PM18AJ233	E19JN25a161.csv	0.21111253	0.02614774	6.60629682	5.4333793	0.61719831	0.02349463	183.689659	2203.0802	43.2929925	0.02196712	1.54648245	68.7224805	69.5491638	69.2450756	16.5753033
PM18AJ233	E19JN25a162.csv	2.01583404	0.82209618	<4.31	24.8823167	0.43257088	0.10709864	217.134799	1718.40191	18.0453981	0.13227092	1.79945412	64.8068694	64.6616475	63.8837414	8.81222568
PM18AJ233	E19JN25a163.csv	2.53228467	0.2255507	<3.49	52.0152198	0.81287683	0.10177921	182.705481	3808.33184	21.292672	0.05482329	1.51822398	67.1321788	68.5035301	67.0406031	16.7225949
PM18AJ233	E19JN25a164.csv	1.11119145	0.3927465	<3.47	23.1797874	0.59700514	0.06672769	161.644806	3213.76499	13.9767318	0.04698818	1.5308292	61.4282211	63.3153654	61.9544687	20.2476396
PM18AJ233	E19JN25a165.csv	0.94793377	0.0262951	<3.49	2.64501209	0.81222576	0.07982414	246.089092	1347.13198	32.347563	0.11563041	4.40317067	25.1807681	25.9501603	25.550721	69.4743716
PM18AJ233	E19JN25a166.csv	0.85561601	0.06355835	11.7302636	3.60751767	1.07702063	0.04066687	774.0709	1357.54892	55.3924569	0.12972968	2.67706922	27.5831411	28.7079313	28.1965259	72.8673337
PM18AJ233	E19JN25a167.csv	1.33992153	0.68424618	<4.35	10.4472527	0.62753215	0.24757375	356.055207	1234.77063	13.3049965	0.35156528	3.35530355	28.9858391	30.1952871	30.6374815	33.9426975
PM18AJ238	E19JN26a129.csv	0.26350276	0.0755623	<3.26	0.66642897	0.11418367	0.00902743	131.061103	1444.37944	<7.26	0.03951664	3.95506797	24.3538073	25.48891	24.6241549	26.8359551
PM18AJ238	E19JN26a130.csv	0.05761645	0.00975707	4.51374329	0.16552857	0.17883331	0.00607672	199.146726	2542.17298	12.5487368	0.29630071	2.95264026	17.7147243	18.174476	17.6233802	30.8021365
PM18AJ238	E19JN26a131.csv	0.34489683	0.00994731	<3.34	0.74992861	0.14597789	0.01770785	174.432856	2275.77	8.59029918	0.10506168	3.17259439	31.3509597	32.8748515	31.77471	24.6645381

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ238	E19JN26a132.csv	0.11642724	<0.00933	19.6428836	0.44465367	1.20028935	0.12307622	208.880139	1721.53659	936.858457	3.02205934	3.58718063	14.6011552	15.4801222	14.9718169	12.1033902
PM18AJ238	E19JN26a134.csv	95.1457143	0.23199078	<3.28	391.211794	0.22866468	2.12266688	314.30286	3051.87829	18.3992771	0.03839029	3.3324198	4.6777386	2.42966298	2.19238925	18.3949658
PM18AJ238	E19JN26a135.csv	43.2399626	0.11444788	<5.12	91.3481952	<0.156	2.31038886	135.937244	1414.00427	16.1133385	0.0407184	1.60037937	15.53587	12.9643229	12.4399452	630.892891
PM18AJ238	E19JN26a136.csv	0.12590266	<0.00663	<3.73	0.53498068	<0.113	0.00421938	186.857828	1610.09059	<8.30	0.13437156	4.40827966	13.5850474	13.4635558	13.2878171	7.88417901
PM18AJ238	E19JN26a143.csv	0.06882891	<0.00586	<3.28	0.4304317	<0.0993	0.0053128	124.210767	2592.40122	8.45817263	0.10662939	6.13931554	28.9857696	29.26818	29.4419836	12.1655307
PM18AJ238	E19JN26a144.csv	5.36968957	1.04983785	<3.68	2.39300187	<0.111	0.1257788	156.837069	2067.72884	34.0930432	0.29464107	2.83842266	38.2938704	38.6512172	39.1488685	17.9454439
PM18AJ238	E19JN26a145.csv	0.38515664	0.01536823	3.39265358	0.77974054	0.21644348	0.02186728	251.612718	6157.29171	161.687261	0.27781652	5.10678182	31.2858516	32.561784	32.1609385	8.3425468
PM18AJ238	E19JN26a146.csv	0.17205551	0.0104733	<4.06	0.69484201	0.19049849	0.00819059	178.18034	4274.93562	19.7229474	0.11752371	13.0200078	27.7639285	27.5730206	28.494723	12.3005145
PM18AJ238	E19JN26a147.csv	0.05949682	<0.00607	<3.38	0.05779512	<0.102	0.15804385	186.356409	1340.07896	12.755713	0.51692054	1.78950889	3.91853204	3.68050609	3.60723242	0.35488641
PM18AJ238	E19JN26a148.csv	0.85896135	<0.0061	5.87752331	2.22678885	0.13048838	0.03914654	387.648135	5529.66879	28.5083841	0.21303504	5.17106812	32.8384491	33.7344512	32.8561497	9.26266247
PM18AJ238	E19JN26a149.csv	2.06118294	0.22273235	9.838662	1.88714896	0.20792353	0.07223342	297.745823	2058.24212	50.5886227	0.1419619	6.24846765	53.1984705	55.3103518	54.312981	38.0850466
PM18AJ238	E19JN26a151.csv	0.06781348	0.00958961	<3.23	0.06576096	<0.0975	0.01191063	160.176273	2013.02368	10.4215001	0.36501568	3.03166184	5.90673063	5.90159506	6.07828309	2.28705722
PM18AJ238	E19JN26a152.csv	2.72831922	0.18989446	<3.54	2.01216554	0.18546187	0.11725564	179.980401	4706.59535	13.713679	0.32108587	3.0071762	42.8839069	44.0996985	44.2523145	12.8910678
PM18AJ238	E19JN26a153.csv	15.7106389	0.21352286	<3.82	17.2498539	<0.115	1.42707611	94.3257406	791.514747	13.0947355	0.00765402	1.61571889	15.3976882	12.400558	12.1792425	148.345992
PM18AJ238	E19JN26a154.csv	8.00651917	0.0402045	<4.50	18.1194635	<0.136	0.23152662	296.571119	4516.38868	51.3193985	0.1543345	7.21654961	21.6207458	20.5248923	20.8477141	24.0224138
PM18AJ238	E19JN26a155.csv	0.26876888	0.06157028	<3.32	1.42177889	<0.1	0.01375643	175.345007	2954.97598	16.420428	0.20069637	7.02625759	25.8131071	26.5836591	25.9654907	11.6095754
PM18AJ238	E19JN26a156.csv	0.4203586	0.10386016	7.59095239	1.31773048	0.24756193	0.02080195	352.081408	2204.47493	125.781283	1.42460244	4.83971283	33.383348	34.8121803	33.7074366	15.0357446
PM18AJ238	E19JN26a157.csv	2.33825635	0.14078397	<3.36	1.82241114	<0.101	0.19833896	191.813434	3626.71548	12.3568119	0.13095007	4.25354816	37.2705123	37.7196133	37.6654208	18.8006073
PM18AJ238	E19JN26a158.csv	0.45688	<0.0059	<3.28	1.01739687	<0.099	0.18550128	274.418763	2090.96008	35.7940574	0.29341369	4.69132783	9.03040511	8.82813123	8.81128159	8.5277375
PM18AJ238	E19JN26a159.csv	1.39835787	0.16810646	<3.38	1.44206515	<0.102	0.29997095	222.397058	1751.27173	8.32080084	0.05927321	3.71174356	18.470625	18.8125341	18.6016957	94.547912
PM18AJ242	E19JL11a070.csv	0.2999024	0.16798735	<3.60	1.74465529	0.23435117	0.05619915	163.168283	1258.35214	8.3412766	0.45829082	0.20842629	2.56761833	2.65036279	2.57157749	0.7257445
PM18AJ242	E19JL11a071.csv	0.51589278	0.0157803	<3.41	1.96908427	0.10616244	0.07347645	123.008744	1296.37859	<5.84	0.02498816	0.47693052	2.58626373	2.46166194	2.53434745	<0.0814
PM18AJ242	E19JL11a072.csv	2.58114244	0.61782323	<3.50	9.71219885	0.11977912	0.22386577	154.480894	2181.63882	11.1968447	0.18483761	0.21013454	18.5085831	18.7202928	18.2337621	0.40967695
PM18AJ242	E19JL11a073.csv	0.23095089	<0.00737	<3.97	0.56151264	<0.0977	0.06256245	77.8802026	842.176699	<6.80	0.00742237	0.30448902	1.28721293	1.26316415	1.29237853	<0.0943
PM18AJ242	E19JL11a074.csv	0.8494706	0.03657381	<5.24	3.1592186	<0.129	0.14872196	138.994205	3419.5239	10.9737292	<0.00347	0.39025725	9.27560981	9.24706494	9.33549636	0.2254826
PM18AJ242	E19JL11a075.csv	0.41770737	<0.00631	<3.37	2.21790278	0.08790294	0.03866877	131.727659	1285.44211	<5.76	0.00459041	0.50557222	4.83017579	4.90599233	4.85989548	0.19933359
PM18AJ242	E19JL11a076.csv	0.40177628	0.01016533	<3.40	0.40257072	<0.0835	0.0350307	38.7433927	761.374835	<5.80	0.02519831	0.0585176	0.70866732	0.73910871	0.77994394	<0.0808
PM18AJ242	E19JL11a077.csv	0.08041055	<0.00636	<3.40	0.33779928	<0.0835	0.07235951	37.5041675	724.580132	<5.80	0.14002516	0.1404492	1.66496207	1.7604349	1.75605813	<0.0812
PM18AJ242	E19JL11a078.csv	0.61144626	<0.00883	<4.72	2.28755278	<0.116	0.15512331	77.5172112	1257.43913	19.1752535	0.08161203	0.19764115	1.64506294	1.19916404	1.50651554	<0.115
PM18AJ242	E19JL11a079.csv	0.1691745	0.04631723	7.92912821	1.01296166	2.94163177	0.02340494	379.876248	1934.71835	100.919443	0.10045052	0.79127408	3.65012652	4.02042123	4.03676366	<0.0856
PM18AJ242	E19JL11a080.csv	1.16068507	0.1038397	<3.71	8.80779148	0.42107436	0.10668805	166.782322	2798.47303	25.2429736	0.3509676	0.69264784	7.38161571	7.45306495	7.21223383	0.2714014
PM18AJ242	E19JL11a081.csv	0.02837443	<0.0065	<3.45	0.50718986	<0.0848	0.00369731	84.1436212	1713.59613	<5.87	0.09284831	0.29869802	3.02674211	2.91977492	3.00589166	<0.0828
PM18AJ242	E19JL11a082.csv	0.08927353	<0.00661	<3.52	0.31412252	0.11310879	0.03062399	109.493586	2306.89122	7.081649	<0.00239	0.41903399	1.92576228	2.04216145	1.98091939	<0.0841
PM18AJ242	E19JL11a083.csv	0.20688757	0.05317191	<6.26	0.70666076	0.33848254	0.03306864	3022.11958	6613.9688	64.0408314	0.03867104	1.32361463	3.17322848	2.86035647	3.93797258	<0.159
PM18AJ242	E19JL11a084.csv	0.34752532	0.02241213	<3.62	1.85529414	0.13910561	0.05690558	106.836798	4558.353	11.2447005	<0.00244	0.17772384	7.08793893	6.90484015	7.29896277	0.13753006
PM18AJ242	E19JL11a085.csv	<0.0134	<0.00715	<3.79	0.10882854	<0.0931	0.00234746	183.530288	2647.91711	<6.42	0.00379746	0.74871406	4.78384112	5.06750091	5.1400121	<0.0908
PM18AJ242	E19JL11a086.csv	1.99182911	0.26941572	<3.80	10.5816672	0.19397804	0.21413673	186.902088	3051.45743	11.4275349	0.2632398	0.98091828	8.56574193	8.76164249	8.31826819	<0.0896
PM18AJ242	E19JL11a087.csv	1.11029498	<0.00651	6.21562163	10.8576109	0.25872266	0.09698666	539.724957	6488.57725	27.2502544	0.02204622	1.64373285	4.97578415	5.09526781	4.75841724	0.09651669
PM18AJ242	E19JL11a088.csv	1.87517692	0.01020405	8.46836557	14.4364963	0.15116156	0.08539419	149.324926	3302.16054	240.025044	0.15636466	6.24027589	6.83210734	7.10644587	7.45647133	0.46185767
PM18AJ242	E19JL11a095.csv	3.23168854	0.04010736	327.321343	22.4964603	1.632321	0.18210011	294.438838	5693.87788	1043.81765	0.09595817	2.40956568	12.3847218	13.280563	12.8283022	1.16654886
PM18AJ242	E19JL11a096.csv	0.56307406	0.02141222	<3.41	2.11346458	<0.0841	0.16740828	131.831584	1319.04619	10.4379511	0.03983797	0.53684566	3.11281437	3.1179605	3.10772841	<0.08
PM18AJ242	E19JL11a097.csv	0.54271575	0.84671695	<3.79	5.72725169	0.16411266	0.04856466	458.832121	1482.98068	11.9357462	0.06536535	1.70455704	13.2649996	13.6146604	13.3502799	0.15506517
PM18AJ242	E19JL11a098.csv	0.65678189	0.49242057	<3.60	4.13133662	0.10592162	0.22657404	162.193419	1893.89163	14.4224954	0.09022193	0.42591693	7.74492711	7.83343134	7.38795336	0.19136552
PM18AJ242	E19JL11a099.csv	0.02953282	0.02203417	<3.56	0.59670442	0.09787104	0.01058093	269.806759	1567.40645	13.5216866	<0.00244	1.11800142	5.71882904	5.68350066	5.69790232	0.11196231
PM18AJ249	E19JN25a225.csv	0.08588447	0.27115334	17.3772688	0.25671176	0.2434808	0.04705249	1693.24272	3239.65858	27.5077881	0.11449652	0.72508637	51.2493438	53.6104553	51.1211106	0.64154668
PM18AJ249	E19JN25a226.csv	0.04995091	<0.00587	6.32940457	0.09616498	0.23984366	0.01459248	678.223432	2304.15511	11.666368	0.16429037	0.39739335	45.9866159	48.8766658	47.3212707	0.55844877
PM18AJ249	E19JN25a227.csv	0.38560675	0.25868593	14.1667899	0.80667682	0.31081581	0.05940018	1912.42219	3639.37371	23.2917947	0.05984345	0.83491708	72.241369	75.2478591	73.8217513	3.1706388
PM18AJ249	E19JN25a228.csv	11.6321939	0.15558746	37.3625135	79.867391	0.28031354	0.89467511	824.076822	3107.64668	180.688989	0.11618521	1.20988369	46.0095087	48.2503799	46.8637178	2.40736635
PM18AJ249	E19JN25a229.csv	0.06521701	<0.00611	5.07524341	0.10354919	0.19602853	0.03867239	609.27233	1898.95581	10.0020154	0.24348896	0.5006305	28.581153	29.2675242	28.984224	0.15095363
PM18AJ249	E19JN25a230.csv	1.02546235	0.22119615	6.63484713	8.93299203	0.23490382	0.12024565	918.491664	3226.61161	24.6195157	0.11473633	0.66234851	43.6698278	46.9211895	45.8534203	0.65069883
PM18AJ249	E19JN25a237.csv	1.4726583	0.04448424	161.233955	7.08410624	<0.0949	0.09909515	822.773652	2592.74639	23.0765114	0.04118697	0.34496572	28.93072	29.8443245	28.9918909	11.2835845
PM18AJ249	E19JN25a238.csv	0.12259612	0.05891892	<4.06	0.58934193	0.13554877	0.018965	333.999986	3971.25344	<8.63	0.1223493	0.4710916	41.3515454	43.2514633	41.7770795	0.71890717

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ249	E19JN25a239.csv	0.03827183	<0.00641	<3.41	0.00742681	0.1521622	0.03622706	417.272139	2152.86901	12.4377943	0.13961086	0.25638037	51.1319317	53.0332685	51.7889268	2.39267289
PM18AJ249	E19JN25a240.csv	0.97744231	0.04530616	<3.26	4.92306117	0.23204684	0.06598732	358.066702	2635.09087	<6.86	0.03160093	0.321663	43.5546793	46.1213195	44.7000413	3.46796404
PM18AJ249	E19JN25a241.csv	0.13950177	<0.00602	7.9129452	0.41193621	0.1437696	0.01103077	1387.12459	2420.60958	17.1699291	0.04788672	0.60879015	26.1437898	27.6850538	26.5921301	0.35319304
PM18AJ249	E19JN25a242.csv	2.19562482	<0.00605	5.99083373	10.6541861	0.13295814	0.05667492	854.699431	2140.87986	16.8996445	0.11946723	0.33103472	31.2180573	33.0005112	31.8923222	1.53485143
PM18AJ249	E19JN25a243.csv	1.37063719	0.42166348	9.30456276	6.87965547	0.18419876	0.11683367	735.124598	3478.61042	100.104271	0.04167654	0.40877736	55.8630493	58.8833897	57.7412768	3.08624478
PM18AJ249	E19JN25a244.csv	0.07047328	<0.00586	7.29645521	1.03189422	0.09526414	0.01357676	1218.04698	1990.98797	14.8743317	0.11537821	0.66163322	28.2471935	29.5322173	28.7067561	0.38608915
PM18AJ249	E19JN25a245.csv	1.75209753	0.05069411	94.284106	4.88056083	0.33009583	0.1816773	1704.63264	2840.45228	814.871356	0.0400254	0.13712991	22.866981	23.4481635	23.0480804	5.91951325
PM18AJ249	E19JN25a246.csv	1.02507661	0.20253784	38.6074774	12.9637171	0.26431452	0.08125822	3379.69735	4103.30127	219.736282	0.13758115	0.86900103	51.6471625	53.7731038	52.5113407	2.17674326
PM18AJ249	E19JN25a247.csv	0.02290175	<0.00613	5.58359742	0.14994883	0.30659332	0.00513316	882.203104	2611.63155	15.6090861	0.13080165	0.79530168	47.7513659	49.5086879	48.3126244	0.44532598
PM18AJ249	E19JN25a248.csv	0.22183201	0.45423305	7.87783927	2.03985768	0.13925462	0.04581369	695.846467	3038.11916	59.0558111	0.04768702	0.85540224	23.9478524	24.9037759	24.5309737	0.35486265
PM18AJ249	E19JN25a249.csv	1.54261576	0.07049372	9.54839763	5.38613947	0.27594863	0.05979157	1488.97041	3301.18646	20.9861777	0.04177444	0.43324377	55.7449293	57.3279195	56.497605	2.40108845
PM18AJ249	E19JN25a250.csv	0.85234531	0.91349971	10.5145559	3.75155875	0.43929634	0.14914429	2084.04877	1763.03539	25.3151919	0.03532222	2.33515076	59.8612347	62.302295	60.6375461	49.301872
PM18AJ249	E19JN25a251.csv	0.3636043	0.25668335	4.57113797	8.26030211	0.71936454	0.04697622	2906.15178	1923.92511	19.7443943	0.11730867	4.52508	32.2550242	34.071999	33.8554894	5.72456842
PM18AJ249	E19JN25a252.csv	0.63199716	0.09925921	19.4361679	1.97300947	0.21087001	0.11559413	1854.49022	3325.883	45.07264	0.15919837	1.41423613	58.8501562	60.5892405	59.7456302	1.31376912
PM18AJ249	E19JN25a253.csv	12.2599299	0.39980484	27.4286697	64.2220681	0.84915319	0.51878047	2297.72175	2093.27311	32.40795	0.06512939	3.1490175	37.8860965	39.8903177	38.3810821	4.34730837
PM18AJ249	E19JN25a254.csv	0.96864606	0.13492122	23.4152029	5.66486596	0.27977102	0.1094076	1015.06735	2832.98035	38.3556868	0.62801837	1.59736305	58.4116341	60.7758332	59.54627	1.86916467
PM18AJ249	E19JN25a255.csv	3.93134706	0.06812068	11.0602803	25.1948221	0.51099867	0.30725797	1044.5916	3227.13849	29.3196635	0.11015893	0.51169013	48.7438807	51.6219047	50.4401401	1.8042363
PM18AJ252	E19JL11a007.csv	35.4513163	0.03718237	67.0148592	70.8658908	<0.189	1.1235345	410.30145	1321.98938	473.912672	0.01814858	0.1240699	5.33128601	5.00010489	4.88469476	1.19725747
PM18AJ252	E19JL11a009.csv	4.74945006	0.03609592	28.2543027	88.0317174	1.04415101	0.15517059	381.778204	2166.1833	27.7145273	0.0333117	<0.115	30.3916016	31.0833303	30.8995972	145.750209
PM18AJ252	E19JL11a011.csv	1.21044939	0.10620702	16.1890754	4.43319014	<0.215	0.34087087	222.32362	1247.85931	81.4971726	<0.00531	<0.129	<0.367	0.5336203	0.49589633	<0.228
PM18AJ252	E19JL11a012.csv	2.87182286	<0.0175	<9.45	9.91135854	<0.243	0.28193642	413.032202	658.577363	22.5607606	0.02992729	0.15887992	1.19654405	1.29809486	1.45830166	<0.253
PM18AJ252	E19JL11a013.csv	3.43726899	0.11773106	198.847104	50.8233275	<0.33	0.35629323	921.710566	1326.12513	143.331965	0.23541161	0.36798999	7.69270473	6.74919672	8.3869438	4.46151167
PM18AJ252	E19JL11a015.csv	0.60804902	<0.0142	7.75755293	9.25296733	<0.196	0.01538945	381.988358	862.891417	43.5565011	0.01153531	0.17149045	3.63782832	3.5981866	3.61289005	0.40182179
PM18AJ252	E19JL11a235.csv	0.74477107	0.07573108	350.231378	13.2926179	0.31996921	0.03037021	697.542056	1820.31362	276.712763	0.03473083	0.17384839	1.86705921	1.92826571	1.98658675	0.43179636
PM18AJ252	E19JL11a236.csv	1.1251872	0.03241437	181.529684	4.20737773	0.33111744	0.03264795	350.189607	3376.17892	165.565247	0.0217417	0.65122396	2.13959349	2.32085255	2.53991152	1.06952246
PM18AJ252	E19JL11a238.csv	0.40940675	0.62631136	74.6120243	5.94752729	0.20627173	0.02600149	654.061629	1015.56011	37.6821463	0.01071112	0.15566819	2.34991607	2.36468689	2.45771428	0.41756559
PM18AJ252	E19JL11a239.csv	0.72869747	<0.00818	22.4767319	10.2044292	0.41252411	0.0278182	297.382283	1844.67945	33.1537448	0.02141417	0.17173373	5.57435521	5.9530759	5.74879463	5.41417763
PM18AJ252	E19JL11a240.csv	0.87498228	0.0271706	219.17756	11.7189504	0.42887136	0.09528581	362.90356	3519.96764	251.70102	0.02875277	0.07797589	5.999688	5.65634622	5.75925335	4.58053188
PM18AJ252	E19JL11a241.csv	0.9605705	0.03441852	406.428464	6.08307872	0.68556919	0.11789671	2321.20363	991.854258	46.3323313	0.19441572	0.68760764	1.45173351	1.35799528	1.33563421	0.44067536
PM18AJ252	E19JL11a243.csv	15.1702383	0.1920325	362.818066	99.1236778	0.09424247	0.75760303	716.213052	1477.84343	1353.37413	0.13499228	<0.0511	5.08200047	4.67750124	4.6902921	1.62576847
PM18AJ252	E19JL11a244.csv	1.04260161	0.01449577	134.646692	11.6772588	0.29744518	0.05241846	393.01052	2243.03107	144.392548	0.04462717	0.30768241	36.6379022	36.9897085	36.765546	6.7777198
PM18AJ252	E19JL11a245.csv	6.82115786	0.14905441	195.347709	26.6290596	0.17038337	0.44289431	564.590628	863.411321	175.291331	0.29220756	0.13670962	1.71084042	1.78827629	1.48746641	0.49314466
PM18AJ264	E19JL11a022.csv	0.19264885	0.0602474	<7.23	2.90156723	0.32470794	0.01909015	434.617199	2129.27249	650.719399	0.11365719	0.20755335	37.1434428	36.9599595	36.2719072	0.69134332
PM18AJ264	E19JL11a023.csv	0.28221574	0.64261475	<7.68	8.00910211	<0.2	0.06148064	235.702569	2173.56966	17.4811788	0.0479882	<0.119	34.7116857	35.6131104	35.6576186	0.69192608
PM18AJ264	E19JL11a024.csv	0.35136384	0.11326765	<7.33	1.9036672	<0.191	0.03542847	240.620711	928.13068	29.0197946	1.79838496	0.15236185	26.5622977	26.2801066	26.9117101	0.23556977
PM18AJ264	E19JL11a025.csv	2.00953784	0.31518771	<7.97	21.6851496	0.36538171	0.19695365	306.884957	2016.78634	1470.02085	0.5516472	<0.126	34.4053656	36.0694463	34.301801	0.67266042
PM18AJ264	E19JL11a026.csv	0.79513251	1.09653719	<8.07	9.69419864	<0.211	0.16187024	229.237423	1684.85106	995.116054	0.07259967	<0.127	28.9969358	29.513499	28.8263884	1.80417241
PM18AJ264	E19JL11a027.csv	0.29791201	0.10211814	<8.94	24.4418562	0.28499792	0.11506233	376.574685	1492.74478	35.4858033	0.18707274	0.25302649	24.5650453	24.3473092	25.0012614	1.91405673
PM18AJ264	E19JL11a028.csv	0.56186552	0.41477179	<8.20	14.8225936	0.77043864	0.05882307	1155.72713	1402.39964	37.5421083	1.14756978	0.51554251	32.7529012	35.1584897	33.1694217	0.70731696
PM18AJ264	E19JL11a029.csv	0.93691502	1.88335128	<8.38	13.497683	<0.219	0.25236381	211.255177	1295.78042	16.9125358	0.40395537	<0.132	16.5332196	16.1523364	16.1614102	0.47942629
PM18AJ264	E19JL11a030.csv	1.51124219	0.66823883	14.6521967	29.2837126	0.79614395	0.27335963	641.67277	2034.45801	60.0570253	1.00244633	<0.111	33.2167222	32.8329425	34.2787858	1.40083206
PM18AJ264	E19JL11a031.csv	3.97004196	2.05155414	<7.56	25.1429401	<0.198	0.26809569	158.780708	1500.19125	18.7456761	0.1287491	<0.118	18.5910124	18.7662448	18.387576	0.70337892
PM18AJ264	E19JL11a032.csv	1.84791057	2.71432734	<9.7	29.581572	0.54500282	0.28605976	409.864118	2107.15049	26.0216398	0.78155514	<0.153	24.0414722	26.6155226	24.0579553	1.88719007
PM18AJ264	E19JL11a033.csv	0.58386003	0.41291237	19.0278974	7.19664247	<0.235	0.06970446	231.628724	1651.50755	56.8667146	0.1367992	<0.142	25.5493535	25.832893	26.602964	0.90917532
PM18AJ264	E19JL11a034.csv	1.70102767	0.37394053	<7.28	22.5395899	0.40520493	0.16181437	213.12227	5844.41797	26.8052057	0.04783652	<0.115	50.7583123	53.3949721	51.4715886	2.75133179
PM18AJ264	E19JL11a035.csv	4.33891331	0.63756345	<8.83	35.2114089	0.51742337	0.34540655	193.704559	6403.90858	37.2778621	0.05546163	<0.14	32.3919345	31.3431329	31.0913298	0.36566874
PM18AJ264	E19JL11a036.csv	1.5018621	2.74751654	11.2744949	17.3043385	1.29367343	0.27463314	1749.09813	1939.21064	25.2275237	0.75945981	0.51105977	24.064966	23.779528	23.6516925	1.60079422
PM18AJ264	E19JL11a038.csv	1.14628915	0.93293454	13.0050063	8.51903504	<0.208	0.18496846	246.060525	1839.13746	1386.49121	0.63065181	<0.126	31.4989713	32.9367351	32.8196542	0.96176499
PM18AJ264	E19JL11a040.csv	3.17186717	1.6680014	<7.52	31.7418447	<0.197	0.3391909	283.138275	1613.3803	17.5037994	0.0872021	0.17414739	37.9568945	41.0594488	38.9320553	1.13116862
PM18AJ264	E19JL11a041.csv	1.72992745	0.28956466	18.9872115	26.3098875	0.38497669	0.19014398	236.68368	4528.8697	38.1497394	0.22473787	<0.116	45.013092	45.5246914	45.2946093	0.40037053
PM18AJ267	E19JL11a140.csv	<0.0148	<0.00803	31.9733952	3.30356546	0.29587745	0.0055771	347.156685	680.076686	171.305405	0.00805477	0.07362675	6.21832836	6.55612345	6.16893175	0.59980908
PM18AJ267	E19JL11a141.csv	0.24107872	0.02068999	<5.51	0.69815569	<0.143	0.05720523	163.699041	838.404317	18.339097	<0.00409	<0.0874	7.33441614	7.81719671	7.97893503	0.32884763

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ267	E19JL11a142.csv	0.04946657	<0.00758	40.1179387	4.4277553	<0.1	<0.00229	165.719383	347.184558	161.629316	0.00975103	0.11828025	6.05721456	6.46073387	6.4398192	0.27103251
PM18AJ267	E19JL11a149.csv	1.04560105	0.01809809	297.862539	2.9069869	0.42599111	0.15037122	362.530977	865.956682	468.169673	0.04471046	<0.0941	10.3039812	10.9458954	10.4367901	1.48591871
PM18AJ267	E19JL11a150.csv	0.20507171	0.01970285	77.0528267	0.55727112	<0.112	0.03424713	160.292586	777.04799	24.9207028	<0.00308	<0.0648	4.80402253	5.03514626	4.85637174	0.26238844
PM18AJ267	E19JL11a152.csv	1.85640771	0.13938003	7.81362755	8.3333918	0.16817911	0.46918996	128.796535	424.622446	17.5918125	0.01059092	<0.061	8.46520144	8.02681901	8.29346198	19.7391429
PM18AJ267	E19JL11a154.csv	59.9617379	0.37270506	26.4918969	308.630261	0.27397845	0.49680519	350.706277	837.537583	158.145565	0.27965284	0.1432082	11.0365517	10.8057986	10.3280489	4.36539047
PM18AJ267	E19JL11a155.csv	0.43180811	0.03483537	6.48555945	3.62184412	0.336637	0.04358427	317.469345	1168.69924	444.503219	0.01932564	0.06452455	7.46072502	8.15571224	7.83616128	0.36172246
PM18AJ267	E19JL11a156.csv	0.10414416	0.0410068	<5.45	0.42989987	<0.142	0.01550707	167.233999	787.312162	<9.07	<0.0039	0.1191429	8.05273001	8.14347135	8.11301559	<0.123
PM18AJ267	E19JL11a157.csv	1.05087387	0.48446815	9.11748116	25.3535823	0.22245745	0.11872427	351.06822	671.986253	344.211921	0.20104015	0.21717765	13.4270147	13.830677	13.1637063	0.17615379
PM18AJ267	E19JL11a158.csv	0.12128002	0.0333741	28.6366344	0.37646802	0.55204248	0.01365842	803.096013	418.994954	13.9355186	0.01081902	<0.0776	5.83934329	5.83307407	6.1224272	0.18122519
PM18AJ267	E19JL11a159.csv	1.55303435	<0.0117	544.484729	11.5496382	4.79668641	0.15663647	2481.48346	799.488751	99.7702273	0.07081993	0.6459592	8.72074597	8.41526359	8.16119563	0.30080793
PM18AJ267	E19JL11a160.csv	0.99204716	0.01757079	9.7542162	7.62592991	<0.129	0.16727843	177.887198	694.309228	439.421424	0.00474773	0.09446187	9.86850519	10.6209678	10.4159362	0.34653894
PM18AJ267	E19JL11a161.csv	0.05262276	<0.00914	57.9938623	0.74955405	<0.121	0.01816496	166.839846	289.813934	139.766608	0.02845422	<0.0703	3.29862523	3.83422074	3.511984	<0.107
PM18AJ267	E19JL11a162.csv	0.04072777	<0.00773	40.2292879	0.56786532	<0.102	<0.00232	195.509785	286.712567	18.679663	0.01041308	<0.0605	3.35054797	3.50937097	3.20223219	<0.0905
PM18AJ267	E19JL11a163.csv	<0.0205	<0.0112	113.108861	0.45985771	0.21606564	<0.00337	515.536578	588.702255	251.860164	0.02719356	<0.0847	4.63074447	4.37843154	5.01274205	<0.127
PM18AJ267	E19JL11a164.csv	0.52914224	<0.0135	15.073814	7.44975885	0.54806781	0.05014933	221.847384	792.939649	396.166246	0.07723259	<0.104	13.630463	14.8298928	14.0556575	0.48174808
PM18AJ267	E19JL11a165.csv	0.14978621	0.08340894	82.678843	0.43463207	<0.124	0.02260126	213.080565	593.656467	495.424904	0.0374384	<0.0732	9.15340374	9.30950838	9.18898942	0.1403457
PM18AJ270	E19JN26a185.csv	0.2108152	0.02446804	<3.20	0.17551231	0.10529378	0.01993987	219.66663	3140.8627	<7.18	0.11855162	0.23883821	7.31249304	7.22162507	7.25095344	4.49399721
PM18AJ270	E19JN26a186.csv	1.31181285	0.11931447	<3.20	1.70299951	0.29341571	0.29425071	229.131437	3585.13065	<7.16	0.87676933	<0.0552	5.37942402	5.51514607	5.48318447	2.15427659
PM18AJ270	E19JN26a187.csv	1.38456594	0.08940797	<3.20	3.17876391	0.22308002	0.16900284	272.254602	6237.54607	<7.17	0.14951355	0.06881029	5.31521512	5.37479029	5.20393615	3.43343673
PM18AJ270	E19JN26a188.csv	<0.0111	<0.00631	<3.47	0.2379925	<0.105	0.00478652	222.015029	2156.73706	<7.78	0.00870371	0.30860729	61.7042532	62.6089107	62.9196575	8.55251215
PM18AJ270	E19JN26a189.csv	0.51347258	0.06936305	<3.20	0.16471509	0.11687629	0.14676711	262.02627	2825.4361	<7.17	1.40806525	<0.0552	12.3113596	13.2231051	12.7993209	4.17785191
PM18AJ270	E19JN26a190.csv	<0.0109	0.01009448	4.54913757	<0.00227	0.20919436	<0.00165	287.27427	3659.43917	<7.68	0.72832663	0.37050192	32.1810564	33.2309207	32.7692229	3.96743992
PM18AJ270	E19JN26a191.csv	4.16124629	1.09861329	5.52107612	9.66567168	0.11959887	0.36890857	297.147036	2453.0617	<7.76	0.0166347	0.18062174	44.2739685	46.1816605	46.1727545	8.67951097
PM18AJ270	E19JN26a192.csv	8.25440412	1.5302422	9.58787337	17.3220831	0.19711139	0.83371623	355.820582	3111.79666	872.076321	0.23256031	0.17253209	42.6339364	43.8745969	43.3324906	5.69391492
PM18AJ270	E19JN26a193.csv	2.49104328	1.00746134	<3.41	10.132936	0.26769584	1.03219461	347.592278	3658.52778	11.4026162	0.50240266	<0.059	31.6741136	32.5794422	32.21528	6.32536995
PM18AJ270	E19JN26a194.csv	1.83967561	0.45695184	<3.18	7.56233858	0.10463933	0.12781511	575.456341	2028.44361	8.31859591	0.39615729	0.86612686	2.51062378	2.36529627	2.38297372	2.19601418
PM18AJ270	E19JN26a196.csv	0.02391789	0.02486517	3.61827929	<0.00228	0.36386365	<0.00167	404.389435	789.617634	8.46809008	1.13844371	0.34356015	21.7926294	22.4829776	22.9656098	13.731396
PM18AJ270	E19JN26a197.csv	1.1338176	0.02034099	<3.35	2.70328138	<0.102	0.07809087	163.007485	3592.58983	<7.53	0.0120434	0.10427344	12.0303931	12.2203071	11.9136519	6.78039054
PM18AJ270	E19JN26a198.csv	0.35434558	<0.00594	<3.25	2.65268855	0.24710817	0.04724013	425.666202	10094.1236	<7.32	0.00817681	0.32060684	4.68162272	4.74733445	4.68365586	2.65058457
PM18AJ270	E19JN26a199.csv	0.09269054	<0.00606	<3.31	0.0307925	<0.101	0.05048151	137.185596	2409.33781	<7.46	0.01908001	0.10316315	20.8716705	21.6434222	21.1955096	3.01908693
PM18AJ270	E19JN26a200.csv	<0.0111	<0.00635	<3.47	<0.00228	<0.106	<0.00168	279.926213	1742.46781	<7.81	0.07243217	0.25845944	11.1155262	11.5073615	11.3072008	5.85709739
PM18AJ270	E19JN26a201.csv	0.02918613	<0.00595	<3.24	<0.00213	0.13075608	<0.00158	216.009041	4452.84064	<7.31	0.09936415	0.0697116	24.8718148	25.2826192	25.6758152	3.45367869
PM18AJ270	E19JN26a202.csv	0.44888898	0.04392049	<3.16	0.57112659	0.12353648	0.05915342	298.935063	3793.61972	<7.12	0.30188863	0.09841035	2.72518849	2.68267214	2.78088152	1.45301317
PM18AJ270	E19JN26a209.csv	<0.0106	<0.00603	<3.28	0.00883852	<0.1	0.00224513	175.84556	3768.37338	9.72242791	0.04374891	0.18154073	31.8524865	32.5134731	32.2633945	3.1387275
PM18AJ270	E19JN26a210.csv	0.81403927	0.69178152	<3.42	2.17532486	<0.105	0.15150688	170.597592	1631.67442	9.49862124	<0.00263	0.1566521	9.22012521	9.1148286	9.05139477	8.60209922
PM18AJ270	E19JN26a211.csv	5.65081287	0.67125799	<3.57	18.7239275	0.36780667	0.47889033	292.389265	4031.80939	14.5981774	0.08667184	0.18091819	29.4001329	30.5418243	29.2285857	7.05176092
PM18AJ270	E19JN26a212.csv	<0.0111	<0.00632	<3.43	0.00244081	<0.105	<0.00168	166.149024	1880.77438	<7.77	0.04578974	0.37281813	11.3588556	11.3389292	11.203648	13.6828389
PM18AJ270	E19JN26a214.csv	3.58813505	1.1888747	<3.22	11.4684665	0.1944906	0.28800326	397.718568	2018.58976	12.728946	0.2771138	<0.0561	5.81953106	5.8810479	5.68049244	6.31996281
PM18AJ274	E19JN25a198.csv	1.19522567	0.26076118	4.11876379	9.48541745	0.79681877	0.43032476	324.98202	3326.43568	18.925433	0.72276836	0.54440924	16.4084767	15.9353763	14.8591597	19.150934
PM18AJ274	E19JN25a199.csv	0.21852827	<0.00616	<3.46	3.76009705	0.33736904	0.0120939	118.345147	6555.35009	17.6333958	0.20672318	0.31162871	57.5517448	59.9728554	57.8612745	24.8599124
PM18AJ274	E19JN25a200.csv	0.64116003	0.06664228	5.15924364	7.83225968	0.34332027	0.12566859	335.29709	6109.51184	12.7875006	1.14337426	0.75888859	14.7050706	14.0494666	13.4343941	17.674557
PM18AJ274	E19JN25a201.csv	2.33871597	0.01527906	4.33076449	26.4108536	0.62805628	0.30326605	798.929863	2309.46854	23.7264154	0.6715913	2.21377381	9.2474776	7.36849271	7.07590659	7.61049571
PM18AJ274	E19JN25a202.csv	2.78196891	0.03932688	<3.21	19.6505059	0.09610112	0.47720115	617.557425	692.722067	<6.67	1.37817432	1.65935755	5.16286797	1.53781198	1.24207164	3.57719039
PM18AJ274	E19JN25a203.csv	1.67328774	0.02484247	5.28087009	21.343977	0.72543106	0.09503479	777.500333	2965.28772	19.0941482	0.56977862	1.48676947	8.00784829	6.97890452	6.55448665	9.21730224
PM18AJ274	E19JN25a204.csv	1.49700858	0.01956882	31.2716958	23.487106	0.32384525	0.22444351	575.051116	1642.8072	165.87414	1.26248264	1.87174999	5.27645864	4.51545938	4.30158361	14.0649091
PM18AJ274	E19JN25a205.csv	1.61004797	0.02498071	<3.30	19.4391793	0.289811	0.29238194	332.511058	4627.69742	12.0471043	0.36624276	0.96020025	15.5734486	13.1740366	12.4285285	9.81780155
PM18AJ274	E19JN25a206.csv	1.14974919	0.71168643	<4.01	6.38425288	0.21962676	0.09663272	158.529037	7665.66011	<8.30	0.15362005	0.50224249	59.0207446	60.0452502	59.6242381	41.2258391
PM18AJ274	E19JN25a208.csv	27.8809519	0.79381822	8.83176607	258.201159	0.09723224	4.08541235	195.288452	3854.62686	485.689526	0.1258112	1.9084096	22.6232217	15.7017493	15.0171353	4.88032857
PM18AJ274	E19JN25a209.csv	4.38981927	0.51183177	7.10297051	45.2535232	0.22627863	0.89716552	618.914844	1936.38047	40.0174328	1.83986723	1.31164131	7.64547416	6.46118769	6.26231644	4.022568
PM18AJ274	E19JN25a210.csv	0.12917227	<0.00705	<3.87	3.20516245	0.35502735	0.02895919	668.812184	1869.70204	13.7163265	0.42001988	1.54249299	3.45681049	2.26494567	2.34629749	5.61771979
PM18AJ274	E19JN25a211.csv	0.25998486	<0.00582	<3.20	3.28102935	<0.0952	0.1204535	550.973192	1263.67769	<6.66	0.80011211	0.67438986	8.00341359	6.51937258	6.07610514	3.4155969
PM18AJ274	E19JN25a212.csv	0.10432491	<0.00592	<3.25	1.21842617	0.12176844	0.01224996	217.836219	1579.19762	<6.74	0.09499925	0.6889863	31.3534598	31.1166213	31.1038418	26.4092847

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ274	E19JN25a213.csv	0.05008244	0.02421008	5.87422819	1.07127521	0.42526898	0.01316262	643.173777	1401.33652	11.3138461	0.89189322	1.62823867	3.36723129	2.52015799	2.36057257	7.50621151
PM18AJ274	E19JN25a214.csv	0.06312567	0.01314859	<4.07	2.09221602	0.21862795	0.02534064	654.461181	893.352529	<8.55	2.47156724	1.12958366	2.56312058	1.15949435	1.16728231	3.59831508
PM18AJ274	E19JN25a215.csv	0.52161313	0.01434049	<3.22	13.7832472	0.32132578	0.07338662	469.905486	2487.82343	10.3880125	0.82063739	1.26159932	7.37517593	5.64366065	5.38228907	7.95607183
PM18AJ274	E19JN25a216.csv	0.53268476	0.06016433	7.20727591	5.17125685	0.19132285	0.11615211	912.732639	1042.70842	11.9223982	1.13733295	1.76261522	4.52371973	3.90026602	3.71585627	4.41173174
PM18AJ274	E19JN25a217.csv	6.20366031	0.10151375	4.626396	143.635773	0.56131819	0.24924894	529.745151	2314.16392	13.7310401	1.01302583	1.22776976	7.48221518	3.83870986	3.4528983	6.98117004
PM18AJ274	E19JN25a218.csv	0.12990589	0.02746433	<3.24	2.90159439	0.45994482	0.03517773	358.842102	3946.93951	9.31987618	0.31255555	4.8439314	15.7616604	16.4498769	16.0735296	19.539966
PM18AJ274	E19JN25a219.csv	5.35981079	1.41274029	20.8455858	112.371619	0.41744915	0.21714826	487.420204	3115.18073	29.4987519	0.84173243	1.2545799	10.615489	7.84726315	7.38113051	8.52521921
PM18AJ274	E19JN25a220.csv	32.3446304	0.67763124	34.5467331	647.023175	0.41049991	0.37927368	514.273964	2484.58601	342.697675	1.55160584	1.60375991	20.0900061	17.2495556	17.0747639	11.5013723
PM18AJ275	E19JN26a428.csv	1.50443848	<0.00644	<3.11	6.10379459	0.13878303	0.07882444	253.984552	2086.41264	10.0618657	0.12422866	8.40009393	15.9821207	17.0307931	16.5906625	12.3279794
PM18AJ275	E19JN26a429.csv	0.80661622	0.0151416	<3.24	3.73631294	0.26248979	0.03475665	273.518265	2426.82099	9.35572254	0.00878094	1.43372022	61.763806	63.6725368	62.9198545	7.00496417
PM18AJ275	E19JN26a430.csv	<0.012	0.00939808	<3.20	0.0074491	0.16341359	<0.00189	113.371697	1362.11827	<7.51	0.01212835	1.760075	62.2709621	66.81067	64.1722761	6.88122084
PM18AJ275	E19JN26a431.csv	0.02307689	<0.00655	<3.16	0.08829473	0.21527535	0.00201683	484.74835	830.088517	11.2235783	0.04408095	1.95020516	38.1199723	39.6863364	38.8503365	9.81737788
PM18AJ275	E19JN26a432.csv	0.70750867	1.43066746	<3.19	4.40620632	0.44443801	0.07391501	811.041174	1540.7894	<7.49	0.01209729	3.65292483	28.9252118	30.5483382	29.1626387	4.51162108
PM18AJ275	E19JN26a433.csv	0.52798672	0.19844856	<3.13	2.52634485	0.7532646	0.10338458	407.104454	5716.11944	7.46705427	0.07185587	0.66922742	73.4754887	77.3466122	75.1518895	7.7725817
PM18AJ275	E19JN26a434.csv	0.13886822	0.15527454	<3.18	1.45131857	0.3884674	0.01513449	273.323381	5101.5831	<7.48	0.02285719	1.22524977	61.1840957	63.0399242	62.6784181	7.40599193
PM18AJ275	E19JN26a436.csv	<0.0119	<0.00661	<3.20	0.06473908	0.26101681	0.00202793	198.238468	1521.84701	<7.52	0.0305796	0.92835475	44.8727071	46.113149	45.2740292	6.37153985
PM18AJ275	E19JN26a437.csv	<0.0157	0.02489325	<4.13	<0.00192	<0.142	0.00287698	115.764829	1224.67813	<9.7	0.0084756	5.17440977	17.6536505	19.7718772	18.7204606	17.6242227
PM18AJ275	E19JN26a438.csv	0.2610972	0.15403693	<3.07	1.33069747	0.35203504	0.05348973	618.661994	1631.94457	<7.24	0.13458114	1.24769958	57.3420549	59.244367	58.1795864	4.38958515
PM18AJ275	E19JN26a439.csv	1.74765607	0.61887875	31.7753477	8.6391773	0.19169883	0.06523943	267.921016	1962.15806	1723.90818	0.06151822	1.77309713	54.4633702	58.1016881	55.9721248	11.1021934
PM18AJ275	E19JN26a440.csv	1.12377778	0.43486741	<3.21	13.8321005	0.66890743	0.05333133	306.825381	7089.68505	<7.57	<0.00246	1.68415016	54.3494173	55.2808948	55.9162944	6.21254596
PM18AJ275	E19JN26a442.csv	0.23393497	0.59079359	<3.15	3.51963454	0.14263083	0.01570708	176.591149	1464.03108	9.95361211	0.00482148	1.66669195	60.543153	62.5125175	61.9758027	5.68348976
PM18AJ275	E19JN26a443.csv	1.09205619	0.67649166	<3.65	4.659056	0.17223436	0.03606313	135.836264	1118.12449	8.85661667	0.01398455	1.2899498	65.3285928	67.7232638	66.1626014	5.28629216
PM18AJ275	E19JN26a444.csv	1.61583949	0.26203084	<3.23	14.2460493	0.77045156	0.14541194	277.575291	5965.94417	12.7472298	0.01583192	1.03950108	60.091042	62.6323623	61.679753	8.26478759
PM18AJ275	E19JN26a445.csv	1.0577872	0.30778092	<5.49	5.9351531	0.36157939	0.05385816	320.298059	1534.10806	<13.0	0.1133164	0.62402339	50.2383199	53.5062282	52.0892432	9.82562657
PM18AJ275	E19JN26a446.csv	0.06324841	0.60256641	<3.48	0.28093442	0.27488137	0.01928065	231.838386	1567.49367	<8.24	0.10156094	0.5792785	49.3798946	49.2035737	49.3860668	13.8032258
PM18AJ275	E19JN26a447.csv	1.52209509	0.79549101	10.1848838	18.4454692	1.28816357	0.08556819	712.047766	2903.1153	8.14714757	0.06234033	1.96655999	45.38274	46.5465882	46.3956288	13.4751901
PM18AJ275	E19JN26a448.csv	0.37670991	0.03441468	<3.12	1.64683943	0.27127302	0.02826931	292.121947	1713.7791	13.9138476	0.0222778	1.09955579	67.7274047	69.3236856	68.4146802	10.679409
PM18AJ275	E19JN26a449.csv	0.02891865	0.00841956	<3.32	0.12277233	0.36169277	0.0099387	307.791044	1697.28916	<7.87	0.00279479	8.23533078	50.4080179	51.6538258	51.3586379	3.98691989
PM18AJ275	E19JN26a450.csv	0.02840217	0.00914017	<3.16	0.27377792	0.45435441	0.01032759	334.611493	3114.85625	8.81076837	0.05786144	4.35756524	66.7439488	67.692528	67.1537406	2.54731419
PM18AJ279	E19JN26a241.csv	0.45785922	<0.00584	3.93219971	1.35242335	0.52855483	0.26994311	460.549287	2192.36778	25.9375847	0.72960537	0.35606289	28.8642656	29.5422986	28.8685425	0.85283206
PM18AJ279	E19JN26a242.csv	0.0172222	<0.00583	<3.08	0.05599182	0.35657551	0.00572576	373.241059	3178.26449	12.4390444	0.52595076	0.52211928	23.3262591	23.8375268	23.6063515	0.95605229
PM18AJ279	E19JN26a243.csv	<0.0165	<0.00934	<5.03	0.05832101	0.25162712	<0.00251	198.071117	1680.40298	<11.6	0.04113854	1.56242542	10.1630032	9.54343021	10.5406021	0.14130981
PM18AJ279	E19JN26a244.csv	0.05539828	<0.00586	<3.09	0.03754177	0.39340249	0.01591367	240.772542	3029.24012	13.408071	0.23744108	0.40249028	15.9345803	16.2351097	16.3345013	0.59915864
PM18AJ279	E19JN26a245.csv	0.20455954	<0.00577	<3.03	0.05120643	0.1291727	0.09643615	255.627738	1311.4032	<6.99	0.62854229	0.47059238	8.38740426	8.70623582	8.49149571	0.12746974
PM18AJ279	E19JN26a246.csv	2.38885941	0.37153894	<3.20	22.7216546	0.24683372	0.3470097	248.362136	2080.03884	19.8962708	0.46080155	0.25191894	31.6057975	32.0013039	31.6612426	0.99194178
PM18AJ279	E19JN26a247.csv	2.18330614	0.30957064	14.9281204	20.8208999	0.39837734	0.33222021	256.193527	1642.93049	1194.37412	0.50635256	0.22704154	29.7283393	31.0945343	29.5938116	1.07643112
PM18AJ279	E19JN26a248.csv	3.78338872	0.36479351	<3.39	38.3079765	0.50073164	0.2748162	223.039474	3211.18035	222.513797	0.12201903	0.32139522	37.2392094	38.8782111	37.6288082	1.79461987
PM18AJ279	E19JN26a249.csv	0.10827347	0.05760779	<3.03	0.42889791	0.1720754	0.09799604	341.11975	1341.94766	<7.00	1.16772045	0.15667025	19.158038	19.1101305	19.1649266	0.09848979
PM18AJ279	E19JN26a250.csv	0.92484358	1.48916286	<3.41	2.50390045	0.33043803	0.24874538	234.992608	2000.26572	9.7881658	0.15984494	0.23770161	32.8942733	36.2414566	33.8444945	1.1605724
PM18AJ279	E19JN26a251.csv	0.08869997	0.17762014	<3.96	0.77628509	0.13077024	0.06023569	227.833849	4307.0685	<9.14	0.04687908	0.41283406	28.1748046	28.6416042	29.0964928	0.9872291
PM18AJ279	E19JN26a252.csv	<0.0112	0.00891681	<3.32	0.01326245	0.14635627	<0.0017	178.280699	1706.47262	<7.67	0.07288288	0.52353145	15.4420268	16.2181954	15.7145922	0.70097711
PM18AJ279	E19JN26a253.csv	0.05418009	<0.00609	<3.18	0.10270327	0.14674918	0.02263001	183.033477	2088.42745	<7.35	0.08460378	0.77892586	15.7536934	16.6595915	16.0580503	0.56963613
PM18AJ279	E19JN26a254.csv	0.09986834	0.02039841	<3.23	0.18125335	0.22752627	0.02781414	236.91777	2564.27791	8.35943171	0.05870728	0.91715274	24.1174998	24.4221622	24.1851425	0.75869668
PM18AJ279	E19JN26a255.csv	0.10004085	0.05838669	<3.34	0.54642413	0.29824284	0.03404352	230.592386	3184.04212	<7.72	0.05116551	1.59195066	22.5827973	23.4312989	22.645392	0.48495311
PM18AJ279	E19JN26a256.csv	<0.0105	<0.00597	<3.11	0.1113976	0.11771615	0.0021266	158.526887	1674.64327	<7.19	0.11716016	0.4388978	10.0022399	10.5363434	10.1035225	0.30321468
PM18AJ279	E19JN26a257.csv	0.02171608	<0.00624	<3.24	0.01514382	0.20398418	0.02142419	497.163295	1348.4473	<7.49	2.10337541	0.17644758	11.8861714	12.4190208	12.3518908	0.13503905
PM18AJ279	E19JN26a258.csv	0.05237298	<0.00767	<4.01	0.06011114	0.41055943	0.01127435	273.004763	6018.90979	<9.29	0.08777074	0.35088894	31.3596163	33.1083872	32.3714623	0.16557192
PM18AJ279	E19JN26a259.csv	0.06205576	<0.00769	<4.04	0.08931699	0.13109003	0.01362419	349.889935	1939.54731	<9.36	0.03755173	0.75451033	15.9047257	16.8510588	16.1348359	0.55849278
PM18AJ279	E19JN26a260.csv	0.77760081	0.00689193	<3.37	4.1445584	0.43372648	0.22344374	434.242191	2099.51259	<7.80	0.87850913	0.33618038	25.4387935	26.6116547	26.2801774	0.42369692
PM18AJ279	E19JN26a261.csv	0.01200555	<0.00602	<3.12	0.01717111	0.15067933	0.00732112	341.294058	1833.78796	<7.24	0.99646098	0.44195914	19.1641049	19.7703879	19.3193967	0.55324565
PM18AJ279	E19JN26a262.csv	0.13713317	<0.00615	<3.19	0.51937883	0.23985375	0.02788648	287.526342	2731.12703	8.0953784	0.06775707	0.70545809	23.0428662	23.4033117	22.7716865	0.60769165
PM18AJ279	E19JN26a263.csv	<0.0114	0.00997591	<3.36	0.06900797	0.36247408	0.00643023	634.678833	2557.22171	80.4190723	0.42154118	1.03898228	19.277738	19.8656522	19.8340363	0.20551594

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ279	E19JN26a265.csv	0.10737127	0.06017215	<3.15	0.42123393	0.15234078	0.03648144	193.388982	1377.08136	<7.30	0.17063756	0.39898152	30.9542026	30.9095736	31.0720093	1.51765134
PM18AJ281	E19JL11a020.csv	0.28380757	1.55423247	<7.38	0.42283742	<0.191	0.17949417	247.617608	2094.7271	<12.8	0.17457489	<0.116	23.456344	23.6381207	23.8287772	1.55557383
PM18AJ281	E19JL11a021.csv	0.50066197	2.41345483	<7.51	1.38427088	<0.195	0.21530227	282.066644	1364.09295	<13.0	0.08060256	<0.118	5.76929689	5.73085105	5.61185015	1.81146997
PM18AJ281	E19JL11a052.csv	11.4178625	0.24220317	274.349049	99.0114682	0.68952399	0.66998624	1184.37274	2239.32462	22.8959943	0.08549059	0.72488937	14.9736524	15.0152874	14.5919662	2.89757851
PM18AJ281	E19JL11a053.csv	0.6990002	3.15339467	38.0214108	4.07923032	<0.0916	0.39721652	244.794181	1406.48998	791.312147	0.08596024	<0.058	13.3307886	13.7095956	13.2113807	1.77054954
PM18AJ281	E19JL11a054.csv	0.84997905	0.82150058	179.332571	2.87403985	0.15142465	0.09507429	438.868118	1240.92845	50.6032494	0.20438988	<0.0683	7.10350908	7.32386932	7.38020597	2.6356653
PM18AJ281	E19JL11a055.csv	14.2466063	2.27471189	197.296587	87.8129891	<0.0895	0.48248684	426.059215	2115.42119	119.661986	0.40193479	0.36205612	14.0854534	13.8195936	13.6989578	1.60730913
PM18AJ281	E19JL11a056.csv	0.05032398	0.03315359	<5.49	0.27089426	<0.137	0.00382814	574.70522	1787.86555	12.7519666	0.1095718	0.35302026	5.77153307	6.61479261	5.91480958	0.96509695
PM18AJ281	E19JL11a058.csv	0.16943907	1.47422186	<3.46	0.54925432	<0.0858	0.15259779	139.823372	2670.86623	<5.97	0.05726998	0.20376771	19.8489734	20.1695407	20.2685113	0.85322274
PM18AJ281	E19JL11a059.csv	0.35817844	1.76435732	<4.40	0.35164716	<0.109	0.12998389	147.274418	1380.57864	<7.60	0.12227904	0.10927164	12.2500746	13.0051698	12.0898465	0.48674333
PM18AJ281	E19JL11a060.csv	5.46720799	0.64604995	17.912999	39.5188472	0.38794679	1.99241225	339.308481	3748.08481	63.2737153	0.05140575	0.79776803	12.6712702	13.7084512	13.1729212	2.95993084
PM18AJ281	E19JL11a061.csv	0.04529825	0.24343746	<4.85	0.02605701	<0.12	0.0821745	232.831859	1409.54346	<8.36	0.02035316	0.36466191	4.07428795	4.12979168	4.38525344	0.41311592
PM18AJ281	E19JL11a062.csv	0.58258543	2.87218724	<3.61	1.24571454	<0.0895	0.18517187	308.536059	1305.84647	<6.23	0.07328418	0.15223003	9.35414217	9.04212825	9.32488928	0.55070097
PM18AJ281	E19JL11a063.csv	0.13795827	1.60062178	<3.39	0.1743004	<0.0838	0.12853713	153.402801	1325.21768	<5.83	0.14346768	0.11261906	15.1817907	15.1245957	15.5097082	0.38164278
PM18AJ281	E19JL11a064.csv	0.17171392	2.00628982	<3.44	0.65073607	<0.0851	0.16950261	187.118464	2048.76358	<5.93	0.03954112	0.40312787	14.789295	15.6130855	15.1999183	0.79021948
PM18AJ281	E19JL11a065.csv	0.06862171	0.39211549	<3.69	0.00464563	<0.0912	0.03472312	289.535813	1184.2204	<6.35	0.07502759	0.09227176	4.36282051	4.44581376	4.6289626	0.25931789
PM18AJ281	E19JL11a066.csv	8.56886792	0.09566652	<3.77	50.9967137	0.24777438	0.26010685	317.353185	2331.62509	80.0725793	0.40246993	0.07290252	9.7264101	10.3750065	9.92564424	2.28934664
PM18AJ281	E19JL11a067.csv	16.3105699	0.25491915	26.5581222	131.589486	0.17500744	0.49508582	356.829755	2276.91178	13.8925219	0.32128921	0.07354746	19.166996	19.6137319	19.0802527	4.68871674
PM18AJ281	E19JL11a069.csv	19.8392068	0.16854115	16.3574854	186.005066	0.09453358	0.45054647	182.674106	2008.73672	9.03777297	0.0394392	<0.056	13.8066503	14.3520151	13.8024037	1.68638882
PM18AJ282	E19JN26a102.csv	0.01674184	0.01795005	<3.31	0.0203831	<0.103	<0.00148	152.988901	465.403856	<7.43	0.41572941	<0.0567	2.58439797	2.56373667	2.43497191	<0.0664
PM18AJ282	E19JN26a103.csv	<0.0151	<0.00871	<5.06	0.03837244	<0.157	0.00562653	185.118448	1027.04274	<11.4	0.09748263	<0.0868	4.16491021	3.46540414	3.92935459	<0.099
PM18AJ282	E19JN26a104.csv	0.04943028	0.02138977	<3.52	0.15709666	<0.11	0.00909991	272.594544	1526.48151	<7.90	0.02141901	0.29457929	10.8267165	11.5622695	11.3013813	0.099328
PM18AJ282	E19JN26a105.csv	0.67898338	0.07920137	<4.84	4.98783282	<0.15	0.06773433	192.398124	991.876297	16.4256673	0.08972114	0.21621012	4.8839323	4.88908409	4.97426308	0.17502911
PM18AJ282	E19JN26a106.csv	0.10279103	0.08370881	3.75015117	1.12594921	0.15962306	0.01648101	426.472245	1339.26146	70.7505494	0.1866188	0.10563593	3.86606762	4.23948003	4.08678214	0.14335692
PM18AJ282	E19JN26a107.csv	0.03884971	0.03817062	<3.37	0.40542959	<0.105	0.0050871	431.240217	959.324207	30.5444987	0.1369574	0.17267586	4.85105622	5.25955134	5.05578495	0.14685361
PM18AJ282	E19JN26a108.csv	0.56510828	0.81152506	<3.60	1.01644148	0.1246921	0.19055462	304.693867	1040.53339	<8.06	0.0654252	0.15558089	9.89411098	10.5658234	10.5367926	1.11672369
PM18AJ282	E19JN26a109.csv	0.7086192	0.08482377	<3.20	3.82261742	<0.0992	0.11045701	207.328775	1200.84568	<7.17	0.07158459	<0.055	6.59725988	6.98698892	6.73485512	0.29008858
PM18AJ282	E19JN26a110.csv	0.66341516	0.09637584	5.89018029	2.20304748	0.19731142	0.0926034	731.405876	1447.99451	107.638121	0.21511737	0.24581323	6.25335296	6.41974581	6.41636567	0.19722418
PM18AJ282	E19JN26a111.csv	2.2109225	1.17345754	3.33280028	9.71816223	0.26469148	0.29491981	509.604052	3240.54534	10.1534094	0.39755614	0.08349561	8.15965211	7.98003607	8.06701042	0.12678459
PM18AJ282	E19JN26a112.csv	0.50097263	0.02371254	<3.10	1.74636093	<0.0958	0.44689761	106.54421	614.825998	<6.94	0.69938067	0.08193918	2.82887023	2.98503254	2.64957519	<0.0596
PM18AJ282	E19JN26a113.csv	0.95190638	0.20486714	8.34200118	8.14479741	0.22486559	0.10552537	473.860112	2394.06856	229.137605	0.17105095	0.15091903	13.4727717	13.5611429	13.5706156	0.73936486
PM18AJ282	E19JN26a114.csv	0.11609954	0.01380178	<3.04	0.71858062	<0.0938	0.00985197	164.175406	2235.2783	<6.80	0.04343939	0.12437812	3.89728803	3.95674044	3.96385101	0.10327234
PM18AJ282	E19JN26a115.csv	<0.00972	0.00945226	<3.17	0.0165258	<0.0977	<0.00144	268.268736	1360.33022	<7.08	0.02486962	0.0990134	5.21815836	5.40351996	5.27755477	<0.0601
PM18AJ282	E19JN26a116.csv	0.09987406	0.01453921	<3.16	0.34896097	0.11032524	0.01545994	285.574025	1866.34004	<7.07	0.13424499	0.39198655	6.77301604	6.5402187	6.86954366	0.08940775
PM18AJ282	E19JN26a117.csv	1.04867737	0.16467028	35.2240211	6.54885945	<0.106	0.06271624	251.926433	1191.34041	<7.70	0.01746569	<0.0597	12.9063287	13.7454564	13.1185307	0.12068896
PM18AJ282	E19JN26a118.csv	11.0222666	0.64376558	49.7476572	49.8415032	1.06074768	0.58018681	1908.5971	2947.62836	18.9068629	0.27039088	0.84574434	14.8758908	14.5447504	14.9493915	0.69340592
PM18AJ282	E19JN26a119.csv	0.54723135	0.37879975	5.27381227	2.04373665	0.12790607	0.12628692	580.056237	1289.84075	75.8076216	0.26597425	0.30546053	13.4461061	13.891201	13.5490761	0.48397069
PM18AJ282	E19JN26a120.csv	0.08953177	<0.00784	<4.45	0.67777589	0.14176196	0.0175832	329.67759	3304.30872	<9.9	0.03333574	0.34531055	8.84050616	9.21865361	8.62461218	<0.0839
PM18AJ282	E19JN26a121.csv	1.11820247	0.05563738	<3.27	5.2481847	<0.1	0.0625366	271.149734	3835.00466	<7.31	0.01165865	0.13395252	10.5727313	11.081471	10.801197	0.50945023
PM18AJ282	E19JN26a122.csv	0.20953514	0.03358035	7.36036112	0.74346002	0.4550041	0.03011979	1134.89343	1921.66266	12.1575986	0.08117138	1.46441806	10.1397075	10.3035236	10.9904204	0.29735153
PM18AJ282	E19JN26a123.csv	0.08677338	0.03835181	13.8847675	0.45347925	0.96129994	0.00506678	1936.94225	2455.99769	29.8278045	0.06446698	0.69798953	14.5668405	14.8666826	14.7264093	0.54176967
PM18AJ282	E19JN26a124.csv	1.48094066	0.01963412	<3.22	8.29287733	0.22168166	0.372494	294.064804	3982.26774	<7.19	0.05984807	<0.0555	7.73199713	7.92702163	7.59604923	0.21666814
PM18AJ282	E19JN26a125.csv	1.18930627	0.02421787	<3.17	8.65389344	0.21429469	0.15645894	265.052294	2111.20185	9.81907155	0.04863107	0.23669423	9.38094852	9.34285708	9.10604405	0.14133241
PM18AJ283	C19AU08C309.csv	0.26200676	0.22293412	<3.18	0.81394185	0.27876306	0.04468819	221.431082	958.82419	<5.49	0.06625339	0.50767292	9.21655695	<0.0138	0.04694055	0.50266499
PM18AJ283	C19AU08C310.csv	0.31444763	0.07947259	<3.26	1.80011055	0.39483908	0.02791909	224.14123	1327.19154	94.7120433	0.09811183	0.29746382	10.1294124	0.05956973	0.03300964	1.07970323
PM18AJ283	C19AU08C317.csv	0.4644154	0.13161037	6.37823088	4.5923196	0.95122466	0.05972662	270.466346	2025.8715	21.3173561	0.18055276	0.30102207	12.9361665	0.09375747	0.00508634	1.77948651
PM18AJ283	C19AU08C320.csv	8.45491141	0.77167273	<3.50	30.1640987	0.69335137	0.92213929	382.676722	4185.03784	42.9656565	0.0752046	0.48318775	12.4853502	0.05211016	1.73851334	0.38793035
PM18AJ283	C19AU08C321.csv	0.98248102	0.33150006	3.6270771	3.28243703	0.31693399	0.18333748	191.243298	1974.48994	280.629699	0.02849095	0.20723255	22.6043231	0.05247582	0.04971437	1.23334091
PM18AJ283	C19AU08C287.csv	<0.0106	<0.0038	<3.23	0.02139792	0.32109508	<0.00169	239.363597	1492.08788	21.3654248	<0.00195	0.53591118	7.63055296	0.040537	<0.00246	0.23551019
PM18AJ283	C19AU08C288.csv	0.06870836	0.01231381	<3.20	0.04789713	<0.179	<0.00167	111.95229	442.095677	<5.55	<0.00192	<0.0974	9.77280039	<0.00983	<0.00243	0.38359024
PM18AJ283	C19AU08C289.csv	0.01563297	<0.0037	<3.15	0.0044253	<0.176	0.02536109	287.386947	419.276029	<5.46	0.56889337	<0.0958	6.93114325	0.0140821	<0.0024	<0.123
PM18AJ283	C19AU08C290.csv	0.15036667	0.02058387	<3.77	0.37943794	0.32763764	0.01921625	213.762768	906.01431	<6.53	0.10163875	0.15778088	8.74587108	0.06085895	<0.00287	0.86041437

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ283	C19AU08C291.csv	0.10487987	0.01245053	<3.23	0.36187406	0.34248381	0.0222426	214.594571	951.138214	7.01350269	0.03713781	0.22655171	8.47804488	0.03166543	<0.00246	0.52006309
PM18AJ283	C19AU08C292.csv	0.23854269	0.02767125	<3.12	0.5056609	0.24982625	0.0677056	389.659093	525.551162	<5.39	1.10998996	<0.095	6.12197993	<0.0103	<0.00238	<0.122
PM18AJ283	C19AU08C293.csv	0.08034554	0.02944068	<3.31	0.19158433	1.01022895	0.0150872	328.594408	4260.2692	10.0706483	0.01812169	0.16459433	14.4927579	0.01557045	<0.00253	<0.129
PM18AJ283	C19AU08C294.csv	0.18634662	<0.00381	<3.25	0.14399604	0.22613328	0.03005927	186.349014	742.047203	<5.63	0.03749178	0.18380503	7.57029378	0.02961253	<0.00249	0.54398542
PM18AJ283	C19AU08C295.csv	0.03368438	0.01243209	<3.21	0.02469259	0.21052149	0.0234146	190.059218	979.155396	<5.55	0.02735048	0.203537	5.05353265	0.01304245	<0.00246	<0.125
PM18AJ283	C19AU08C296.csv	0.06023115	0.02212169	<3.45	0.01937653	<0.19	0.01432703	176.308994	866.442157	<5.94	0.01399127	0.32936139	6.40432883	0.01608529	<0.00264	<0.134
PM18AJ283	C19AU08C297.csv	0.72572647	0.06039501	<3.18	2.08619383	0.20037851	0.06302943	312.196328	540.85886	<5.50	0.50885708	0.20151013	9.20787414	<0.0116	0.02821554	0.38365211
PM18AJ283	C19AU08C298.csv	0.06233571	<0.00389	<3.32	0.17514092	0.38309988	0.01125996	256.5434	1930.18495	17.136752	0.04846707	0.346603	13.8747624	0.02102389	<0.00255	0.26414502
PM18AJ283	C19AU08C299.csv	0.05847388	<0.00598	<5.23	0.02365346	0.30603404	0.00812012	175.176154	1614.14407	<9.02	0.03602611	0.83245154	11.9058063	0.03244096	<0.00402	<0.197
PM18AJ283	C19AU08C300.csv	0.01571941	<0.00368	<3.15	0.06053897	0.50138773	0.00328425	250.778782	4012.23437	<5.43	<0.00173	0.54347688	10.9527231	0.06019701	<0.00243	0.29487287
PM18AJ283	C19AU08C301.csv	0.1107175	0.01221397	<3.14	0.12628329	0.30573414	0.00573264	143.857293	929.38187	<5.41	<0.00171	0.32763943	11.8677635	<0.0123	<0.00242	0.3319077
PM18AJ283	C19AU08C302.csv	0.08682177	0.01251654	<3.21	0.16643231	0.18471693	0.00964518	147.463663	837.508329	36.2524615	<0.00174	0.22549845	13.2549774	0.01302129	<0.00248	0.39749119
PM18AJ283	C19AU08C303.csv	0.47465582	0.07722377	<3.20	2.16151073	1.23703733	0.02593152	238.543223	3069.36202	15.1784548	0.00800976	0.33447111	14.0986927	0.25702418	<0.00248	3.31552145
PM18AJ283	C19AU08C304.csv	0.37944473	0.41836576	46.3499334	2.78892215	0.62100919	0.05632608	753.18143	1650.76356	119.963058	0.03847761	0.6286133	14.4570106	0.16276331	0.31779519	1.08120783
PM18AJ283	C19AU08C305.csv	0.22402929	0.09573415	<3.27	1.33796116	0.53506039	0.05097664	219.593446	1057.48558	10.8271004	0.05801681	0.16271256	10.7867371	0.08789083	0.00375742	1.09222951
PM18AJ283	C19AU08C306.csv	0.54281965	0.47031025	<3.77	1.36270382	0.32219387	0.06400875	306.860819	1065.81831	<6.50	0.06114164	0.42390635	11.1062254	0.10336295	0.25107389	1.28381673
PM18AJ283	C19AU08C307.csv	0.31942385	0.01304412	5.11143614	1.53299325	1.02926182	0.03747316	240.838834	2720.81083	17.6508025	0.03878925	0.18818849	21.0684596	0.03586153	<0.00259	0.70610121
PM18AJ283	C19AU08C308.csv	0.02431547	<0.00365	<3.12	0.03409186	<0.173	0.01802895	327.368582	480.994855	<5.39	0.52178438	<0.0965	44.6194887	<0.0134	<0.00244	<0.117
PM18AJ285	E19JL11a167.csv	0.01803851	0.10005526	<3.63	0.00461821	0.33239846	0.01449856	450.207125	923.745743	53.4642472	0.01922929	1.05805886	5.56741934	6.30927167	5.88709632	7.44192731
PM18AJ285	E19JL11a168.csv	<0.0135	0.01090245	9.1954929	0.01182953	0.15587938	<0.00222	808.55075	696.954713	53.5279994	0.00471584	0.49394479	6.77586521	6.61801125	6.69391185	1.67315477
PM18AJ285	E19JL11a169.csv	0.27201775	0.01037248	59.1916466	0.18542079	2.08257886	0.01658773	327.280305	761.242959	397.997976	0.06807049	1.29380677	14.9451103	15.6090127	15.6408671	27.9788149
PM18AJ285	E19JL11a170.csv	0.05958227	<0.00992	36.280243	0.02342548	0.65481875	0.01732909	317.851205	1501.0946	15.9767058	0.0072059	0.87495447	28.971343	30.3059745	30.1232252	10.2401451
PM18AJ285	E19JL11a171.csv	<0.0132	<0.00724	6.10559462	0.01623481	<0.094	<0.00217	789.728248	802.117295	26.6217811	0.01188718	0.78452149	3.95092593	3.92990671	3.87885122	2.99636466
PM18AJ285	E19JL11a172.csv	<0.0128	<0.00696	5.37502338	0.00452968	<0.0904	0.00545958	222.353389	1737.23029	<5.84	0.01517392	0.3700266	9.23512143	9.12334465	9.43285737	1.74044613
PM18AJ285	E19JL11a173.csv	1.63294936	0.0224292	4.02068076	0.6422618	0.66372158	0.48841481	255.173317	1574.6502	10.3676699	0.06614518	0.64654663	14.1617788	14.6178552	14.1813988	8.25548537
PM18AJ285	E19JL11a174.csv	0.05937786	<0.007	3.52240401	0.09418237	0.1297777	0.01306964	96.7461275	506.08192	<5.84	0.00793938	1.04556743	9.54239888	10.1227804	9.90468888	2.00497542
PM18AJ285	E19JL11a175.csv	<0.0221	0.02381022	158.922351	0.03337402	0.71939698	<0.00363	222.463916	829.002319	301.951327	0.0350306	0.64454872	17.6056294	19.1026102	18.1593012	11.8129769
PM18AJ285	E19JL11a176.csv	0.07276646	<0.00757	339.148531	0.02705476	0.61583551	0.00585048	205.006523	1087.26085	16.0900042	<0.00284	1.59437349	9.4643906	9.87723	9.31927365	5.39123702
PM18AJ285	E19JL11a177.csv	<0.0127	0.01015474	3.89786084	0.00439292	0.09814518	<0.00208	125.707424	430.729135	<5.81	0.02868284	0.35369628	11.3050551	11.4880294	11.1670267	2.63421461
PM18AJ285	E19JL11a178.csv	<0.0132	<0.00725	43.6203807	0.04172284	0.85783052	<0.00217	325.568047	1004.06162	165.00414	0.05168694	0.94737561	21.9440448	23.2746318	23.0277787	11.9619163
PM18AJ285	E19JL11a179.csv	0.50504603	0.01077695	68.2844214	0.2029596	0.5670807	0.07314963	370.66065	843.97659	284.121159	0.0931029	1.26741781	25.0630068	25.3242853	25.5579405	17.9726243
PM18AJ285	E19JL11a180.csv	0.09830751	<0.00723	4.28197302	0.02538166	0.21597643	<0.00216	247.463018	651.665604	<6.02	0.00455411	0.83896249	25.2222222	25.8772078	25.4118047	9.66403217
PM18AJ285	E19JL11a181.csv	0.19114351	<0.00723	5.27460886	0.18719508	0.44796574	0.01084541	262.914632	1055.33365	21.0937159	0.01538064	0.92832242	28.6415635	30.1673613	29.5706359	6.66939996
PM18AJ285	E19JL11a182.csv	1.84416131	<0.0098	396.438122	9.57538458	0.40686191	0.06622347	278.930633	860.242974	70.7718241	<0.00377	1.36202877	14.1393794	14.3975837	13.9727869	20.7188127
PM18AJ285	E19JL11a183.csv	0.01866375	<0.00739	<3.64	0.01196727	0.30753193	<0.00221	613.835903	1184.23058	54.0169663	0.00475431	1.93755548	10.0045757	10.3341391	10.0788071	7.33592308
PM18AJ285	E19JL11a184.csv	<0.0154	<0.00847	117.621167	0.07223774	0.25397253	<0.00253	236.39201	591.927747	63.9541327	0.02217889	0.567954	13.1670021	12.4963123	12.4370852	8.00588281
PM18AJ285	E19JL11a185.csv	<0.0131	0.01633631	42.2195899	0.09427749	1.62758757	<0.00216	247.746534	816.382303	264.552354	0.00463806	0.95538606	12.6152534	13.1264567	12.895252	11.9493171
PM18AJ285	E19JL11a186.csv	0.04847543	0.01165322	77.7365625	0.11966294	0.51870325	<0.00305	545.918084	1067.40939	70.0674681	<0.00394	1.19483031	10.3802899	10.2410429	10.4156405	2.42173582
PM18AJ285	E19JL11a188.csv	0.20339166	<0.00832	5.39016224	0.13770226	0.26384319	0.0281951	274.52081	770.339622	7.92850466	0.02431853	4.58144825	10.38182	10.0495985	10.1199561	4.86256176
PM18AJ286	E19JL11a016.csv	0.24241809	<0.0133	<7.13	0.88765313	0.28370002	0.00980536	155.269178	1393.83717	<12.4	0.01748693	0.26491016	37.0036927	38.2480791	37.4343267	0.80629671
PM18AJ286	E19JL11a017.csv	<0.0255	<0.0133	<7.05	0.0140053	0.33764662	<0.00411	259.831218	3056.11953	20.5524372	0.03135242	0.51402717	36.6472403	37.2118248	36.2448933	0.53255449
PM18AJ286	E19JL11a215.csv	5.25247209	0.54751995	12.9439923	20.5995816	0.83370442	0.6075008	203.123511	2982.92882	47.3752342	0.20627082	0.12033782	56.9203554	57.0605486	57.2912837	1.63141086
PM18AJ286	E19JL11a216.csv	5.10699513	0.0854218	19.6144593	17.820775	0.86741415	0.56563395	300.945192	3038.40446	38.1088348	0.27039239	0.2523433	55.3312958	56.5085329	55.2725302	1.2749807
PM18AJ286	E19JL11a217.csv	6.40553045	0.57831737	24.9773138	29.3764128	0.88145308	0.81111865	185.198377	2775.5878	48.7991345	0.22603289	0.17767479	56.8504682	57.4834714	56.5461743	1.57292713
PM18AJ286	E19JL11a218.csv	2.61350321	0.09144971	4.57282947	10.7475649	0.59737997	0.19976793	204.456567	3136.18817	45.6661653	0.02797178	0.10717841	38.6152418	38.5464877	38.7256009	2.90477055
PM18AJ286	E19JL11a219.csv	0.46530206	0.0772985	<3.32	3.76215826	0.13310732	0.04416608	110.379032	1817.41703	19.7933098	0.03588853	0.22104238	15.5450035	15.9801702	15.6773762	0.32742116
PM18AJ286	E19JL11a220.csv	2.76659012	0.29074082	4.86110721	8.34466239	0.24405164	0.23409378	160.648522	1863.4522	180.83027	0.12250686	0.31424852	25.1140646	25.273005	25.7757321	0.51249362
PM18AJ286	E19JL11a221.csv	1.43132423	0.01023341	<3.41	4.90996729	0.18622447	0.08315555	254.93239	3574.31527	255.956854	0.05770628	0.28212609	11.5252335	11.9791917	11.8786632	0.44380969
PM18AJ286	E19JL11a222.csv	7.26752759	0.01694375	<3.94	13.532571	0.18684291	0.61317961	215.659174	3502.25472	14.3958116	0.08455741	0.33969158	22.3848212	23.4095113	22.3030109	0.54022547
PM18AJ286	E19JL11a224.csv	0.09436646	0.02131573	<3.34	0.1199937	<0.0815	0.09203395	163.140756	960.999614	<5.80	0.05980231	0.39009261	3.46000427	3.40616657	3.36566538	0.409036
PM18AJ286	E19JL11a225.csv	3.7174003	0.71977238	15.7625273	14.5815367	0.70353857	0.48112369	873.6462	2254.61925	38.4287867	0.20421605	1.01578168	31.5368388	31.634222	31.7655631	0.85868356
PM18AJ286	E19JL11a226.csv	0.09569604	<0.00723	<3.37	1.65256465	0.199511	0.0629147	349.244395	2130.74793	18.7249281	0.19806757	1.74736837	11.3302431	11.3214396	10.7658524	0.99080379

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ286	E19JL11a227.csv	7.84204945	0.7396382	11.9240083	32.9743956	1.1394225	0.55895993	204.721396	2616.44271	51.5990313	0.41453243	0.21109672	74.0358173	76.1519418	73.7905137	2.37617333
PM18AJ286	E19JL11a228.csv	3.61553299	<0.00694	<3.22	10.3111205	0.21483183	0.39563576	425.369227	1394.71726	21.770533	0.11211675	0.40689242	13.4982615	14.3247786	14.0535061	0.1926875
PM18AJ286	E19JL11a229.csv	0.20678076	<0.00855	4.31702724	1.23959582	0.26839927	0.27566634	349.786211	1865.24545	24.2811476	0.03438194	0.95161308	11.5274669	12.2150721	11.725622	0.43962147
PM18AJ286	E19JL11a230.csv	0.03866833	<0.00678	3.76033167	1.21828556	0.18993988	<0.002	253.072584	1380.0311	22.9172657	0.05669936	0.20690286	37.2380916	38.0393284	37.9137883	0.41418675
PM18AJ286	E19JL11a231.csv	3.97025561	1.929398	54.6321314	12.3219686	1.60181257	0.36754062	1532.97201	2043.23484	41.0858315	0.15313398	1.72474138	31.937649	31.7873981	31.9807818	1.0425996
PM18AJ286	E19JL11a232.csv	7.05489181	1.154173	63.9727956	26.1044229	0.98421509	0.37363443	687.217671	2137.52449	50.2004134	0.19897346	0.90858496	39.6564938	41.2845422	40.1319688	1.70191622
PM18AJ286	E19JL11a233.csv	2.3559381	0.07779194	4.63471647	4.09088228	0.20880573	0.23823877	188.245043	2168.73827	21.6902744	0.06331754	0.07732677	34.3339044	34.8713047	33.8990854	0.28719435
PM18AJ289	E19JN26a216.csv	4.60872376	0.85540161	4.17693742	73.2364207	0.26781949	1.03710361	429.848566	2728.57958	20.115245	3.88429472	0.90988803	8.62256869	7.72916797	7.97401778	10.0764455
PM18AJ289	E19JN26a218.csv	3.14935489	0.70291213	<3.42	15.4862475	<0.106	0.45055005	209.436998	1095.94306	<7.78	0.49781366	2.75381463	5.87305353	5.0922398	5.11228369	12.9175736
PM18AJ289	E19JN26a219.csv	1.02472502	0.30802264	<3.43	16.9762917	0.18138431	0.19173084	111.989717	3348.14948	9.20959169	0.73976572	1.34430648	16.2152849	16.0254434	15.8389243	4.46570864
PM18AJ289	E19JN26a220.csv	0.78697415	0.0157238	<3.47	25.1034653	0.54814194	0.10414864	305.685337	2976.20929	9.60658094	1.72412326	1.95025842	5.5713017	5.44779673	5.40758431	15.0445387
PM18AJ289	E19JN26a221.csv	1.39972941	0.41567143	<3.30	17.9970097	<0.102	0.23606596	128.00175	1691.53546	<7.52	0.11958628	1.80789758	5.67555091	5.17665161	5.14836683	2.91675476
PM18AJ289	E19JN26a222.csv	1.33915688	0.49565648	3.41849615	13.5409558	<0.101	0.27423824	190.198915	1160.96699	10.9991169	0.30410873	1.73251603	5.32405798	4.98864491	4.9640962	12.3547459
PM18AJ289	E19JN26a223.csv	17.2497836	0.76246593	9.10744772	103.836965	0.48685996	3.40202632	214.255416	4528.04261	32.172576	1.85497074	0.50918554	15.1814822	14.2940037	13.786487	29.041388
PM18AJ289	E19JN26a226.csv	3.59714323	1.22501772	8.53034237	21.7634711	0.33685603	0.7778002	324.667697	3422.8216	34.0605665	2.77272931	0.78610801	12.7118228	12.5599752	12.5215734	26.3620324
PM18AJ289	E19JN26a227.csv	3.41616926	0.45743171	5.99189475	22.1064619	0.35289907	0.77435965	269.87015	4276.7263	40.2881586	4.39283076	0.74953747	16.9585639	15.9263862	16.3487313	19.2332143
PM18AJ289	E19JN26a228.csv	1.81245986	2.2155419	7.70055694	24.8332047	0.59397126	0.17684318	292.322579	5014.53921	25.1345531	2.39816219	0.47365868	16.1529518	16.5854341	16.1868564	64.8285084
PM18AJ289	E19JN26a229.csv	5.57740378	2.02083219	13.291721	41.1459295	0.36399904	0.79766526	260.042969	6369.14731	27.4696278	1.51836247	0.88608913	25.8629469	25.7634191	27.5337103	25.8486999
PM18AJ289	E19JN26a230.csv	0.9684508	1.47084743	6.45051069	6.03782212	0.15652756	1.00977766	271.842103	2838.48984	31.0393798	1.41685857	0.35114141	9.285003	8.53602801	8.68558608	14.4087959
PM18AJ289	E19JN26a231.csv	1.31182126	0.18114463	8.91351338	12.8261831	0.2551533	2.17018199	132.964841	3167.34745	47.1423353	0.47133659	1.15125281	10.242931	10.2016297	9.79868337	15.4981136
PM18AJ289	E19JN26a232.csv	1.63404819	0.27763099	5.61887545	14.2622787	0.28861808	0.19506864	418.724334	3143.22726	15.5828105	11.2257134	0.28098026	14.0642035	14.9144734	14.1188031	30.5206365
PM18AJ289	E19JN26a233.csv	3.03496218	1.53900823	7.36552586	19.6748805	0.24157411	0.25995615	241.104239	3298.88851	89.8812865	0.73230174	0.52969048	24.7566043	24.4758448	24.471772	23.8043757
PM18AJ289	E19JN26a235.csv	0.47801395	0.76622495	18.1197748	6.71493627	0.29154315	0.17601669	219.235636	7053.50889	42.2673273	1.03275654	0.8041783	43.945796	44.3373647	44.0384198	13.9390448
PM18AJ289	E19JN26a236.csv	0.67884963	0.21426679	<3.39	6.22942313	0.10920561	0.34194406	340.68433	1151.79182	<7.77	13.5559366	1.65282439	3.54306266	3.61995664	3.6484504	7.67629477
PM18AJ289	E19JN26a237.csv	1.14227807	0.01566657	<3.44	15.1716145	0.23668651	0.07567836	170.599952	3715.8046	<7.90	0.65762659	2.16853055	4.56097769	4.38937044	4.22017122	4.02157585
PM18AJ289	E19JN26a238.csv	1.26787219	2.75836432	4.41821467	40.1175481	0.14289738	0.12903957	205.24979	4890.96907	12.0739677	0.30503931	1.6483942	35.8338962	35.3932612	34.988844	7.47626249
PM18AJ289	E19JN26a240.csv	1.15647389	0.43128799	6.14099553	41.3442185	0.4499266	0.17023482	227.452885	4905.55796	27.3106471	0.45176923	0.88685145	18.3641561	17.7320364	18.1507837	114.025329
PM18AJ290	E19JL11a100.csv	8.10210045	0.62589969	40.8327433	36.6877577	0.38924804	0.31392399	3333.34432	3113.13875	107.057494	1.26640872	2.38827752	29.5427126	30.0302699	29.1124059	2.9522901
PM18AJ290	E19JL11a101.csv	2.05458508	0.06842276	15.1116914	9.25052775	0.10880079	0.08878538	1886.02999	2308.99346	85.0002518	0.22764998	1.30598863	19.2725205	20.4633187	19.7119559	2.02567057
PM18AJ290	E19JL11a102.csv	0.03941689	<0.00806	31.5250688	0.21124467	0.27844055	0.02719472	1481.60691	826.654791	9.58261191	0.54705567	1.08216132	5.98273383	5.99559385	6.20571162	<0.0996
PM18AJ290	E19JL11a104.csv	5.25020188	<0.00639	289.215111	27.5420997	0.12195019	0.09311757	1750.64977	1797.87521	134.603446	0.02438528	1.3419904	19.8697125	19.6879541	20.3822734	0.81015216
PM18AJ290	E19JL11a105.csv	0.22709241	0.05472398	32.6703562	1.89026149	0.11825719	0.04494312	2434.79325	2197.1091	114.888438	0.10661204	0.76710153	2.09726506	2.24870411	2.22683432	0.77697258
PM18AJ290	E19JL11a106.csv	2.12345588	0.03513145	66.3771644	7.79217445	0.23010731	0.1341365	520.419259	3204.02867	87.4000307	0.01954305	0.21417256	4.79568972	4.91882689	4.76670915	17.2799696
PM18AJ290	E19JL11a107.csv	4.46847327	0.0089786	16.8397802	6.6012922	<0.0936	0.7361324	474.830303	2031.31126	27.2078208	0.05123942	0.34632246	0.60186503	0.48103861	0.32911737	2.66053117
PM18AJ290	E19JL11a108.csv	3.69616701	<0.00803	<4.19	4.89378014	<0.104	0.40629613	421.222878	1762.00031	9.35191259	0.20708626	0.12215232	19.7296091	20.2538256	19.434973	26.3074623
PM18AJ290	E19JL11a109.csv	0.62682009	0.018508	11.1603568	4.83069833	0.49311874	0.05188246	970.514552	4481.71496	28.7448052	0.03052607	0.75566644	13.4485056	13.7274212	14.3580846	2.80128524
PM18AJ290	E19JL11a110.csv	1.15733221	<0.00649	117.174158	7.96939776	0.30368965	0.02550547	993.723626	3261.29324	692.460299	0.01453452	0.66623181	16.3365612	17.0975707	16.2710086	0.27838985
PM18AJ290	E19JL11a111.csv	5.77001332	0.12630048	76.0406567	38.729976	0.3560649	0.0651191	3336.94981	2329.78259	509.496647	0.05397846	1.47384741	17.9751444	18.9197254	18.6368156	1.14756277
PM18AJ290	E19JL11a112.csv	0.73608388	0.40400439	56.5222156	4.1706166	0.20427328	0.15974628	2704.80507	4075.3003	135.582474	0.14913223	1.36268866	19.9931429	21.1669873	20.9011921	4.29770554
PM18AJ290	E19JL11a113.csv	15.4208889	0.03898879	<5.27	28.6103089	<0.132	1.65180678	269.722608	2664.24561	9.16306481	0.27688059	0.18113069	20.1189931	20.2370081	19.3205662	5.98927471
PM18AJ290	E19JL11a117.csv	0.14107512	<0.0119	36.5794235	0.95548162	0.16197611	0.01951988	270.264752	1514.70849	138.338529	<0.00435	0.4977003	6.84599441	6.79910621	6.77202253	0.30012861
PM18AJ290	E19JL11a118.csv	6.80706481	0.112492	42.4277628	28.1823343	0.13622958	0.16535914	1581.5097	2940.85553	138.968671	0.11811817	1.10750677	11.869491	12.0276976	11.7696783	0.67484093
PM18AJ290	E19JL11a119.csv	2.66320239	<0.0122	106.863692	15.4576562	<0.164	0.02985584	504.527003	2245.78973	176.843545	<0.00445	0.61803399	25.1416952	25.3338277	26.1586109	0.84531202
PM18AJ290	E19JL11a120.csv	8.81165083	0.1566369	142.327126	42.0416854	0.5449415	0.10184228	2342.5621	4364.18959	101.763343	0.1767847	1.05268118	18.3101671	18.2130928	18.2436742	1.06159527
PM18AJ297	E19JL11a189.csv	0.09632179	0.03434415	<5.74	1.59030497	<0.147	<0.00349	483.011666	930.168956	26.1237464	0.07998246	<0.0895	22.7815255	23.7437918	23.0984374	0.56200448
PM18AJ297	E19JL11a190.csv	1.10781259	0.32290438	<3.84	14.9199961	<0.0981	0.12261572	237.355607	1539.17081	28.2368719	0.14760358	<0.0599	49.9196257	50.511035	49.9410507	4.10263279
PM18AJ297	E19JL11a191.csv	0.67837132	0.04051554	<3.40	35.6226433	<0.0867	0.02231827	472.445517	1857.61014	9.34675074	0.11186514	<0.0531	23.7899592	23.4624554	23.6384076	0.70391087
PM18AJ297	E19JL11a192.csv	0.05850643	<0.00784	39.8271112	0.895674	0.18993977	0.00366956	618.622	1151.66457	355.207938	0.13072019	0.09247746	34.0042785	35.1553042	33.9092485	0.5659492
PM18AJ297	E19JL11a193.csv	0.08540133	0.05529806	<3.52	0.68030372	0.28176901	0.01990166	354.448233	3452.07833	29.5338565	0.03991345	<0.0549	51.1400483	52.3266699	52.6631038	2.75153241
PM18AJ297	E19JL11a194.csv	0.27804729	<0.00694	<3.38	9.64906733	<0.0857	0.00539813	512.221755	1071.97866	8.26881268	0.11880098	<0.0528	13.2640351	13.9912892	13.6617263	0.16215329
PM18AJ297	E19JL11a195.csv	<0.0216	0.02142361	<5.61	0.12963516	0.23587363	0.00625292	407.695316	2605.00812	100.816362	0.04975285	<0.0906	50.7922596	54.8436002	52.1531675	2.95618859
PM18AJ297	E19JL11a196.csv	1.10897835	<0.00877	<4.26	26.1171571	<0.108	0.08751667	456.180205	1490.68603	75.2167346	0.21823355	0.09811449	38.8259343	40.1601024	40.0873935	1.60219399

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ297	E19JL11a197.csv	0.95021209	0.0411539	<4.33	18.7349258	0.12314846	0.08170655	190.791786	736.391288	31.4083356	0.100477	0.1066001	59.1784774	59.2666687	58.6713613	3.18455736
PM18AJ297	E19JL11a198.csv	0.04973754	<0.00937	<4.48	0.27262882	<0.113	<0.00279	643.71807	784.212897	29.2441849	0.17941806	0.12185295	13.0188387	13.253415	12.8705296	<0.103
PM18AJ297	E19JL11a199.csv	0.33936764	0.02624004	69.8374303	4.66875191	0.2106412	0.02002063	463.805634	1825.51367	714.556901	0.02276695	<0.0614	43.1025211	44.3666127	43.28883	1.65022365
PM18AJ297	E19JL11a200.csv	2.82199062	0.49311256	<3.53	32.6454875	0.37579893	0.27528611	320.440387	1512.34728	226.754365	7.70809713	<0.0553	61.1492576	61.8429828	61.4114986	11.2176718
PM18AJ297	E19JL11a201.csv	2.94988446	0.48880348	<5.17	36.6709051	0.26921967	0.15724288	234.088142	1954.44864	32.5954051	1.39917729	<0.0809	59.8456943	61.326626	61.829517	19.9130425
PM18AJ297	E19JL11a202.csv	0.66831455	<0.00778	177.227078	13.5814831	0.20211184	0.01194436	386.521025	2674.25955	497.377977	0.42091335	<0.0583	42.5975955	43.1733398	43.062871	1.40233842
PM18AJ297	E19JL11a203.csv	3.48451851	0.52520548	<3.60	28.996477	0.21497128	0.40054351	297.127933	1162.42848	745.209583	1.27078422	0.14656999	54.426369	55.5066155	54.6887687	12.3858114
PM18AJ297	E19JL11a204.csv	0.07819786	<0.00822	<3.96	0.31825828	0.18392933	0.00497438	539.719481	1399.00705	74.5094218	0.14293391	0.06622343	20.248622	20.7817841	21.038122	0.23881748
PM18AJ297	E19JL11a205.csv	0.97622708	0.03629363	126.490178	9.48529597	0.17114617	0.06633207	471.096566	1934.45186	1126.78613	1.12718892	<0.0756	32.5867473	33.9594948	32.3469153	0.97623746
PM18AJ297	E19JL11a207.csv	0.19783494	<0.00713	<3.40	7.23759663	0.16317286	<0.00212	627.2075	1392.48696	24.9810298	0.00787555	0.06123957	29.552232	30.080669	29.7805237	0.72582714
PM18AJ297	E19JL11a208.csv	0.05445268	<0.00996	<4.77	0.92002081	0.20232994	0.00912912	668.931236	1364.25513	127.944744	0.53441377	<0.075	31.9891219	31.9853453	32.7582964	2.36762136
PM18AJ299	E19JL11a246.csv	0.57889235	<0.0111	5.83610666	1.82799894	0.54117561	0.08403119	147.54955	3511.73197	24.2198704	0.26736369	<0.0804	25.4625299	24.9052966	24.913485	50.1342472
PM18AJ299	E19JL11a247.csv	1.58004292	0.34863167	1204.13926	11.5258439	0.49543447	0.16583112	305.393229	3488.21866	47.2999358	0.19900346	<0.056	48.3065849	49.749176	48.6253223	25.3834705
PM18AJ299	E19JL11a248.csv	1.35076614	0.10423303	109.341981	4.99536158	0.29157085	0.10267585	287.570042	4247.92837	7.93179844	0.12535433	<0.0696	51.2400283	53.0491955	53.4542573	17.2727335
PM18AJ299	E19JL11a250.csv	0.28438654	0.09933722	10.8916266	1.55708632	0.36469188	0.0434023	292.335151	4031.72582	11.7434184	0.46389568	<0.0571	51.8652418	52.8120094	52.7112492	16.3233971
PM18AJ299	E19JL11a251.csv	0.05295091	0.02415662	15.4573892	0.25644767	0.22052607	0.01331661	133.271069	7237.16103	10.926858	0.10029908	<0.0678	57.2929262	58.4834514	57.3885039	10.8098076
PM18AJ299	E19JL11a252.csv	0.18537621	0.02982072	5.60245119	0.58910622	1.09538525	0.01681937	1446.19119	2523.63643	10.2661211	0.05861561	0.77499162	74.4707737	76.7991382	75.8370289	14.3485424
PM18AJ299	E19JL11a253.csv	0.12697944	0.01594347	<3.36	0.50261601	0.2311961	0.0114664	120.310825	2586.52445	7.36196267	<0.00287	<0.0533	56.5691155	57.4385695	57.1277906	10.5850493
PM18AJ299	E19JL11a254.csv	0.20080002	0.03534925	10.1156331	0.65210152	0.32822413	0.01532619	203.080712	3939.28404	8.69047618	0.07832128	0.09919681	66.9487887	66.9843773	66.9695895	11.0028244
PM18AJ299	E19JL11a255.csv	0.57332583	0.04652558	4.63244426	1.32468596	0.10890604	0.04875278	175.044944	3224.45296	13.7853831	0.00538666	<0.0645	59.2305849	60.9766146	60.9502137	9.74001278
PM18AJ299	E19JL11a257.csv	2.04033681	0.11714187	89.4486058	9.72367925	0.97309583	0.28807222	298.133588	2967.03758	78.4890474	0.87034912	0.33347324	55.8703694	57.7080528	57.0956481	52.059136
PM18AJ299	E19JL11a258.csv	0.38119748	0.13376578	16.5248618	0.84672349	0.3668281	0.03751181	381.694329	3842.80939	10.850036	0.09182448	0.09746458	64.7657417	68.0088006	67.00158	9.76707741
PM18AJ299	E19JL11a259.csv	0.3200541	0.52321615	<3.99	0.87554897	0.12174998	0.04875023	129.334576	5104.98861	12.5461966	0.08122528	0.06754168	65.3202464	65.2584368	66.1501259	16.9349465
PM18AJ299	E19JL11a260.csv	4.16612653	0.18956885	80.3419449	9.82922718	0.43151994	0.62822117	179.193747	5779.78591	20.3950947	0.08464836	<0.0891	52.8424782	55.4428689	52.9374617	30.2276981
PM18AJ299	E19JL11a261.csv	3.57232649	0.05998076	294.201806	7.61969118	0.26779832	0.33437579	348.089189	5115.67838	23.4793082	0.16893053	0.23283578	55.5608953	56.6930461	56.203733	15.7378911
PM18AJ299	E19JL11a262.csv	1.27766941	0.01579229	46.0581327	4.23975366	0.48328035	0.10836662	200.256073	3612.82222	38.9399174	0.1484249	<0.0708	68.3395579	68.2934432	68.1434258	12.0579883
PM18AJ299	E19JL11a263.csv	10.0028087	0.24467583	156.791143	30.1633524	0.98754371	1.21932099	518.121316	6168.03401	40.6727305	0.13564283	0.1552563	68.6798643	70.3714619	70.2409873	27.7347405
PM18AJ302	E19JL15a007.csv	8.50078468	0.42038298	<6.96	60.2700254	0.2958256	0.64681751	233.527581	1253.59881	<13.7	0.67907661	<0.103	40.7351025	41.6539086	41.1586922	0.35645258
PM18AJ302	E19JL15a009.csv	1.43970471	0.20535739	<7.18	36.3194892	1.51746614	0.32847457	394.413326	3279.98768	<14.1	0.34804566	0.18211117	28.5087505	29.8549842	29.0839044	0.84451738
PM18AJ302	E19JL15a011.csv	1.91404894	0.20991307	157.709766	6.89276878	0.78135354	0.2361021	395.132551	1621.31183	38.7545289	0.18981774	<0.104	22.0843695	22.526509	22.6819115	0.32002662
PM18AJ302	E19JL15a012.csv	0.6245418	0.27942397	149.585627	3.52189742	1.09069939	0.11366972	402.555803	710.728351	36.4265518	0.5092362	0.20635344	16.0146758	17.2556108	16.1376244	0.23022345
PM18AJ302	E19JL15a013.csv	1.58270181	0.49573266	69.5858035	10.5048347	1.23975434	0.21963427	373.926268	1495.39183	19.8307048	0.47050307	<0.154	18.3849912	19.758616	19.1147083	<0.29
PM18AJ302	E19JL15a014.csv	29.4346684	0.8390028	<7.74	24.3634446	0.54023382	2.97818592	293.524546	650.146535	<15.2	0.61841151	<0.116	38.329377	38.3331392	36.7423244	0.52773841
PM18AJ302	E19JL15a015.csv	2.48838535	0.734838	<6.71	15.6757024	0.39298304	0.22043374	106.818244	722.647065	<13.1	0.07820985	<0.102	52.2047543	53.9360944	54.5887357	1.66506878
PM18AJ302	E19JL15a016.csv	5.4249564	0.18835622	<7.59	62.1536985	1.45814542	0.6023956	244.494698	3906.98508	<14.8	0.08717133	<0.116	32.5263279	33.2225502	32.6320857	0.47126302
PM18AJ302	E19JL15a018.csv	5.28856674	0.27845829	<7.07	30.3137545	1.81796625	0.26044522	269.401892	2684.56372	44.1437236	0.62959942	<0.108	60.1907878	61.5809556	59.9104734	4.53222368
PM18AJ302	E19JL15a019.csv	12.3008281	1.05569559	<7.00	93.3862518	0.45869365	1.00592621	169.749641	2256.86594	<13.7	0.17353878	<0.107	128.814278	131.535633	128.817486	5.60386511
PM18AJ302	E19JL15a020.csv	2.01163713	0.96721488	<6.93	22.8329645	0.21215495	0.21262689	255.758634	741.883843	<13.5	0.03345616	<0.106	67.0539988	69.0330826	68.1796842	16.4881454
PM18AJ302	E19JL15a021.csv	359.688739	0.80776457	<8.47	386.421373	2.31076659	18.0785978	259.474408	4279.38926	<16.3	0.16141953	<0.128	22.6822862	22.1883827	21.7546732	1.10198315
PM18AJ302	E19JL15a022.csv	15.1568363	1.88655589	<6.84	182.833925	0.85135495	0.60217364	258.30613	892.3608	<13.3	0.22872086	<0.105	40.0300828	41.1556623	40.8398477	1.4815416
PM18AJ302	E19JL15a023.csv	7.531028	0.18972149	<7.10	60.9343774	0.91313379	0.58346793	241.907617	2536.6675	<13.8	0.02823131	<0.109	24.8281822	25.0620876	25.2714551	0.53982124
PM18AJ302	E19JL15a024.csv	0.78677484	<0.0147	<7.15	21.9404091	<0.217	0.06158755	185.093701	2979.38678	<13.9	0.03580927	<0.111	18.4836669	19.819736	19.5686113	0.23138664
PM18AJ304	E19JN25a061.csv	7.52991431	0.26749752	<4.07	18.0216233	0.55324813	1.09108652	226.783645	7691.70025	8.99459021	0.65575406	<0.0745	37.3718359	37.472128	37.6414909	27.0845476
PM18AJ304	E19JN25a062.csv	1.14993672	0.34766315	<3.69	4.74586485	0.15860057	0.10300395	298.223542	2690.40232	<7.54	0.56234936	<0.0676	37.1582768	38.659442	37.2562546	2.78732873
PM18AJ304	E19JN25a063.csv	1.21815374	2.23489547	<3.59	5.71499284	<0.0963	0.0892393	305.728871	2307.38578	<7.33	0.09037995	0.1631353	49.0036351	50.2693058	49.8154721	5.34165603
PM18AJ304	E19JN25a064.csv	3.7703087	0.72769152	<3.56	13.9958144	0.28822628	0.25672644	459.478183	2727.13527	15.5256584	1.02418565	<0.0654	36.0634461	38.1728236	36.5726138	11.3563623
PM18AJ304	E19JN25a079.csv	1.53565965	0.32567489	5.03357028	13.2719944	0.31444967	0.12434912	319.655904	4868.33357	24.5188402	0.66237868	0.1314021	58.60364	60.3315862	59.3974527	8.10775682
PM18AJ304	E19JN25a083.csv	2.43177448	0.69471528	<3.70	14.9246305	<0.101	0.13432027	337.045	2549.83935	12.351498	0.12337601	0.07308232	57.8650698	59.8443924	58.1325464	9.65560888
PM18AJ304	E19JN25a084.csv	1.66205697	1.04884569	<3.61	12.4800297	0.10945297	0.13755976	258.274092	2726.88296	<7.31	0.08886519	0.11785751	52.4466391	53.3001483	52.5951892	6.5436955
PM18AJ304	E19JN25a085.csv	3.43128016	0.34746579	<4.13	18.6621192	0.22469218	0.33396972	254.251866	6764.92369	19.3450441	0.27422694	<0.0768	80.7880134	81.0852081	81.0112157	4.52742935
PM18AJ304	E19JN25a106.csv	4.37591667	0.51103787	87.9470592	10.5716153	0.5990795	0.95349652	621.149365	3717.3386	1863.73573	3.61364554	0.26243839	39.3663439	41.4635171	40.1259565	1.61294804
PM18AJ304	E19JN25a107.csv	10.8518159	1.32088802	<3.61	58.4079587	0.27392142	0.82389609	298.54255	6052.93609	14.2426353	1.4104952	<0.0673	25.8255155	26.1630794	25.9155472	9.48944699

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ304	E19JN25a108.csv	6.26146996	1.31786891	3.55219417	30.5502012	0.17842605	0.66365514	335.074119	4510.25104	14.7115195	0.54979574	0.0698873	34.6754823	34.39761	34.4450927	10.6836884
PM18AJ304	E19JN25a109.csv	3.47712803	0.61174712	3.92267369	15.2924936	0.31345449	0.36541647	380.914019	4192.5278	20.2334923	1.17376111	0.0709316	48.9646316	48.5500774	48.9356412	4.42904666
PM18AJ304	E19JN25a110.csv	0.31455827	<0.00698	<4.43	1.76024132	0.4531229	0.02820169	778.643619	3275.9079	16.1984923	2.12552182	<0.0827	17.9852741	19.1067376	19.2096697	10.1518438
PM18AJ304	E19JN25a114.csv	0.7839937	0.29200598	<3.40	7.40874633	0.12866436	0.07780316	443.202036	1958.54214	<6.88	1.25402991	<0.0636	34.5498828	35.044615	34.3135697	5.96354587
PM18AJ304	E19JN25a115.csv	4.06396302	0.32981217	97.8034273	24.8561084	0.33203174	0.21772835	406.252395	4934.07796	1171.49316	0.38234336	0.14885992	37.4543224	38.3497855	38.738111	5.8452013
PM18AJ304	E19JN25a116.csv	7.98693823	0.85999792	9.78790563	39.8436717	0.45674674	0.47603494	566.683897	3012.06148	18.9700705	2.35812588	<0.0855	20.4729291	21.3362405	20.1726676	16.1318194
PM18AJ309	E19JL15a288.csv	<0.012	<0.00696	<3.08	0.00711049	<0.0991	0.13076743	337.290197	1421.5922	<6.27	0.13018828	0.31444845	4.74867666	5.01010752	4.94587014	0.38395518
PM18AJ309	E19JL15a290.csv	0.01381572	<0.00743	5.89318945	0.02717525	0.15633345	<0.00197	575.633813	1101.85086	<6.69	0.41108676	0.79674738	9.94489846	10.3216314	10.2665625	1.3340652
PM18AJ309	E19JL15a291.csv	0.01682056	0.01468508	<3.03	0.03109915	0.16362139	<0.00181	600.220478	1317.11147	7.14653603	0.21632692	1.35140358	15.2284087	15.401278	15.6336793	2.63336998
PM18AJ309	E19JL15a292.csv	<0.0119	<0.00687	<3.03	0.00481649	0.37237639	<0.00182	470.144524	2230.42141	<6.19	0.71854467	2.6576621	31.5939376	33.4756058	32.7080352	1.12442955
PM18AJ309	E19JL15a293.csv	0.17815086	0.01955584	<2.95	0.19501913	<0.0962	0.04398859	465.594564	1104.33472	<6.03	0.10777136	1.01927308	11.7688207	12.0785137	11.8680382	1.95809924
PM18AJ309	E19JL15a294.csv	0.07993735	<0.00689	<3.03	0.06200066	0.12867704	0.01699882	474.914082	945.84833	8.84161696	0.08251744	1.14105362	10.3387473	11.0098526	11.0154533	2.08088168
PM18AJ309	E19JL15a295.csv	0.03380922	0.01461758	4.9384066	0.0397226	0.15749102	0.00442341	535.538904	1233.30253	<6.16	0.03620472	5.66863175	11.7826843	11.9293216	11.7364367	1.74980412
PM18AJ309	E19JL15a296.csv	1.25793986	0.25490805	7.79145339	2.99548611	0.85621105	0.10655867	803.150888	1561.50664	20.0593798	0.04212226	2.04653095	12.1299674	11.9721813	11.9526518	1.63091634
PM18AJ309	E19JL15a297.csv	0.2049056	0.04377969	<3.19	0.21812844	0.17407761	0.04514425	603.057439	1397.43766	<6.53	0.02348369	3.25914364	8.17571852	8.44241025	8.20562892	2.63413221
PM18AJ309	E19JL15a298.csv	0.02465434	<0.00739	<3.23	0.04339268	0.12894565	0.00995695	795.019792	1398.13002	<6.65	0.20082743	2.48861259	10.966745	11.8135651	11.7730519	2.01745499
PM18AJ309	E19JL15a299.csv	0.60497139	0.05857224	6.40861843	0.69242076	0.24440591	0.04193967	435.874786	1227.53493	9.91676986	0.0621631	1.98405254	9.66365842	10.0395945	9.90842013	1.67074452
PM18AJ309	E19JL15a300.csv	0.79583863	0.04828547	4.1148486	0.87822051	0.17661073	0.06830041	416.642561	1322.50434	17.7160511	0.06667639	1.56953546	12.1749613	12.1424547	11.9870336	1.63678196
PM18AJ309	E19JL15a301.csv	0.15622601	0.01020352	<3.30	0.09180756	<0.11	0.02286767	985.718979	1459.82679	<6.79	0.26442377	1.48240709	9.45350475	9.38550674	9.54466994	0.8280802
PM18AJ309	E19JL15a302.csv	<0.0122	<0.00705	<3.08	0.00493327	<0.103	0.00774693	899.096924	1162.86337	7.4332557	0.1528277	1.28940103	5.46251526	5.5327833	5.05387473	0.39533332
PM18AJ309	E19JL15a303.csv	0.04257734	<0.00717	<3.14	0.05421419	0.13603479	0.03559771	543.817271	1148.99408	<6.46	0.14402915	1.03681964	8.70787702	9.15705327	8.83743411	0.67777693
PM18AJ309	E19JL15a304.csv	0.06833961	<0.00711	<3.09	0.12384699	0.16928889	0.01676448	305.298071	1099.29129	10.6857455	0.01630649	1.08507797	13.0763378	13.4581492	12.7237001	1.67390834
PM18AJ309	E19JL15a305.csv	0.02962725	<0.00712	3.66675168	0.0463026	<0.105	0.01202981	449.523361	1125.64837	<6.41	0.18191292	0.85252472	13.2820209	13.5761865	13.333639	1.61439264
PM18AJ309	E19JL15a306.csv	0.18724588	<0.00758	<3.31	0.06001797	<0.111	0.09873856	266.053989	2031.11375	<6.82	0.03717563	0.31664526	4.52172073	4.44011996	4.396044	0.42044747
PM18AJ309	E19JL15a307.csv	0.03067917	0.01022357	4.45652756	0.01703702	0.52313422	0.0056889	523.727032	1635.29925	13.5465013	1.15126266	2.65665633	27.5911622	28.5695507	28.0213097	2.66762111

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ209	E19JN26a350.csv	182465.934	2.17414451	2736.34461	<0.0023	0.12066191	86.2394233	78.6744899	<0.0248	0.02628108	173.585862	0.83824215	0.06812421	21.3337524	2.61269912
PM18AJ209	E19JN26a351.csv	171112.237	1.79518199	1644.94512	<0.00198	0.02724881	133.1226	130.703578	<0.0218	0.02426291	28.8201017	0.36499871	0.03624548	7.64564112	2.68824054
PM18AJ209	E19JN26a352.csv	177776.745	2.17007074	3084.48884	<0.00195	0.05081697	367.921478	364.178268	<0.0216	0.11847627	183.759173	6.00032674	0.68697801	13.4560815	6.42948983
PM18AJ209	E19JN26a353.csv	181662.363	2.15749142	2813.72139	<0.00224	0.58257365	333.165341	339.893524	<0.0248	0.35328224	350.700439	4.44613368	0.79808845	17.8634087	98.4804186
PM18AJ209	E19JN26a355.csv	176822.645	1.97658463	2118.02239	0.00881795	0.46646604	64.5414729	63.4164782	<0.0229	0.36037007	89.5192699	4.36138157	0.90977596	11.5817373	118.310179
PM18AJ209	E19JN26a356.csv	173059.068	1.71521983	3172.38129	<0.00226	0.01992853	277.070785	281.591569	<0.0261	0.07475882	134.635123	1.36361386	0.10719783	10.5835078	4.60230898
PM18AJ209	E19JN26a359.csv	171565.457	2.19524805	1523.73634	0.00321683	0.0565783	107.813694	108.170111	<0.0227	0.10834502	133.291149	4.39832382	0.43838215	6.96283823	0.49367595
PM18AJ209	E19JN26a361.csv	175733.655	2.1131833	1404.75893	0.00540253	0.45841804	102.097491	99.9103138	<0.0238	0.18692955	340.789506	24.8052783	2.45477857	23.0867428	1.89033019
PM18AJ209	E19JN26a362.csv	178029.798	2.93315945	1644.78649	<0.00243	0.00907594	348.63442	359.117356	<0.0287	1.92767771	769.296782	65.0288584	3.23475015	5.32632468	2.67598741
PM18AJ209	E19JN26a363.csv	182173.72	1.85240103	3003.67084	0.0136534	0.28211494	525.458891	521.9634	<0.0417	0.18325593	406.092011	2.81657457	0.57081076	16.3829996	56.2838465
PM18AJ209	E19JN26a364.csv	175540.506	1.92450381	3079.08801	0.00957372	<0.00226	434.803265	430.706777	<0.0218	0.05541239	310.89757	0.96240372	0.11731104	21.2068428	0.23994973
PM18AJ209	E19JN26a366.csv	179746.965	2.16967876	2664.88235	<0.00214	0.03982756	146.259219	152.773241	<0.0256	0.40277343	542.490797	20.6537671	1.54541117	18.7939571	2.83951616
PM18AJ209	E19JN26a367.csv	171889.062	1.62028274	1348.48006	<0.00297	<0.00363	793.165051	829.202521	<0.0357	0.15557791	659.690275	4.98281099	0.82363253	3.79481572	18.8572094
PM18AJ209	E19JN26a370.csv	175132.311	2.31298244	1393.70145	<0.0018	0.49979692	122.822499	126.017255	<0.0218	0.31157479	413.963976	17.091235	1.67511512	6.86954626	5.88509758
PM18AJ209	E19JN26a371.csv	176168.961	2.09209255	1062.56526	<0.00184	0.00845366	79.5802663	79.2862157	<0.0222	0.23248097	327.028975	5.44554749	0.596142	6.67771256	0.35919383
PM18AJ212	C19AU08C322.csv	179708.815	0.81442244	756.247035	<0.00429		110.305208	110.341142	<0.0306		410.402274	15.4341055	1.64726155	5.40388746	0.3038914
PM18AJ212	C19AU08C323.csv	182281.557	0.40702787	1051.95775	0.01006587		118.894201	118.509305	<0.0245		110.81469	11.9417725	0.36594154	8.73005859	0.353688
PM18AJ212	C19AU08C325.csv	177319.213	3.66707248	2100.98492	<0.0026		235.637149	233.325509	<0.0177		185.084251	58.9662594	3.15716241	7.64690814	38.0366517
PM18AJ212	C19AU08C326.csv	179002.292	0.88722075	1641.23731	<0.00271		85.3543196	88.4901305	<0.0182		174.955482	6.75876439	0.38313507	4.47678134	0.74254427
PM18AJ212	C19AU08C327.csv	172522.435	1.22045051	688.789037	0.00727033		203.143466	207.613597	<0.0193		549.514308	11.592777	0.97353223	4.75124915	0.87666253
PM18AJ212	C19AU08C328.csv	180405.482	3.52116113	2847.64179	<0.0041		411.082827	413.506121	<0.0267		1022.44875	27.5453613	2.59881557	3.9100868	1.82720687
PM18AJ212	C19AU08C329.csv	179020.98	0.173699	920.29128	0.01853675		128.546161	134.000292	<0.0265		16.073576	0.64723098	0.13657282	6.14200368	0.27631749
PM18AJ212	C19AU08C330.csv	172317.617	0.67566168	1023.74122	<0.00279		93.407853	93.2101066	<0.0177		83.1084157	1.32419743	0.14894002	2.28149544	0.08040342
PM18AJ212	C19AU08C331.csv	184160.85	0.96370363	822.577718	<0.00508		238.543872	245.546384	<0.0318		384.759645	10.1343523	0.75242615	12.951545	1.29897248
PM18AJ212	C19AU08C332.csv	180633.963	0.284771	1518.84889	<0.00305		170.793489	176.869174	<0.0189		11.0447768	2.98136451	0.10095112	4.2350931	0.08828165
PM18AJ212	C19AU08C333.csv	177256.961	0.757276	863.066296	<0.00269		150.441052	155.6843	<0.0166		150.609187	0.41618477	0.02087577	5.28081743	0.0148998
PM18AJ212	C19AU08C334.csv	176423.073	0.47358962	864.283181	<0.00257		148.591973	143.513238	<0.0157		123.168055	2.27023736	0.17998713	6.11809198	0.21481406
PM18AJ212	C19AU08C335.csv	179620.742	0.11231516	907.117358	<0.00259		127.135479	128.83688	<0.0158		8.16356458	0.40390852	0.03025173	3.17348844	0.04987174
PM18AJ212	C19AU08C336.csv	180662.093	0.61190984	938.32248	0.00846644		61.0375598	60.5878247	<0.0193		91.1566226	20.9832897	0.7629342	7.87658235	0.33808972
PM18AJ212	C19AU08C337.csv	180719.822	2.61400569	1354.26117	0.00587237		299.221169	301.758182	<0.0189		375.299066	64.8248729	4.02455368	8.16547923	12.4694274
PM18AJ212	C19AU08C338.csv	167370.517	0.21484172	775.115499	<0.00371		78.7891756	87.7623297	<0.0228		54.140552	0.71486726	0.05511201	11.2048018	0.20889745
PM18AJ212	C19AU08C342.csv	184428.629	0.63352634	755.261646	0.02870147		183.315212	191.372344	<0.0253		42.2648009	9.68148417	0.65289556	5.32499419	12.3540958
PM18AJ212	C19AU08C344.csv	181679.87	2.38644126	409.5724	0.00299613		107.550191	106.159056	<0.019		94.0332048	3.62684863	0.43962943	3.54545611	0.01489879
PM18AJ212	C19AU08C345.csv	181023.47	3.91994457	903.816987	0.01108482		127.624404	121.392248	<0.0194		121.057729	6.5213557	0.63053752	6.14383966	0.78447377
PM18AJ212	C19AU08C346.csv	172062.162	0.58815006	1148.05767	<0.00325		99.0920765	101.948833	<0.0236		153.192257	30.4738176	0.91078823	3.72109926	0.08752444
PM18AJ215	E19JN26a373.csv	172886.472	5.14255239	910.513661	<0.00206	0.00546639	37.7768109	29.210349	<0.0249	0.01424697	692.509221	0.39143379	0.06410378	9.5330887	0.32811723
PM18AJ215	E19JN26a374.csv	175486.153	4.24786158	1166.66166	0.00220342	0.03183672	161.786141	163.313247	<0.0233	0.09479099	406.734853	5.58785914	0.44352632	7.19008053	1.56095493
PM18AJ215	E19JN26a375.csv	177542.691	4.27778552	891.618717	0.01592766	0.14269089	300.178627	299.897489	<0.023	0.18268922	576.578453	5.50191443	0.59707941	7.46575652	23.7740444
PM18AJ215	E19JN26a376.csv	176046.231	3.29029832	532.672768	<0.00187	<0.00231	24.87082	27.4249614	<0.0225	<0.00208	23.4292581	0.05873186	<0.00691	3.72794374	0.01915963
PM18AJ215	E19JN26a377.csv	174819.904	2.43692771	663.929702	<0.00182	<0.00225	21.09904	22.6237219	<0.0219	<0.00202	45.0616019	0.03784302	<0.00673	3.46341487	0.03647787
PM18AJ215	E19JN26a378.csv	176367.696	3.65056874	588.523025	0.00315291	0.01257472	220.348227	222.982055	<0.0222	0.01042437	118.728742	0.56472644	0.04287544	3.54615729	0.5579132
PM18AJ215	E19JN26a379.csv	177039.679	2.14172637	920.554004	<0.00186	<0.0023	43.3147011	42.6454232	<0.0222	<0.00207	10.6613436	0.07543199	<0.0069	5.9186046	0.01911089
PM18AJ215	E19JN26a380.csv	168314.792	1.91701561	1787.99834	<0.003	0.00620777	70.3041238	64.2788964	<0.0357	<0.00334	17.8807663	0.23704204	0.04089209	4.79334221	0.45707177
PM18AJ215	E19JN26a381.csv	176800.905	4.13126893	1217.04459	0.00480456	0.07725698	180.509881	185.096162	<0.022	1.20644901	716.925295	31.3304045	1.63411654	6.45136811	2.64172873
PM18AJ215	E19JN26a382.csv	177366.997	4.65287737	915.806877	0.00490881	<0.00235	208.044443	215.311467	<0.0223	0.00908891	298.8886	0.37292602	0.02702134	5.43363194	0.50331926
PM18AJ215	E19JN26a383.csv	173804.437	2.30554192	924.622241	<0.00198	0.12269396	57.5374063	61.1505729	<0.0232	0.03246942	25.4472137	1.09923732	0.14202262	6.73596012	7.32465131
PM18AJ215	E19JN26a384.csv	178764.926	2.91218561	1485.24275	<0.00239	0.03521727	111.587836	112.463803	<0.0278	0.01289063	46.8875406	0.44596882	0.01819679	1.74777258	0.52007685
PM18AJ215	E19JN26a385.csv	177101.692	4.69088825	913.050413	<0.00183	0.00842549	258.250537	259.602554	<0.0211	0.74932291	583.825328	16.58477	0.81894811	4.57541139	0.86272131
PM18AJ215	E19JN26a386.csv	183457.724	3.49252906	1423.05134	<0.00307	0.03928844	153.930412	145.938519	<0.035	0.01782416	161.523348	0.3118652	0.05033415	3.73826777	1.09724137
PM18AJ215	E19JN26a387.csv	172053.686	2.02376578	1044.41548	<0.00219	<0.00269	21.5052026	21.7723603	<0.0248	<0.00242	7.98932275	0.17306336	0.00868054	2.39281448	0.00823647
PM18AJ215	E19JN26a394.csv	178834.543	2.66229984	892.37489	0.01323461	0.39219366	118.189475	120.064649	<0.0199	0.10593339	39.9713626	3.59913005	0.40757996	3.45529184	19.8014934
PM18AJ215	E19JN26a395.csv	176264.85	5.03249773	1359.20831	<0.0019	0.32199091	346.632126	355.496572	<0.0195	0.44340777	628.566131	8.02200999	1.08435732	5.06377118	41.4989607

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ215	E19JN26a396.csv	179085.383	3.38713499	941.218283	<0.00187	<0.00231	54.5962781	53.1799896	<0.0188	0.00580215	353.98928	0.51654229	0.0365502	7.42921509	0.13488992
PM18AJ215	E19JN26a397.csv	170261.213	2.41195891	1113.22915	<0.00271	0.00456054	432.244262	432.721168	<0.0276	0.04824344	175.946968	1.23908081	0.19193886	18.0660991	1.54351143
PM18AJ215	E19JN26a398.csv	178324.943	3.07744225	860.106095	0.00645014	0.00911365	149.737671	152.233088	<0.0178	0.0081097	82.3999616	0.65659828	0.06608968	9.62641146	0.54498741
PM18AJ215	E19JN26a400.csv	179346.61	7.58426345	1213.72026	0.007198	<0.00257	521.924223	520.311015	<0.0195	0.98765525	1173.13938	18.8890696	2.05045933	7.6082778	2.96910201
PM18AJ215	E19JN26a401.csv	179466.912	3.1574422	1139.86026	<0.00231	0.02466739	114.975181	121.534167	<0.0209	0.10038685	152.535006	2.68061131	0.26667109	3.68691445	1.45659425
PM18AJ215	E19JN26a402.csv	178011.437	3.69883213	839.900154	0.00354685	0.01024318	77.4614438	80.305755	<0.0181	0.0152302	361.534392	0.71641991	0.09995335	15.9197865	0.61790563
PM18AJ219	E19JN26a296.csv	179263.716	1.99690936	2116.56096	<0.00191	<0.00238	320.736315	322.993044	<0.014	0.1159637	172.587546	1.16080266	0.13943421	5.24392812	3.81803373
PM18AJ219	E19JN26a297.csv	177648.853	2.10207401	1968.57193	0.00314375	<0.0023	1188.46845	1175.69093	<0.0135	0.08487243	1010.77001	1.92869822	0.26611863	8.20530368	6.82560402
PM18AJ219	E19JN26a299.csv	178879.47	2.11025665	1925.2058	0.01006719	<0.0024	735.140112	732.765015	<0.0141	0.12074434	484.595254	1.91112622	0.18133565	6.94391628	2.73164344
PM18AJ219	E19JN26a300.csv	178907.547	2.03586752	2469.06173	<0.00201	0.03580503	281.548398	267.610232	<0.0147	0.31001505	300.642086	8.87150573	1.04158875	10.8228923	33.4323799
PM18AJ219	E19JN26a301.csv	178994.519	1.83780621	2164.04812	<0.00193	0.00402008	546.563028	529.99574	<0.0142	0.11965274	266.543683	2.10715701	0.18227449	6.53121108	2.2623985
PM18AJ219	E19JN26a302.csv	177011.988	2.03177067	1953.69863	<0.00193	0.01129429	780.205707	771.419973	<0.0142	0.21381538	690.936979	2.9188221	0.34735198	6.41295175	9.23054651
PM18AJ219	E19JN26a303.csv	178947.616	2.09309446	2143.86853	0.00336125	0.00781037	570.988145	562.788436	<0.0146	0.21477664	468.562691	3.28185306	0.28178688	7.07532766	3.83774001
PM18AJ219	E19JN26a304.csv	179774.554	1.90730273	2240.64084	0.00334038	0.00592548	393.878452	378.943685	<0.0145	0.14199088	218.112385	4.81992214	0.50290309	7.25487698	17.0314202
PM18AJ219	E19JN26a305.csv	179100.933	1.96687062	2057.58176	0.00329463	<0.00241	589.814066	577.726994	<0.0143	0.15000369	316.689126	3.23633191	0.27223884	6.81845653	4.8450321
PM18AJ219	E19JN26a306.csv	179125.352	2.00068999	2570.87748	0.00333609	0.00499949	501.604126	494.100707	<0.0146	0.14597019	231.086905	2.76787141	0.26865039	5.85496901	7.78057879
PM18AJ219	E19JN26a307.csv	179755.197	1.67555021	2409.37118	<0.00197	0.33178187	397.340187	389.576839	<0.0147	0.24064082	216.533678	9.11053641	0.90809704	9.35664374	31.0392479
PM18AJ219	E19JN26a309.csv	177783.335	1.85335506	1812.70088	<0.00192	0.08516539	1003.0625	980.077488	<0.0145	0.11864704	634.772161	1.6622842	0.19137448	7.14454434	9.92650131
PM18AJ219	E19JN26a310.csv	179806.53	1.82525762	2507.70664	0.00854953	<0.00245	474.64711	476.068928	<0.0149	0.13648845	230.225265	2.79436377	0.2554039	8.43139601	4.92848375
PM18AJ219	E19JN26a311.csv	177793.874	1.74734909	2076.79702	<0.00189	0.0058517	454.359924	447.343871	<0.0144	0.09322633	231.572802	1.15611063	0.13816384	5.22967828	3.56186321
PM18AJ219	E19JN26a312.csv	179612.235	1.91097562	2398.99786	<0.00195	<0.00243	418.671523	414.179976	<0.0149	0.11730384	209.796986	1.58068661	0.1250379	7.80786525	4.23132573
PM18AJ219	E19JN26a313.csv	179408.532	1.88245944	2250.78158	<0.00192	<0.00239	305.817061	301.969859	<0.0148	0.10512394	264.912042	2.28166467	0.23927845	10.1891914	6.58168372
PM18AJ219	E19JN26a314.csv	176765.542	1.81740163	1590.60345	0.00644489	<0.00231	1889.29721	1884.27951	<0.0144	0.0704746	739.0963	2.82637326	0.46659085	7.87361105	15.3193084
PM18AJ219	E19JN26a315.csv	178487.852	1.79406875	2044.04097	0.00327873	<0.0024	678.65578	688.169605	<0.0151	0.10207994	250.073101	2.27292894	0.21259109	5.75785447	3.14437766
PM18AJ219	E19JN26a316.csv	180216.827	1.74446135	2677.27108	<0.00199	0.00788234	445.696755	443.468557	<0.0157	0.16051971	246.467083	2.79461722	0.40704828	8.36559946	13.9981983
PM18AJ219	E19JN26a317.csv	179649.328	1.84548142	2178.66274	<0.00194	0.13940142	883.331723	892.633599	<0.0154	0.14304965	506.519899	4.80613105	0.4920468	6.61744791	32.5347081
PM18AJ220	E19JN25a281.csv	179235.667	2.34390414	882.210195	<0.0023	<0.00259	559.759146	569.359514	<0.0214	0.50745119	205.108432	8.4024918	1.09294848	3.2245947	0.81898648
PM18AJ220	E19JN25a282.csv	180395.436	2.39383846	1041.31846	<0.00233	0.03979322	590.726188	596.684987	<0.0216	0.5117147	403.369463	26.7650335	2.2955797	10.1060617	11.1578175
PM18AJ220	E19JN25a283.csv	172679.76	2.16853715	2225.50701	0.00492226	<0.00351	627.783864	621.373357	<0.029	0.06589938	939.496338	2.11436296	0.18381023	6.50621783	0.04155892
PM18AJ220	E19JN25a284.csv	179017.115	1.79962826	1693.91752	0.01092095	0.00262428	592.768713	590.174832	<0.0196	0.04151756	692.371786	0.48799314	0.10592947	14.8645716	0.97825588
PM18AJ220	E19JN25a285.csv	181328.667	1.9167932	458.959738	0.016024	0.20764309	323.377882	338.344263	<0.0402	0.39741824	144.368313	3.27233002	0.51638738	8.76872317	3.246844
PM18AJ220	E19JN25a286.csv	176657.152	2.0197173	2669.4286	<0.00227	0.00445003	230.788674	232.818135	<0.0211	0.19843085	419.798337	35.5986857	1.75896857	6.05941389	2.59175874
PM18AJ220	E19JN25a293.csv	175832.279	3.01989191	1021.65255	<0.00237	0.63724951	184.952151	181.791104	<0.0213	0.93165854	461.458388	60.7763817	5.00942694	5.82153281	7.11311906
PM18AJ220	E19JN25a294.csv	171435.7	2.3968987	1651.9378	<0.00294	0.05159247	445.495816	434.734448	<0.0261	0.65339939	319.927181	35.5891887	4.21090952	4.37016985	18.6259129
PM18AJ220	E19JN25a295.csv	179939.009	2.28941352	2529.05938	0.0030767	0.22632304	486.195569	483.145885	<0.0198	0.27544416	465.800107	11.2633138	1.30988762	7.26624841	13.8844043
PM18AJ220	E19JN25a297.csv	181257.623	2.11276684	1131.28608	<0.0031	<0.0035	87.7758314	86.5768316	<0.0266	0.05771628	335.503435	2.5064614	0.13938035	7.12715463	0.31367766
PM18AJ220	E19JN25a298.csv	177661.554	1.75674847	2446.15473	<0.0022	<0.00245	213.351034	212.271074	<0.0186	0.02274457	649.778826	0.08974647	0.01095461	7.50763683	0.01480147
PM18AJ220	E19JN25a300.csv	174702	2.34334301	1178.25858	0.00268263	<0.00231	115.775906	114.775911	<0.017	0.35816576	417.541811	21.6306019	0.8669064	7.82892467	1.38069987
PM18AJ220	E19JN25a302.csv	174276.335	1.85680169	1670.2435	<0.00211	<0.00235	337.687603	339.214419	<0.0167	0.11749956	721.926217	9.39199542	0.79379299	5.46870689	0.15639034
PM18AJ220	E19JN25a303.csv	178652.615	1.94312143	2320.54239	0.00997796	<0.00251	521.197029	532.621576	<0.0175	0.06107253	519.495514	0.37134021	0.07066379	9.90274526	0.02720709
PM18AJ220	E19JN25a304.csv	175498.533	1.78716479	1388.73979	<0.00211	0.01500162	167.322088	171.101189	<0.016	0.23982535	549.19114	8.94934412	0.75790749	5.75078877	4.33149956
PM18AJ220	E19JN25a305.csv	176011.937	2.30567199	1441.95809	<0.00223	0.01294119	131.073873	132.512432	<0.0166	0.0519485	515.640916	6.94345728	0.61240024	4.79804191	0.31493408
PM18AJ220	E19JN25a307.csv	184539.298	1.85005599	2060.60492	0.00567074	0.02997193	490.408836	479.6241	<0.0221	0.22329616	737.230988	5.46307246	0.63937612	10.3620525	18.5065248
PM18AJ220	E19JN25a308.csv	179340.221	1.74984494	1995.14566	<0.00227	0.388181	594.769927	615.523643	<0.0156	0.46364457	382.628643	12.3688466	1.56642105	8.9628202	25.2846744
PM18AJ220	E19JN25a309.csv	178609.152	1.77380688	911.044605	<0.00235	<0.00262	135.365441	139.585242	<0.0157	0.14818634	124.070976	6.70352235	0.52294925	4.07203544	0.48786677
PM18AJ220	E19JN25a310.csv	176897.112	1.72460705	1751.65813	<0.00213	0.2053097	282.084028	290.820056	<0.0139	0.27677897	439.569748	15.0909897	2.16303146	7.11463903	26.8619616
PM18AJ225	E19JN25a322.csv	176396.594	2.12833086	1240.20772	<0.00217	<0.0024	130.525186	136.150588	<0.00945	0.05927584	424.694657	0.25470261	0.02943893	3.28669286	0.07132414
PM18AJ225	E19JN25a323.csv	176342.434	1.75501272	1038.19396	<0.00212	<0.00234	51.3310621	52.1751462	<0.00899	0.01175049	102.983961	0.16923386	<0.00652	2.7858001	0.05833405
PM18AJ225	E19JN25a324.csv	181122.21	2.09264255	1074.03034	<0.00237	0.00642394	327.323852	325.14118	<0.00981	0.06224388	170.528905	0.8174008	0.06699591	3.14310535	0.30713945
PM18AJ225	E19JN25a325.csv	175575.562	1.73841041	1206.72044	<0.0022	<0.00243	80.5248457	81.9448824	<0.00897	<0.0022	91.0566247	0.1887387	0.03974139	2.60252084	0.13070837
PM18AJ225	E19JN25a326.csv	177933.554	1.64453812	995.503472	<0.00214	<0.00237	58.08437	58.6469056	0.01410002	0.00642163	67.9595691	0.50218901	0.09661717	3.02457505	0.19528363
PM18AJ225	E19JN25a327.csv	178058.434	1.67497103	1444.0452	<0.00323	<0.00359	158.253528	155.456017	<0.0129	0.01563907	328.318432	0.46280364	0.01098441	2.10683366	0.54332465

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ225	E19JN25a328.csv	173248.131	1.68479878	1039.87492	<0.00214	<0.00236	90.3061392	90.83181	<0.0086	0.00485929	111.467368	0.06188569	<0.00658	1.44744898	0.01326007
PM18AJ225	E19JN25a330.csv	176922.797	1.53287216	779.836365	0.00447662	<0.00248	29.6537627	31.6835445	<0.00932	<0.00224	45.329986	0.09197756	0.01349168	2.78336091	0.07357703
PM18AJ225	E19JN25a331.csv	178623.926	1.63544497	1148.73893	0.0045617	<0.00248	70.7431336	72.2951169	<0.00961	0.01487266	188.399964	0.0874138	<0.00692	3.5251236	0.03828348
PM18AJ225	E19JN25a332.csv	176318.663	1.59622589	1120.34383	<0.0022	<0.00242	39.4932912	42.6123677	0.01946656	<0.00219	46.4024512	0.25227559	0.03295149	2.08802374	<0.00404
PM18AJ225	E19JN25a333.csv	180319.513	1.77461509	1655.57636	0.00292431	<0.00259	52.4021579	53.5410197	<0.0109	0.00278255	178.064694	0.01461361	<0.00723	1.99716282	<0.00432
PM18AJ225	E19JN25a334.csv	177702.983	1.75006088	1178.56526	<0.00221	<0.00243	52.3627724	53.1193868	<0.0109	<0.0022	41.095564	0.15164803	0.05616434	2.16232558	0.05448296
PM18AJ225	E19JN25a335.csv	174005.461	1.78199369	860.73345	<0.00217	0.02651678	67.8758903	69.1207217	<0.0113	0.02526991	424.699255	1.07844589	0.0843322	14.8008212	0.1278755
PM18AJ225	E19JN25a336.csv	174755.303	2.21043827	1009.89282	<0.00221	0.09257648	88.680316	88.2090991	0.01281987	0.39736689	386.973259	26.4675998	2.34176938	5.94047839	1.12363992
PM18AJ225	E19JN25a337.csv	176166.833	2.25184479	1060.56957	<0.00221	0.08191533	31.2837123	31.1391096	0.01765884	0.36877273	331.081248	22.1172965	1.87568775	6.23814577	0.99523767
PM18AJ225	E19JN25a338.csv	174920.601	3.03620798	1526.0951	<0.00218	0.14820016	260.127814	264.260002	<0.0144	1.03066574	635.996409	85.8558406	6.28397338	3.25401586	32.2349022
PM18AJ225	E19JN25a339.csv	176417.244	2.14799072	644.283933	<0.00224	0.10287775	292.08257	289.3844	<0.0161	0.51999448	390.284135	27.4951357	2.5503198	8.59572288	3.23599852
PM18AJ225	E19JN25a340.csv	177482.684	1.57124752	1609.43094	0.0032323	<0.00255	181.722538	180.911195	<0.0184	0.00478539	43.3566539	0.14274885	<0.00712	3.1308351	0.22335094
PM18AJ225	E19JN25a341.csv	174683.073	2.89516127	1743.87831	<0.00219	<0.0024	157.949199	160.025355	<0.0189	0.00271045	133.275942	0.0434383	<0.0067	1.02849681	0.0432471
PM18AJ225	E19JN25a342.csv	173604.89	1.49325423	867.518349	<0.00221	0.00426075	70.2942011	70.5884363	<0.0209	<0.00218	38.3759696	0.05168095	<0.00675	2.42163053	0.06080661
PM18AJ225	E19JN25a343.csv	174473.376	1.8420695	1250.79381	<0.00216	<0.00237	102.649099	105.378862	<0.0227	0.00254188	266.966327	0.0602564	0.00956628	2.05123729	0.06420813
PM18AJ225	E19JN25a344.csv	173719.863	3.02735242	3636.66782	0.01056045	0.14471423	446.460078	452.529374	<0.0256	1.33347996	1348.60503	127.289321	7.84545584	8.92839023	17.0771631
PM18AJ225	E19JN25a345.csv	180152.57	3.01608372	4869.48178	<0.00354	0.14214078	273.422374	270.158165	<0.0449	0.86066361	927.39649	45.7497404	2.06337059	6.50610103	5.2607093
PM18AJ225	E19JN25a346.csv	175561.788	2.0172565	769.643539	<0.0022	0.02228684	102.077225	110.064749	<0.031	0.2711391	343.930956	13.4518847	1.50140612	7.56454004	0.84965708
PM18AJ228	E19JL11a018.csv	180802.401	2.24180075	3039.29943	0.01498498	<0.00553	194.804707	202.303993	<0.0588	0.29015618	146.085211	2.03357706	0.16879104	5.71849883	4.11243225
PM18AJ228	E19JL11a019.csv	182267.493	2.89364821	1546.3339	0.0430323	0.47810842	564.415758	559.037042	<0.0546	0.36324603	200.139161	8.81179907	0.8855143	4.76045203	7.70172133
PM18AJ228	E19JL11a121.csv	179744.47	3.83522893	1089.29133	0.28069523	0.03379427	1109.02279	1109.18051	<0.0202	0.72294646	313.29408	15.3542198	1.27826731	5.69304229	5.91668926
PM18AJ228	E19JL11a122.csv	176968.495	3.90534187	3999.36507	0.01480318	0.00631352	946.223265	935.65948	<0.0232	1.06622685	257.12374	6.20117805	0.6858462	5.60811075	5.44512429
PM18AJ228	E19JL11a123.csv	180707.502	4.07036488	2018.33632	0.02550563	<0.00332	255.230275	266.750471	<0.0243	0.75832515	240.052853	7.65018876	0.41638556	2.02780803	7.73381687
PM18AJ228	E19JL11a124.csv	179698.419	2.75087687	2043.38106	0.01630293	<0.00277	245.987812	247.872485	<0.0202	0.57230321	163.867875	2.37414127	0.24761175	6.98011037	7.10823659
PM18AJ228	E19JL11a125.csv	178279.65	4.05213519	1993.61336	0.03171579	0.06547499	300.731918	302.675236	<0.0202	1.11622788	300.543597	10.0901875	0.79483091	3.06199211	14.83595
PM18AJ228	E19JL11a126.csv	176195.206	2.67052037	2078.095	0.03993807	<0.00314	777.588407	782.087036	<0.0228	2.13289218	183.401356	24.5078777	2.07283353	11.4293441	11.6220226
PM18AJ228	E19JL11a127.csv	180807.671	2.35099451	1866.31464	0.05703168	0.37992709	756.133663	757.684525	<0.0201	1.39195031	188.25398	16.7376801	1.49734745	9.32440584	15.1877186
PM18AJ228	E19JL11a128.csv	180767.09	3.16818377	3677.82436	0.02802674	0.27392864	627.330248	631.942784	<0.0256	0.91212375	155.793349	18.8557381	1.95245133	6.64829228	17.31374
PM18AJ228	E19JL11a129.csv	181243.494	3.0033937	2369.87656	0.02548711	6.36531449	525.798427	531.880916	<0.0198	3.12478232	275.936268	106.288556	6.89241684	5.77042649	40.8253192
PM18AJ228	E19JL11a130.csv	181481.057	2.66804516	1382.94575	0.03053976	0.1541732	363.200231	359.841607	<0.0195	0.49037139	215.399154	11.9207138	1.24702492	3.44213541	9.11853473
PM18AJ228	E19JL11a131.csv	180629.558	2.53369742	1822.55316	0.08199572	0.02371343	620.394024	621.776445	<0.0196	0.51353891	253.563448	5.40898443	0.55233886	13.6975505	6.8720932
PM18AJ228	E19JL11a132.csv	177850.242	3.10488748	1315.47902	0.06781891	0.01489148	282.298418	284.173696	<0.0207	1.28265938	275.580635	13.887246	1.39104494	3.54886371	18.9577092
PM18AJ228	E19JL11a133.csv	179961.379	4.0077476	3641.7016	0.00899521	<0.0028	706.07434	728.068835	<0.0197	1.29970599	240.581018	25.1439146	2.2205497	2.97650878	5.29665522
PM18AJ228	E19JL11a134.csv	182476.592	1.81651001	885.128092	0.01401454	<0.00339	27.5278763	32.6090637	<0.0234	0.01785829	77.4436121	0.04044847	0.04871481	23.6425612	0.0238986
PM18AJ228	E19JL11a135.csv	175726.267	1.62399895	754.866641	0.01532675	<0.00389	39.405402	42.7520902	<0.0271	0.08179287	117.768811	0.25694211	0.06240815	16.4739886	0.03670735
PM18AJ228	E19JL11a136.csv	180336.609	1.90954904	812.401846	<0.00233	<0.00306	19.665439	18.0162873	<0.0214	0.00554873	78.3720801	0.23551592	0.02135239	20.8778149	0.06727473
PM18AJ228	E19JL11a137.csv	181531.608	3.05934795	3379.55437	0.01771444	0.05477265	653.526347	642.303943	<0.0203	0.95188195	224.149746	6.76651908	0.59713263	10.8195927	10.1761819
PM18AJ228	E19JL11a138.csv	184513.043	2.35632845	2450.66841	0.00706518	0.57445974	236.363073	235.400809	<0.0193	0.50623774	158.042815	4.3548278	0.44682342	6.1462517	19.9709169
PM18AJ228	E19JL11a139.csv	174850.666	3.48458907	4324.55563	0.00656249	<0.00342	645.757685	661.46588	<0.0239	0.71524519	167.714437	3.3699747	0.43728222	5.83124457	2.93295437
PM18AJ229	E19JN25a012.csv	177735.997	2.19809517	2602.79977	0.00537642	0.01114517	423.874806	435.402198	<0.0369	0.59837071	349.106003	9.67026748	0.54956458	10.2949692	8.86400486
PM18AJ229	E19JN25a013.csv	181577.786	1.91763889	1648.88497	0.00338058	<0.00231	953.47764	964.983317	<0.0297	0.21082507	412.384819	10.2100535	0.39387161	8.8968419	3.35137545
PM18AJ229	E19JN25a014.csv	179231.926	1.81375615	1650.62095	0.00539247	<0.00241	488.499522	486.395959	<0.0295	0.12388744	314.648381	4.37135954	0.13159646	7.77886834	0.4771797
PM18AJ229	E19JN25a015.csv	182438.461	1.90187775	2678.79089	0.00528446	<0.0024	673.376928	698.720708	<0.0279	0.1065173	281.835554	2.91253475	0.14076678	11.7660831	0.15474557
PM18AJ229	E19JN25a016.csv	181718.879	2.20222381	1701.1546	<0.00179	0.05899297	781.11074	815.695118	<0.0256	0.27945983	415.019311	13.7002672	0.87988752	10.3480509	12.5877108
PM18AJ229	E19JN25a027.csv	183524.466	2.16536651	1637.27714	<0.002	0.02572446	325.79987	318.784047	<0.0222	2.39666358	418.427502	33.7940451	1.72032274	8.94280766	2.73342704
PM18AJ229	E19JN25a028.csv	183062.724	2.26204617	2397.87241	<0.00188	0.08053152	693.906079	695.032976	<0.0208	0.66350456	310.647317	17.9249202	1.10661559	10.3149861	8.31511011
PM18AJ229	E19JN25a029.csv	180488.788	1.87356879	1397.02816	0.00874954	0.14285261	1128.23084	1142.57528	<0.0204	0.27328104	484.841744	19.4588328	1.23125903	6.67587489	20.3463523
PM18AJ229	E19JN25a030.csv	179551.781	2.03054215	1354.81553	0.00709144	0.00747284	1381.76481	1413.99006	<0.0202	0.32478565	610.550738	13.7459298	0.79258402	7.40713862	6.13610692
PM18AJ229	E19JN25a031.csv	175922.32	1.9930959	1171.6876	<0.00219	<0.0028	1218.23397	1260.79685	<0.0245	0.10971597	456.015253	0.55191787	0.05728242	11.1424632	0.11300471
PM18AJ229	E19JN25a032.csv	178388.565	1.8210623	1377.99793	0.00482724	0.00605869	1008.68877	1038.46004	<0.021	0.13727844	536.518567	6.22401504	0.38779305	5.75360292	2.97589875
PM18AJ229	E19JN25a044.csv	179477.24	1.73823567	1260.08697	<0.0017	0.10563077	162.88703	172.316918	<0.0218	0.37442094	362.48122	138.381217	5.07139135	19.0806347	2.17807557
PM18AJ229	E19JN25a045.csv	181635.386	1.9035066	2192.2947	0.00507231	0.00712676	590.07662	608.158224	<0.024	0.58569404	336.350695	6.50230126	0.39374989	8.36740314	9.87377823

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ229	E19JN25a046.csv	182564.481	1.81231716	1787.03305	0.00670747	0.0061079	720.298738	723.040483	<0.024	0.65400351	418.110758	6.23871845	0.23801154	10.4431668	1.70984317
PM18AJ229	E19JN25a047.csv	182916.634	2.17637449	2597.97372	<0.0019	<0.00241	799.616593	814.93706	<0.0251	0.55330821	352.730374	8.74739119	0.31119076	10.9685407	1.06047964
PM18AJ229	E19JN25a048.csv	181755.668	1.94237809	1387.8902	0.00712273	0.02236976	833.446235	842.089467	<0.0269	0.8136624	478.031245	8.04650421	0.49698769	6.48947991	9.23981052
PM18AJ229	E19JN25a049.csv	180732.163	1.81956735	1555.81609	0.00849399	<0.00235	436.313725	440.076747	<0.025	0.25232362	288.516657	3.80197973	0.18172254	14.3646568	0.45015777
PM18AJ229	E19JN25a050.csv	180534.228	1.83920947	2058.09617	0.00678949	0.0033463	500.014473	502.07234	<0.0252	0.62641833	288.433376	3.58095657	0.17512986	9.76565205	3.1244362
PM18AJ229	E19JN25a051.csv	179530.117	2.11537197	1503.87326	0.00540456	0.00258723	1133.93073	1134.51369	<0.0253	0.53157638	477.794405	4.13739368	0.25575304	9.14433052	6.05299442
PM18AJ229	E19JN25a052.csv	182458.636	1.65691975	1289.26707	<0.00219	<0.00275	48.5153653	50.7272003	<0.0301	0.14057632	393.904661	1.12864691	0.10313862	12.3578395	0.04767499
PM18AJ229	E19JN25a053.csv	179885.51	1.89157863	1950.77734	<0.00184	<0.00232	379.210481	384.109136	<0.0255	0.32901612	312.714536	3.07282245	0.18002333	11.4448155	0.72958946
PM18AJ229	E19JN25a060.csv	182097.534	1.70188426	1985.80029	0.005112	<0.00234	961.272136	976.724524	<0.0263	0.34157735	404.067039	6.71374098	0.5594719	7.75678185	3.47020394
PM18AJ231	E19JL15a026.csv	176885.534	4.9189354	717.903719	0.0159514	0.11400423	470.240272	428.377884	<0.0461	1.09349812	304.688134	2.03858778	0.1892917	1.9364206	10.8511073
PM18AJ231	E19JL15a027.csv	182140.544	6.9515257	871.648058	0.01186975	0.40121731	169.366385	161.459212	<0.0479	0.42327106	242.625433	0.13504894	0.02335557	<1.04	4.62421247
PM18AJ231	E19JL15a028.csv	178505.685	3.5513657	780.474866	<0.00754	0.12122514	650.886156	642.582809	<0.0423	0.2631475	333.382187	4.22205174	0.18329809	2.04513935	9.41344191
PM18AJ231	E19JL15a030.csv	175813.203	4.1990399	596.094295	<0.0062	0.06022065	805.445676	793.441663	<0.0348	0.47657747	471.410951	0.41715848	0.02305324	1.88532057	8.64216392
PM18AJ231	E19JL15a031.csv	180262.697	9.77013585	2320.09721	0.13520591	0.13344678	945.765602	944.996986	<0.0343	4.73828785	288.36585	1.96611466	0.1135708	12.9037774	1.00257605
PM18AJ231	E19JL15a033.csv	183282.895	31.5297508	1528.0814	0.01250832	<0.00662	342.180007	336.553387	<0.0387	7.41779417	252.561145	2.26702442	0.42819115	1.9428601	44.264807
PM18AJ231	E19JL15a034.csv	173402.242	11.2306467	1760.78023	<0.00636	3.97754506	1049.94021	1059.9462	<0.037	5.72566177	511.780669	6.13970767	0.87196097	7.93201476	30.8720315
PM18AJ231	E19JL15a035.csv	182727.319	14.1712465	1651.93278	<0.00845	0.33461547	504.276402	518.382256	<0.0499	3.04204252	326.820068	0.31432572	<0.0196	3.18073908	37.4001498
PM18AJ231	E19JL15a037.csv	174420.468	2.41525844	966.070235	0.01430472	0.67298099	201.565746	198.696279	<0.0439	0.64205976	190.717016	3.1136294	0.55092667	3.45834136	15.0123375
PM18AJ231	E19JL15a038.csv	179418.775	16.2294121	1362.90906	<0.00609	0.16627965	415.216888	419.233226	<0.0377	1.76876841	174.723782	0.37985376	0.0738175	1.43660626	7.14294736
PM18AJ231	E19JL15a039.csv	181315.155	2.35639689	1481.59572	<0.00626	0.75386516	395.386427	401.586708	<0.0394	0.16712079	247.437309	2.43904196	0.18298111	1.4105941	0.97276762
PM18AJ231	E19JL15a041.csv	180221.784	9.08271063	1714.69957	0.04528534	0.1098218	365.62184	373.157691	<0.0428	0.93969652	267.416746	3.24378558	0.30802083	1.24023104	5.71829453
PM18AJ231	E19JL15a042.csv	173932.443	7.54744019	2151.9734	0.0684655	2.61939837	822.639602	786.150034	<0.0424	1.09342909	297.999091	7.01180716	0.30880755	1.68975434	3.09950572
PM18AJ231	E19JL15a043.csv	179606.023	2.26004065	1030.04519	<0.00683	4.32870797	543.304522	526.425288	<0.0459	1.55144449	272.672938	12.7342297	1.08063857	5.02022847	11.4775859
PM18AJ231	E19JL15a044.csv	176086.163	9.04628483	1182.01792	<0.00607	0.5083797	474.084921	469.472401	<0.0415	1.66102198	325.983171	1.92241305	0.1365885	1.47800923	15.8735139
PM18AJ231	E19JL15a045.csv	170591.306	8.57831207	2234.08277	0.03707785	0.71804489	781.966469	757.470104	<0.0568	2.30671738	284.059507	15.0082842	1.61904062	4.83528114	11.337085
PM18AJ231	E19JL15a046.csv	184663.525	2.90208266	602.643689	0.00903245	2.18796436	434.895561	436.080544	<0.0489	1.95724727	238.843735	0.60489498	0.24213001	1.72843509	6.64469991
PM18AJ233	E19JN25a145.csv	180814.886	2.03113197	2180.23943	<0.00194	0.23414321	279.351479	282.222446	<0.0189	2.74206666	302.530031	14.341126	1.01116713	9.74958296	7.03386062
PM18AJ233	E19JN25a146.csv	180099.841	2.16268254	2401.85151	<0.00201	0.01228246	297.547409	301.341516	<0.0197	3.16352434	289.978091	7.24201507	0.56787051	6.42753009	4.20483431
PM18AJ233	E19JN25a147.csv	181852.548	2.19259182	2602.45953	<0.00201	0.42383648	324.166975	331.998624	<0.0197	3.48154038	315.604623	33.3264562	1.88061117	9.77179633	6.66367833
PM18AJ233	E19JN25a148.csv	181070.381	2.18115785	2460.40566	0.00334038	0.1782204	470.0947	468.278353	<0.0204	4.61909763	420.339816	27.0602764	1.99169404	9.83828073	6.12291842
PM18AJ233	E19JN25a149.csv	175551.142	2.04390349	2301.04701	<0.00227	0.00835083	606.250985	605.928402	<0.0224	0.24741707	584.753678	3.87736061	0.34671401	8.18947949	2.03415391
PM18AJ233	E19JN25a150.csv	180125.056	2.01149092	1595.2949	<0.00196	<0.00235	339.914505	334.97883	<0.0194	0.27417037	373.722782	1.41078595	0.21741875	5.37996551	0.99163618
PM18AJ233	E19JN25a151.csv	180147.936	2.03313806	2037.01883	<0.00202	0.2399823	217.5549	212.906405	<0.0201	0.35916654	340.091054	4.8051744	0.53593881	5.437076	14.4189725
PM18AJ233	E19JN25a152.csv	178183.301	2.01827402	1602.26296	0.00476149	<0.00236	972.848722	971.575533	<0.0196	0.1915992	885.855835	3.64532186	0.44842838	8.1363237	10.7533145
PM18AJ233	E19JN25a153.csv	180135.737	1.76112882	1588.98796	<0.00198	0.03174468	470.719645	478.762537	<0.0198	0.33025094	483.368751	3.2561657	0.43788523	5.4397902	3.86479754
PM18AJ233	E19JN25a154.csv	176659.939	1.67846463	1768.29139	<0.00213	0.02450338	287.490569	291.860564	<0.0213	0.34730489	384.119722	5.53473145	0.78747782	6.98209211	4.92021102
PM18AJ233	E19JN25a155.csv	182163.938	2.37319842	3371.64638	<0.00233	0.14421803	380.947243	378.505406	<0.0234	0.67377442	363.352315	12.6249595	1.15290851	7.48251205	6.07252658
PM18AJ233	E19JN25a156.csv	182465.422	3.57452584	2486.08731	<0.00203	<0.00243	274.03635	277.45431	<0.0205	1.24049772	773.503689	99.7713066	7.3160141	12.6046044	13.2887055
PM18AJ233	E19JN25a157.csv	179543.351	1.99269452	2513.37535	0.00309044	0.40734631	661.450544	670.722786	<0.02	3.15474409	368.452005	7.92961464	0.79680374	12.8463337	59.5970699
PM18AJ233	E19JN25a158.csv	181380.41	1.84102071	2520.57841	0.00489688	<0.00243	213.955965	220.420359	<0.0206	0.15599072	285.042775	3.54697248	0.23999446	16.94751	1.70590341
PM18AJ233	E19JN25a159.csv	182710.066	1.54642641	2563.7692	0.00508094	<0.00248	202.09925	201.768247	<0.021	0.11379385	312.997642	2.36308127	0.16169821	14.6469662	0.55050506
PM18AJ233	E19JN25a160.csv	181024.838	1.75986435	2427.05737	<0.00198	<0.00237	160.848227	158.512898	<0.0201	0.0240518	364.177317	0.33661095	0.01730314	11.2023686	0.03805591
PM18AJ233	E19JN25a161.csv	183058.398	1.82436792	2979.77758	<0.00206	<0.00245	313.493266	323.626922	<0.0209	0.9223866	203.527057	1.93465948	0.17881253	16.4678839	1.69949708
PM18AJ233	E19JN25a162.csv	174976.977	1.80622882	2228.69024	<0.00253	0.12790747	1257.76007	1237.60512	<0.0257	1.57938997	361.963459	8.04767633	0.76723551	12.2919019	26.9001894
PM18AJ233	E19JN25a163.csv	181852.723	1.80368528	3916.09698	<0.00206	1.31991262	597.488341	610.783834	<0.021	1.85995202	211.998503	7.49493281	0.61657749	12.7051715	14.0837706
PM18AJ233	E19JN25a164.csv	179988.091	1.84893114	3482.31335	0.00492264	0.02988365	565.11777	577.180068	<0.021	1.32453838	233.733151	3.81579789	0.34326652	10.1406834	18.9285385
PM18AJ233	E19JN25a165.csv	183000.93	1.85652275	2288.08305	0.00321054	<0.00247	269.9612	263.59325	<0.0212	0.28018927	343.932674	5.92243599	0.43707932	18.6312393	1.0610511
PM18AJ233	E19JN25a166.csv	178145.613	1.80256836	2687.0999	0.0045798	0.02283202	403.372532	404.18576	<0.0239	0.44268709	429.817943	4.89833342	0.34365026	21.0183131	2.84136965
PM18AJ233	E19JN25a167.csv	185284.21	1.86927103	1843.35603	<0.00256	0.09333957	897.56263	891.449026	<0.0261	1.09661963	770.981856	9.90576462	1.38345923	10.673947	46.7318539
PM18AJ238	E19JN26a129.csv	176632.413	2.53103921	1748.70368	0.00974408	0.11507601	214.775718	213.992006	<0.0151	0.14891658	47.2246011	0.74104828	0.07624158	3.92318819	3.04121451
PM18AJ238	E19JN26a130.csv	176165.78	2.87501729	2194.10443	<0.00186	<0.00237	63.9533604	66.9899582	<0.0151	0.16878081	71.4988946	0.42284173	0.0267515	2.24549669	0.02647978
PM18AJ238	E19JN26a131.csv	178725.778	2.53272944	2123.93422	0.02182617	0.03990926	171.248314	169.076619	<0.0154	0.15607138	37.9123953	1.78339008	0.12926639	5.49723046	0.16992218

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ238	E19JN26a132.csv	183071.927	2.59109557	900.554572	0.13064966	<0.00386	836.886868	856.215274	<0.0243	0.30097152	78.6845224	1.98738305	0.54496602	7.6911398	0.21312523
PM18AJ238	E19JN26a134.csv	176711.208	2.81684484	2121.62196	<0.00186	1.35799383	421.714974	428.544798	<0.0148	23.8310453	168.99121	215.547566	13.9122034	2.7919292	11.4038522
PM18AJ238	E19JN26a135.csv	183632.191	2.63704192	2732.47679	<0.00287	0.25599475	358.09145	352.469438	<0.0228	30.4589076	121.594926	252.586193	18.2175446	1.94273806	9.2828544
PM18AJ238	E19JN26a136.csv	173142.222	2.43694987	1690.64104	0.00440005	0.00604319	105.995853	104.593176	<0.0168	0.36890645	74.3882848	0.57042003	0.07405698	2.5437554	0.15418353
PM18AJ238	E19JN26a143.csv	177668.736	3.19781363	2468.92685	<0.00187	<0.00237	101.791259	102.175476	0.01579977	0.11301121	41.9564056	0.65336519	0.02343229	3.87752617	0.06300631
PM18AJ238	E19JN26a144.csv	182586.037	2.96765735	2111.1978	0.09166968	0.42361853	692.015413	681.475889	<0.0163	0.47573204	46.8097576	19.520352	1.30932056	5.74674284	24.1844249
PM18AJ238	E19JN26a145.csv	179438.36	2.82510351	3416.20707	0.06327913	0.00858162	581.384578	584.459822	<0.0151	0.18955295	43.6462362	1.85405837	0.14859422	6.31726153	0.58264526
PM18AJ238	E19JN26a146.csv	179948.025	2.80669987	2499.33805	0.01436692	<0.00293	200.0429	203.045144	<0.0181	0.11883582	42.6792471	0.59276799	0.04705121	6.2540778	0.23352626
PM18AJ238	E19JN26a147.csv	176785.378	3.00076933	1282.8143	0.00843803	<0.00244	827.889984	821.710072	<0.0151	3.15332994	130.637254	1.90335945	0.71390109	1.9770251	0.02097086
PM18AJ238	E19JN26a148.csv	175905.357	2.8026208	3412.2006	0.07209488	0.11404985	662.863545	673.356722	<0.0152	0.5984612	58.9257347	3.37344228	0.31198893	7.97734819	0.69218768
PM18AJ238	E19JN26a149.csv	183410.836	2.34236382	2084.44105	0.05630895	0.03237461	287.213424	284.367912	<0.016	0.35309671	26.9186055	9.19859254	0.6912119	13.2614799	10.0705189
PM18AJ238	E19JN26a151.csv	176593.4	3.14142946	1842.08118	0.00804736	<0.00233	503.056147	500.795528	<0.0145	0.14151331	100.92724	0.43795319	0.04941206	2.50020211	0.11007473
PM18AJ238	E19JN26a152.csv	180237.894	2.26790704	2951.80167	0.07428882	0.00621913	593.761031	594.160289	<0.0159	0.54546978	38.4944159	12.7391547	0.92900866	6.03497001	6.11856967
PM18AJ238	E19JN26a153.csv	179598.418	2.51793395	1875.53346	<0.00219	0.08815518	375.503986	373.668592	<0.0174	33.1714033	122.703406	144.077511	11.9155681	1.80912525	7.64263974
PM18AJ238	E19JN26a154.csv	177508.54	3.43178072	2871.26322	0.02260574	0.21453225	617.687108	620.848463	0.02076318	4.87185066	101.512694	23.9927215	1.63092884	4.94226731	5.36896676
PM18AJ238	E19JN26a155.csv	177082.747	2.35856213	2493.22494	0.02167593	<0.0024	326.744918	322.561233	<0.0151	0.22951667	55.4573203	1.59700185	0.08117825	4.93221371	1.84187023
PM18AJ238	E19JN26a156.csv	179148.112	2.09559609	1993.62701	0.1471485	0.00577023	936.228709	942.036624	<0.0153	0.42071371	87.2749747	2.36393792	0.19440569	7.91769356	5.01552706
PM18AJ238	E19JN26a157.csv	179032.361	2.41534138	3101.00617	0.01854782	0.09358933	953.341999	948.859268	<0.0154	1.56893636	54.8717118	13.3053992	1.40195088	6.69664269	3.91191833
PM18AJ238	E19JN26a158.csv	176726.473	2.26976609	1614.88581	0.02311554	0.0083007	1116.5491	1120.70815	<0.0151	2.6198061	111.968158	5.54453781	1.06912803	3.74584034	0.72789545
PM18AJ238	E19JN26a159.csv	179276.258	2.323408	1551.50137	0.04260173	0.07968886	364.925265	367.937544	<0.0156	4.70325638	64.730089	10.6427484	1.83879568	5.97001675	2.88912148
PM18AJ242	E19JL11a070.csv	180316.816	2.01137178	734.918505	0.01816933	0.02641134	193.568487	198.123197	<0.0276	0.3760347	180.296496	2.59331252	0.28445335	5.30687932	6.49707613
PM18AJ242	E19JL11a071.csv	177915.888	2.65553796	1278.20083	<0.00176	0.004667	35.6632069	37.3040585	<0.0262	0.65713511	163.987086	3.97921905	0.40834815	3.09373513	0.47011932
PM18AJ242	E19JL11a072.csv	176195.549	3.3513183	2762.38115	0.01454762	0.01771413	172.473504	170.798041	<0.0268	1.62581449	345.289614	19.0077113	1.23217925	4.25536739	29.1087589
PM18AJ242	E19JL11a073.csv	181094.505	2.22856305	1119.58284	<0.00205	0.00660847	25.3060176	25.7696773	<0.0302	0.06897477	55.87396	2.62346596	0.42448814	1.93575396	0.02146758
PM18AJ242	E19JL11a074.csv	184865.071	3.09969678	5577.23873	<0.00271	0.0067495	82.7128654	72.9953429	<0.0398	0.25121365	88.0896288	6.24717388	0.82401547	2.51568922	3.99907865
PM18AJ242	E19JL11a075.csv	177252.444	3.02089478	2161.04579	0.00344815	<0.0025	18.5780785	18.5567005	<0.0257	0.58458218	116.289742	2.28931694	0.1910384	3.35073253	0.62481951
PM18AJ242	E19JL11a076.csv	177467.678	2.37898442	1566.37577	<0.00177	0.0038279	22.8808585	21.1368342	<0.0257	0.26547692	53.9475595	3.56304414	0.31260419	0.70038926	0.02623242
PM18AJ242	E19JL11a077.csv	176073.725	2.20807601	2628.87461	<0.00178	<0.00252	25.6634293	26.6402867	<0.0258	0.17518961	53.6588001	1.42663834	0.31766959	1.00344477	0.09954632
PM18AJ242	E19JL11a078.csv	173001.48	1.82110108	2070.53626	0.00972775	<0.00352	123.584723	124.190798	<0.0357	0.25521871	24.8634204	6.04255743	0.84319633	1.68491194	1.20860488
PM18AJ242	E19JL11a079.csv	173469.324	1.79403534	3804.78066	0.00299652	0.05962136	66.4475574	67.3403806	<0.027	0.15119043	59.083986	1.28509949	0.10252768	3.8896831	1.53453078
PM18AJ242	E19JL11a080.csv	174673.931	2.43639887	2674.90992	0.00829239	<0.00276	202.015683	207.064837	<0.0279	0.83442349	234.212215	8.0904209	0.83902531	5.82374544	5.41362022
PM18AJ242	E19JL11a081.csv	173877.878	1.93036484	3291.25987	<0.00183	0.05857345	35.5581905	34.4303113	<0.0258	0.07825953	18.2811064	0.29045982	0.0159265	1.1954345	1.05833484
PM18AJ242	E19JL11a082.csv	179224.459	2.0023773	1945.33582	<0.00186	<0.00262	11.9983215	12.2706354	<0.0262	0.05650686	59.765608	0.98160261	0.10844539	2.73530634	0.0204037
PM18AJ242	E19JL11a083.csv	181053.284	1.72690143	3548.96828	<0.00336	0.03718321	61.1003797	61.1624242	<0.0471	0.05787567	52.0214016	1.7854552	0.26048519	7.47842115	1.74393211
PM18AJ242	E19JL11a084.csv	179396.574	2.38133802	5118.77673	<0.00191	0.01762864	17.1659883	17.4151313	<0.0265	0.16839639	83.0394553	2.85388819	0.35095114	2.08716651	2.31897263
PM18AJ242	E19JL11a085.csv	175128.386	1.95465199	4415.07359	<0.00202	<0.00283	4.30015435	5.19193374	<0.0279	0.06667948	32.500803	0.36682892	0.01612347	3.19073281	<0.00556
PM18AJ242	E19JL11a086.csv	176759.639	2.95587562	2304.74567	0.02234363	0.04176065	499.787717	508.491721	<0.0275	0.97948574	240.61218	10.5396206	1.31195121	4.74138622	6.04507817
PM18AJ242	E19JL11a087.csv	178248.129	1.84010486	3030.09902	0.005258	0.00398973	21.981	22.4926801	<0.025	0.81008971	154.10076	5.98186355	0.58621688	4.95070416	0.35481172
PM18AJ242	E19JL11a088.csv	173405.141	2.11639592	1857.28896	0.00836358	0.02969212	379.576889	372.183834	<0.0332	0.44826582	62.2011953	7.94472836	0.49502292	3.54183199	0.7625041
PM18AJ242	E19JL11a095.csv	177957.916	2.26000003	3580.01569	0.0035978	0.09545803	231.106765	227.226326	<0.0241	0.64844328	106.655713	16.1585012	1.38469008	5.52316161	1.80664611
PM18AJ242	E19JL11a096.csv	175412.645	2.411186	2514.9119	0.00338861	0.00399007	102.757277	100.823844	<0.023	0.32947528	55.0446485	5.66108908	0.91267987	2.66151194	0.9127304
PM18AJ242	E19JL11a097.csv	174541.743	2.27843585	1961.98107	0.00408438	0.22010031	180.505734	180.252261	<0.0256	0.79075841	110.209406	3.39294584	0.24865216	7.02573328	31.7208871
PM18AJ242	E19JL11a098.csv	178405.172	2.36770651	3275.54941	0.00894895	0.0468257	227.118258	221.673611	<0.024	0.40875464	82.729702	5.54910685	1.07591288	3.9119851	21.0319615
PM18AJ242	E19JL11a099.csv	178584.626	1.6865313	3717.28097	<0.00194	0.00398329	35.6379857	34.1746426	<0.0235	0.04217878	24.0067905	0.29626306	0.03137215	4.33610786	0.21850404
PM18AJ249	E19JN25a225.csv	179235.584	2.28589026	1653.56398	0.00301996	<0.0024	949.204087	941.554883	<0.0147	0.34687243	1061.08919	1.34891257	0.19345939	18.5918029	10.0470457
PM18AJ249	E19JN25a226.csv	177545.914	2.07392456	1755.02251	0.00450793	0.00302567	1052.39054	1046.21694	<0.0143	0.25741691	518.097253	0.48848915	0.06253719	13.980484	0.60484665
PM18AJ249	E19JN25a227.csv	178711.76	1.94810412	2120.95205	0.00604196	0.00298408	645.644004	645.468285	<0.0141	0.49189053	661.140754	3.69549918	0.41089654	17.6230675	5.83073548
PM18AJ249	E19JN25a228.csv	178903.499	2.70834838	2150.52069	0.00212925	1.23895508	349.779692	340.130407	<0.0148	1.2855264	707.500566	55.3226474	4.6298655	24.8132059	4.64230168
PM18AJ249	E19JN25a229.csv	174721.575	1.94447253	1224.04571	0.00699813	0.00263029	425.795005	412.383866	<0.0148	0.07753371	368.06253	1.93067217	0.19985677	10.7824877	0.02758009
PM18AJ249	E19JN25a230.csv	173964.975	1.94382662	1960.67179	0.00744469	0.07818637	1031.2693	1011.38657	<0.0161	0.56898632	422.230615	6.38241463	0.74195708	14.3467037	6.46772491
PM18AJ249	E19JN25a237.csv	179435.709	3.03306987	1159.00125	0.00291081	0.0156969	253.593223	253.202246	0.02216974	0.60493326	197.570155	9.08771656	0.7216441	9.38218365	1.40972801
PM18AJ249	E19JN25a238.csv	181105.345	2.35657708	2167.60342	<0.00264	<0.00306	581.601544	584.70612	0.0274044	0.33257045	687.379075	1.03622762	0.12852029	7.19550007	2.39295278

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ249	E19JN25a239.csv	175361.953	2.09975756	1682.3392	0.00538251	<0.00255	923.240562	900.197475	<0.0155	0.14523714	707.435133	0.79549838	0.08530245	10.8639354	0.32885835
PM18AJ249	E19JN25a240.csv	177495.313	2.79863042	1676.9636	<0.00212	0.00403175	747.583937	739.899354	<0.0148	0.7769038	1020.66756	5.42575127	0.41685079	9.61582326	1.82132819
PM18AJ249	E19JN25a241.csv	178168.027	2.2853431	1049.23268	<0.00207	<0.00239	128.209753	125.719088	<0.0145	0.11550599	237.094846	0.5788476	0.03340227	21.170036	0.0785566
PM18AJ249	E19JN25a242.csv	177645.132	2.10001278	1324.90266	0.00290829	<0.0024	398.692346	392.133843	<0.0147	0.89899196	385.77233	9.03023766	0.50993184	11.3773112	0.16153583
PM18AJ249	E19JN25a243.csv	177587.707	2.61233326	1969.06428	<0.00211	0.17753187	657.138912	653.785801	<0.0149	1.25913155	689.440339	8.20424213	0.74688197	11.831041	9.60372982
PM18AJ249	E19JN25a244.csv	176572.216	1.89103726	1237.78826	<0.00202	<0.00232	154.668123	154.66955	<0.0143	0.30573832	327.059174	0.63987216	0.08383746	13.3170972	0.07047684
PM18AJ249	E19JN25a245.csv	182820.801	2.76080523	957.761038	<0.00238	<0.00275	713.558976	713.232452	<0.017	1.10898089	138.599012	11.6728717	1.20507509	17.0738372	1.01092682
PM18AJ249	E19JN25a246.csv	179598.844	1.93426885	1789.30592	0.00458323	0.08692532	562.734298	558.445713	<0.0151	1.40474196	493.096425	5.76330995	0.50073509	32.057715	4.77251196
PM18AJ249	E19JN25a247.csv	177484.647	1.96197946	1876.52768	<0.00211	0.00581438	954.190923	941.747761	<0.0153	0.18869205	458.197367	0.22752847	0.02708913	15.1655146	0.01403478
PM18AJ249	E19JN25a248.csv	177638.684	2.41809587	1342.63878	<0.00208	0.00302566	1052.69378	1025.80287	<0.0151	1.11991165	1630.00525	2.81268433	0.38014775	11.2467387	19.1760631
PM18AJ249	E19JN25a249.csv	179294.178	2.28085208	1782.31084	0.00636273	0.04560562	690.387579	679.918415	<0.017	0.99673224	933.819038	5.59705337	0.36460515	16.149667	5.20834571
PM18AJ249	E19JN25a250.csv	180171.915	1.80558619	2232.19971	<0.00215	0.03180586	393.760049	390.169464	<0.0159	1.99041818	527.790724	8.18868222	1.01036946	27.2034711	35.5977344
PM18AJ249	E19JN25a251.csv	175110.361	1.64216327	2605.54568	<0.00255	0.06082181	426.897073	416.657381	<0.019	0.58725094	386.744283	2.07367808	0.34553994	29.8408945	9.48707277
PM18AJ249	E19JN25a252.csv	178279.586	2.05189983	1603.18306	<0.00208	0.04339219	327.096908	327.378732	<0.0156	1.33308549	681.329582	6.27433301	0.70798202	25.7868063	2.43260659
PM18AJ249	E19JN25a253.csv	182453.808	2.34922063	2370.36527	<0.00321	5.00345498	471.343769	460.573054	<0.0243	2.83473624	667.034261	40.3896292	3.71370078	24.1466029	12.6645302
PM18AJ249	E19JN25a254.csv	177959.86	1.93934072	2818.18516	0.07661115	0.08770638	540.443726	537.147562	<0.016	1.07899904	916.063798	6.64458999	0.67133362	35.8657628	4.18352528
PM18AJ249	E19JN25a255.csv	176666.028	2.97866446	2542.25609	<0.00206	0.25085918	516.507216	515.304919	<0.0158	1.87408649	1232.63293	20.0483048	1.83295187	19.635953	2.45841457
PM18AJ252	E19JL11a007.csv	181616.127	7.02660186	877.032404	<0.00344	0.63668892	94.2264824	95.2492582	<0.101	2.84683918	181.693343	125.024854	8.08826719	4.77948486	1.14238627
PM18AJ252	E19JL11a009.csv	182452.074	3.13595216	3229.0599	<0.00348	0.05257864	601.67568	607.331699	<0.0899	0.55954655	295.75124	13.7399895	0.94808387	7.68443556	1.42675198
PM18AJ252	E19JL11a011.csv	178895.681	3.31550943	279.015827	0.05589379	0.78819417	456.534479	443.968795	<0.0895	0.63795701	182.028979	12.0591184	1.89408307	2.71564365	2.02382707
PM18AJ252	E19JL11a012.csv	180194.127	2.82082983	268.199582	<0.00443	0.07158365	66.3026928	59.746843	<0.0954	0.51319313	83.6592771	27.0455807	2.23031824	5.86126655	0.02100344
PM18AJ252	E19JL11a013.csv	183766.736	3.87016731	709.27551	<0.00603	6.01419049	860.276769	899.409802	<0.123	0.65194012	620.008521	18.0403928	2.09326018	6.75152593	6.46104388
PM18AJ252	E19JL11a015.csv	180161.956	1.92114965	758.088196	0.00494109	0.20357996	60.0944319	58.4885606	<0.0661	0.13678264	7.65594045	1.5931274	0.09170315	4.8616443	0.15244236
PM18AJ252	E19JL11a235.csv	180908.643	2.89872637	615.961589	0.00612747	0.76519377	114.887588	108.158378	<0.031	0.21468101	51.9490456	2.0767701	0.26011288	3.18939714	0.98375096
PM18AJ252	E19JL11a236.csv	179378.135	3.69637852	941.599804	0.00381758	0.09405407	106.161433	103.996312	<0.0248	0.30043181	31.3613928	5.65031143	0.3099987	8.04091417	0.59141865
PM18AJ252	E19JL11a238.csv	171725.818	1.34238559	731.364436	<0.00353	0.24434244	212.737082	196.902962	<0.0243	0.09295686	10.4895167	1.09853516	0.08758605	4.00634443	25.0240663
PM18AJ252	E19JL11a239.csv	175737.941	2.55214018	1542.71564	<0.00276	0.21198158	79.2913757	77.9679358	<0.019	0.40953818	86.9786696	2.88091052	0.21047993	3.04491307	0.35314855
PM18AJ252	E19JL11a240.csv	178410.84	3.10174858	1460.80616	0.00296464	0.04699637	116.022532	111.770115	<0.0168	0.68771003	45.1938584	5.90564191	0.69746089	3.3980452	0.29882175
PM18AJ252	E19JL11a241.csv	180432.162	3.00067748	531.809162	0.01060239	0.11991117	877.188773	850.127481	0.03164798	0.38514544	130.249914	6.42198746	0.92272941	10.2562703	1.2197897
PM18AJ252	E19JL11a243.csv	178432.737	7.40296368	757.149429	0.00631398	7.17130585	294.46659	291.555181	<0.0162	6.29975567	185.983522	54.2583194	5.13796816	6.72708848	3.51813274
PM18AJ252	E19JL11a244.csv	177896.272	3.22780804	1098.15749	<0.00307	0.41084306	177.306116	169.536741	<0.0216	0.92419093	279.734454	6.29029333	0.29493636	9.69139911	0.48537432
PM18AJ252	E19JL11a245.csv	175291.264	4.04682434	450.993663	<0.00341	0.28414315	561.951162	564.703072	<0.0233	1.19455817	122.442072	30.2312333	2.91061674	5.01758546	6.49678933
PM18AJ264	E19JL11a022.csv	180401.365	2.92736305	643.860687	0.0118489	0.00824701	278.926089	270.668992	<0.0491	2.57139387	517.406497	2.10454679	0.21581895	16.6280305	2.50607551
PM18AJ264	E19JL11a023.csv	178824.593	2.85796948	766.920302	<0.00374	0.11761816	223.015158	227.077432	<0.0505	2.13422225	335.872908	2.22673794	0.26770308	6.50816123	21.1757709
PM18AJ264	E19JL11a024.csv	175722.071	2.6418181	1268.11442	<0.00363	0.01209526	1397.89002	1402.81646	<0.048	0.65430799	529.72361	1.91778841	0.17670919	3.42349044	6.78533168
PM18AJ264	E19JL11a025.csv	177967.581	2.49943001	874.059123	0.00995236	0.04950535	579.071014	583.757318	<0.0504	3.0898952	414.454329	13.3704162	1.33433958	10.3043221	21.2297639
PM18AJ264	E19JL11a026.csv	176074.85	2.3629732	1060.57011	0.00487515	0.15572282	240.188196	233.802463	<0.0511	1.57218056	202.182165	9.01209343	0.94840391	5.66429959	44.1260294
PM18AJ264	E19JL11a027.csv	184718.662	2.42003259	966.394212	0.00826267	0.00661362	263.388656	284.267326	<0.0554	1.27821222	218.728582	3.32317097	0.35219985	7.19277127	10.8471192
PM18AJ264	E19JL11a028.csv	169362.09	2.39691807	995.854862	0.00750458	0.16539908	677.138334	705.970829	<0.0519	1.12344311	392.671761	4.8360449	0.65321645	15.5804265	17.4869559
PM18AJ264	E19JL11a029.csv	184074.317	2.65862371	976.427495	0.00696567	0.04718834	862.80585	860.004894	<0.0513	0.765442	300.176138	8.45447873	1.21325148	5.52303063	84.2760831
PM18AJ264	E19JL11a030.csv	182359.744	2.18832812	1049.33678	<0.0035	<0.00523	707.414557	710.325931	<0.0431	1.39345705	359.582363	12.0622309	1.68313563	13.0383716	47.1364981
PM18AJ264	E19JL11a031.csv	178637.457	2.42115557	1533.95274	<0.00376	0.68823305	435.070861	429.520103	<0.0461	2.15660323	206.088096	23.690741	1.64965131	4.15527742	59.8974514
PM18AJ264	E19JL11a032.csv	168753.453	2.48900855	1556.91398	<0.00502	0.97227921	781.686221	769.533392	<0.0613	0.8991061	315.808109	12.6964499	1.66229162	6.23075033	129.74109
PM18AJ264	E19JL11a033.csv	173135.679	1.84817454	1214.51407	0.00915592	0.07181941	336.557688	320.598381	<0.0565	1.49212095	218.741575	4.83637711	0.52539739	7.54821614	24.2653336
PM18AJ264	E19JL11a034.csv	179542.463	2.11568832	1636.27536	<0.0037	0.71984982	418.78735	417.402157	<0.0454	1.80012142	181.770483	11.0749232	1.27365451	5.40925673	22.4254706
PM18AJ264	E19JL11a035.csv	170161.669	1.91079425	2018.05586	<0.00456	0.49789767	614.377819	602.918606	<0.0561	3.05874862	142.915832	26.0611057	2.49131333	5.86640012	27.0712336
PM18AJ264	E19JL11a036.csv	180484.847	2.73407851	1333.32053	0.00807637	0.39464635	877.436035	888.869856	<0.0454	0.80513431	376.659466	10.0675459	1.51062511	11.2909108	126.621101
PM18AJ264	E19JL11a038.csv	181906.181	2.27329526	1040.99412	<0.00404	0.03424372	750.506554	753.127098	<0.0508	1.25867556	355.748913	9.74705907	1.41135101	6.48187122	50.8019903
PM18AJ264	E19JL11a040.csv	176687.007	2.38135545	1195.27193	0.01745873	0.0951375	288.974243	294.054691	<0.0496	2.96160582	199.76429	25.403327	2.06062825	8.05365823	73.2932212
PM18AJ264	E19JL11a041.csv	178613.785	2.34637231	1431.24659	0.02476669	0.20224334	624.505913	625.805315	<0.0486	2.36059012	190.101109	15.0685745	1.55382047	9.70648998	15.2897108
PM18AJ267	E19JL11a140.csv	183642.485	1.90385871	975.708628	0.00335126	0.01033643	50.7573588	52.0903036	<0.0221	0.01906136	18.8014179	0.25509778	0.04699737	2.06298355	0.13997562
PM18AJ267	E19JL11a141.csv	172542.464	3.12384311	1136.7965	<0.00336	0.00995582	151.800526	158.785785	<0.0303	0.76968077	395.873661	5.17358824	0.42301095	1.25613203	0.8410427

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ267	E19JL11a142.csv	177414.219	2.12270736	960.637813	<0.00231	0.00377931	48.4903454	51.3137452	<0.0208	0.01276912	5.94829543	0.19018371	0.02288402	2.12325582	0.08282441
PM18AJ267	E19JL11a149.csv	184993.656	2.2461074	1182.81967	<0.00367	0.02249862	47.40185	54.8963793	<0.0327	0.64410026	188.372973	8.661086	0.87048351	2.5186651	0.2528779
PM18AJ267	E19JL11a150.csv	176975.806	2.08266925	1091.93912	0.00621965	0.02440704	60.7083638	61.4538564	<0.0228	0.04632626	39.110014	1.8936489	0.18330399	1.09423395	0.09696779
PM18AJ267	E19JL11a152.csv	176490.253	3.52644495	1217.52675	<0.00241	0.0058897	265.155597	265.083629	<0.0214	6.39477546	708.057907	33.3894913	3.61631961	0.63441026	2.14182158
PM18AJ267	E19JL11a154.csv	176937.915	4.53875622	1345.99234	0.01636535	0.95035519	870.020555	864.610562	<0.0211	12.2032262	456.487366	183.708303	4.35715757	2.73451189	8.09741669
PM18AJ267	E19JL11a155.csv	181519.203	2.19756488	1047.70239	<0.00218	0.00618389	126.532164	123.097903	<0.0194	0.27830408	251.167593	2.42883044	0.29117386	1.84741791	0.82935905
PM18AJ267	E19JL11a156.csv	174033.928	2.27720059	1312.26476	0.00547798	<0.00429	29.1806598	25.5867563	<0.0297	0.03540435	35.2151756	0.83730401	0.06283948	0.88672995	0.04520628
PM18AJ267	E19JL11a157.csv	175614.363	2.38069859	837.778818	0.01207907	0.14766506	396.021497	405.762306	<0.0245	0.93028709	542.680824	6.49955236	0.85719426	1.89291071	15.246504
PM18AJ267	E19JL11a158.csv	179848.604	1.97735204	872.962636	0.00432299	0.02916785	42.2500803	45.5921603	<0.0268	0.07386354	66.1256811	0.70606355	0.10064848	1.65805939	0.4688595
PM18AJ267	E19JL11a159.csv	180248.844	2.10548546	755.086533	<0.00365	1.09193684	146.170156	148.345478	<0.0324	0.56525042	214.280207	8.68775152	0.70011501	5.72121762	0.39602895
PM18AJ267	E19JL11a160.csv	185664.617	2.46920217	938.648868	<0.00309	0.02037281	105.55826	104.662952	<0.0275	0.85804364	310.870098	9.32299723	0.83265166	1.88605719	0.28845886
PM18AJ267	E19JL11a161.csv	184702.858	2.08515238	604.083159	<0.00285	<0.00365	79.2299701	79.4064092	<0.0254	0.02293292	27.8906809	0.58319146	0.14461429	1.23856601	0.10774315
PM18AJ267	E19JL11a162.csv	175644.244	1.7121304	608.473564	<0.00241	0.02664098	44.4093525	40.5172743	<0.0214	0.01257406	41.0201788	0.23568795	<0.0102	1.08788162	0.03010689
PM18AJ267	E19JL11a163.csv	173760.095	1.51653138	851.620055	0.01407436	0.06583524	45.8368301	51.5808838	<0.0311	0.00810049	18.5753615	0.32824984	0.05772023	1.80693794	0.26369549
PM18AJ267	E19JL11a164.csv	184990.922	2.24447964	1153.34489	0.007842	0.05178227	27.0441185	21.6037982	<0.0377	0.46754935	45.6034371	4.92037334	0.42896682	1.37767522	0.06723725
PM18AJ267	E19JL11a165.csv	182672.716	2.24219834	823.331486	<0.00297	0.08566598	33.349966	29.7418211	<0.0264	0.20146766	42.2447817	2.02753854	0.15794769	2.25777477	1.64356669
PM18AJ270	E19JN26a185.csv	177868.286	2.81374097	1275.34405	0.02586142	0.00381332	408.544119	412.854518	<0.017	0.13183011	215.190188	1.58497972	0.12773198	2.71115141	0.98157164
PM18AJ270	E19JN26a186.csv	177860.738	3.99164299	1049.50464	0.0663228	<0.00231	1905.09458	1903.55584	<0.0171	0.22725551	566.569086	12.7435915	1.56887005	3.10513226	6.93144339
PM18AJ270	E19JN26a187.csv	177415.837	2.89798013	1498.64677	0.01610673	<0.00231	668.715492	669.90125	<0.0172	0.26851779	411.628292	9.69518713	1.11870074	3.83549849	4.05472408
PM18AJ270	E19JN26a188.csv	181749.777	2.860693	2860.50212	0.00514683	0.00319248	136.570902	134.409957	<0.0187	0.03640852	133.288163	0.37997267	0.03902304	8.8938086	0.76492736
PM18AJ270	E19JN26a189.csv	177644.19	2.95582136	1061.93369	0.13275997	<0.00231	1728.53711	1725.85933	<0.0174	0.10535249	373.491145	5.33885397	0.8303309	4.50319433	4.2422326
PM18AJ270	E19JN26a190.csv	181928.2	2.49843261	2610.91543	0.01375083	<0.00247	296.091108	298.45672	<0.0187	0.00533976	117.26133	0.00863859	<0.00719	11.5708339	0.14870135
PM18AJ270	E19JN26a191.csv	182958.051	3.23887924	2368.57467	<0.00197	0.13854989	335.206845	335.72445	<0.0189	1.42438684	118.056595	35.5538147	2.62525505	12.1144842	43.0402086
PM18AJ270	E19JN26a192.csv	180306.789	4.25056788	2472.17188	0.01570203	0.18080984	1318.93476	1317.55375	<0.019	1.47317869	303.974069	69.5270285	5.64865425	12.5196961	51.1926206
PM18AJ270	E19JN26a193.csv	182213.78	3.51758139	1994.5241	0.01372529	0.10768983	1217.81633	1215.85971	<0.0189	1.30639466	237.196504	32.4743486	5.81123069	16.4898142	38.4782253
PM18AJ270	E19JN26a194.csv	177564.735	2.59790876	794.641786	0.0224871	0.00982558	1306.11337	1314.14718	<0.0177	0.56171943	297.847066	10.6665333	0.89219024	2.845412	27.9295892
PM18AJ270	E19JN26a196.csv	175925.38	2.78346561	1911.33329	0.02008577	<0.00249	1058.63627	1093.7737	<0.0194	0.24360975	1186.62101	0.05418091	<0.00728	9.97582366	1.14858898
PM18AJ270	E19JN26a197.csv	179607.231	2.57419599	2289.94774	0.00327999	<0.00242	747.738118	757.936258	<0.0189	1.01401046	216.526104	9.61393466	0.64788623	1.9235531	0.68348158
PM18AJ270	E19JN26a198.csv	176388.882	3.3613781	2727.2703	<0.00186	<0.00235	1287.20709	1280.1553	<0.0184	0.52749629	209.720556	3.36463998	0.34584414	2.54932006	1.04552348
PM18AJ270	E19JN26a199.csv	181037.444	4.94901362	1456.03068	0.00828942	<0.0024	249.257458	255.55252	<0.0189	0.04929612	328.821358	2.72971972	0.3697305	4.87901749	0.71966715
PM18AJ270	E19JN26a200.csv	183579.906	2.34198264	1327.73078	<0.00199	<0.00251	214.726643	217.102675	<0.0198	0.0196921	62.2783679	0.0201418	<0.0073	13.2537249	0.07959067
PM18AJ270	E19JN26a201.csv	177551.449	2.61370872	1901.71012	0.01141415	<0.00235	379.954562	380.603709	<0.0186	0.019206	301.912973	0.0462248	<0.00684	3.98414678	0.06842522
PM18AJ270	E19JN26a202.csv	176482.564	2.71351401	1357.37477	0.03518451	<0.00229	954.447168	954.103717	<0.0182	0.21543681	289.121679	2.95407906	0.35948091	1.76450177	2.85482283
PM18AJ270	E19JN26a209.csv	180775.229	3.57614136	1940.16323	<0.00188	0.0030365	214.835098	217.680132	<0.0192	0.01309891	332.499899	0.24838401	0.02358946	4.85998363	0.23486309
PM18AJ270	E19JN26a210.csv	183916.976	3.48575094	1795.42602	<0.00197	<0.00249	323.130446	310.817101	<0.0201	0.65359917	132.417238	8.79569694	1.04436305	3.62327489	26.4640166
PM18AJ270	E19JN26a211.csv	180871.042	4.04812248	3472.3228	<0.00205	0.1641392	485.283234	496.941057	<0.021	0.9983458	175.423932	37.5846675	3.23792356	9.67548996	25.4048236
PM18AJ270	E19JN26a212.csv	181378.639	2.7385734	1532.17091	<0.00197	<0.00249	127.945992	132.976553	<0.0203	0.00788398	218.956294	0.01835828	<0.00725	5.61132277	0.10455586
PM18AJ270	E19JN26a214.csv	178738.124	3.26388344	1216.65168	0.00645589	0.24000748	1400.64204	1398.39585	<0.0191	1.25910911	408.991313	19.0236373	1.72060278	2.64909763	60.6894911
PM18AJ274	E19JN25a198.csv	182976.296	13.0840711	1791.97042	0.10452744	0.15227798	384.081359	382.797264	<0.0185	15.6545785	239.627403	15.1260914	2.19376499	9.00072682	4.80051512
PM18AJ274	E19JN25a199.csv	182027.59	2.26609976	3030.36586	0.01221832	<0.00251	220.462219	222.770009	<0.0187	2.04474163	173.754053	2.78807141	0.10884615	9.89607421	0.21878406
PM18AJ274	E19JN25a200.csv	177310.835	34.7133219	1745.02156	0.02331813	0.07934853	294.918002	291.243852	<0.018	9.02575237	344.237291	4.5722217	0.73467816	4.56030414	1.71897935
PM18AJ274	E19JN25a201.csv	177031.222	33.8625759	2001.52412	0.03413064	0.02738737	270.173003	260.282604	<0.018	19.7647069	237.701878	12.7124013	1.67863789	7.16944847	0.43198551
PM18AJ274	E19JN25a202.csv	176609.835	14.304628	960.73619	0.07952145	0.05147157	579.900061	580.660956	<0.0171	31.1019854	249.650112	16.3252015	2.11598518	1.45345057	1.21632229
PM18AJ274	E19JN25a203.csv	176677.727	33.8328675	1732.71217	0.01630299	0.05068602	232.052536	236.807986	<0.0173	14.7580377	246.769899	7.34430406	0.64598958	8.19037343	0.38760403
PM18AJ274	E19JN25a204.csv	178266.459	24.6596927	1868.86852	0.09525181	0.36505672	409.913015	410.586485	<0.017	11.025674	238.671529	7.62606299	1.30041192	1.85347531	0.45506749
PM18AJ274	E19JN25a205.csv	178212.649	35.7711184	1671.70088	0.03981343	0.06943046	288.195341	293.612817	<0.0171	29.6604826	252.440407	13.9896854	1.89837915	3.6870231	0.41986967
PM18AJ274	E19JN25a206.csv	172584.636	10.0947983	2064.60516	<0.00247	0.21856036	526.99817	520.837046	<0.0204	5.02721861	478.175511	4.47870294	0.54048097	7.18193742	17.7713144
PM18AJ274	E19JN25a208.csv	178469.753	19.892149	1600.12813	0.00623848	5.31834069	771.325507	758.417423	<0.0164	70.8068945	377.098321	154.849558	17.7967245	2.95664105	17.5653747
PM18AJ274	E19JN25a209.csv	177661.159	20.2017447	1563.38786	0.13155768	2.91685211	1735.53432	1718.47179	<0.016	13.8020202	319.803674	28.6232572	5.0638169	3.20318813	14.3627412
PM18AJ274	E19JN25a210.csv	173671.724	16.3534857	1831.11739	0.053989	0.00394523	538.977363	527.393033	<0.0194	11.4263438	193.552339	1.71984964	0.16734123	1.44840151	0.06312267
PM18AJ274	E19JN25a211.csv	178164.072	27.7646534	1212.79623	0.14620443	<0.00235	869.930139	868.9407	<0.0159	16.7157297	296.26858	4.58941049	0.70525716	2.01995052	0.19395136
PM18AJ274	E19JN25a212.csv	178417.319	10.4409273	1807.59628	0.01158345	<0.00238	156.782338	157.219827	<0.0159	6.69872679	188.54221	0.69097855	0.09652043	4.68966054	0.11728768

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ274	E19JN25a213.csv	177653.795	15.6308022	1276.22268	0.03052025	0.00661887	376.577536	381.047626	<0.0156	9.33089106	252.116564	0.65774999	0.05614902	2.61716699	0.98802144
PM18AJ274	E19JN25a214.csv	181572.516	19.1174795	809.885553	0.09190739	<0.00301	642.300824	653.470435	<0.0197	10.1338674	328.922091	0.60837406	0.09470261	1.59925615	<0.00489
PM18AJ274	E19JN25a215.csv	177990.719	18.9916439	1588.82189	0.08136183	0.00395927	558.023878	563.753751	<0.0155	21.9312176	241.448761	3.58761684	0.44672764	3.05438529	0.3409807
PM18AJ274	E19JN25a216.csv	176449.552	9.2935572	1531.37395	0.12678477	0.02730743	1407.27015	1413.77956	<0.0151	8.39940381	291.251439	4.47367456	0.77191387	3.10732916	2.76815012
PM18AJ274	E19JN25a217.csv	177928.749	26.9295806	1531.99204	0.15978346	0.11704103	848.99195	845.368562	<0.0155	36.1582418	270.964598	15.3765608	1.694984	4.31175431	2.28600214
PM18AJ274	E19JN25a218.csv	175633.757	8.98736882	2158.0409	0.00885242	0.00845116	215.691768	214.132149	<0.0153	5.09719893	203.715564	1.87201517	0.21930962	4.80187367	0.27263798
PM18AJ274	E19JN25a219.csv	178220.902	25.3681934	1845.48944	0.15284602	11.2704271	842.988014	825.907942	<0.0155	33.0331688	291.212781	17.9139467	1.49275706	4.61523156	24.9373023
PM18AJ274	E19JN25a220.csv	178283.732	19.098654	1674.51921	0.13911958	3.3829567	539.998896	551.086301	<0.0156	24.8207856	293.461187	54.7600563	2.88933759	8.40790628	12.9033275
PM18AJ275	E19JN26a428.csv	179677.713	3.07294512	1460.64662	<0.00187	<0.00231	708.589453	724.940871	<0.00904	0.04188601	673.131378	4.59495031	0.31281865	6.82772719	0.19532475
PM18AJ275	E19JN26a429.csv	181525.003	2.79191195	1393.75989	<0.00195	<0.00242	471.751026	479.435492	<0.00949	0.10151256	670.367636	2.18763676	0.16882	9.4937882	1.15062718
PM18AJ275	E19JN26a430.csv	180137.285	2.2377386	1456.01081	0.0032593	<0.00237	203.327695	201.367928	<0.00945	0.01727205	680.417314	0.01316125	<0.00714	4.58426676	0.60121323
PM18AJ275	E19JN26a431.csv	180876.463	2.01236859	1071.00812	<0.0019	<0.00234	167.186566	171.982082	<0.00949	0.02820574	550.520087	0.07351138	<0.00705	9.55888482	0.08090082
PM18AJ275	E19JN26a432.csv	179940.501	2.99225277	641.36319	0.00325173	0.4709345	213.928846	210.14878	<0.00981	0.18935499	522.497341	5.16412853	0.46430318	36.1232545	35.2277264
PM18AJ275	E19JN26a433.csv	179815.246	5.03936376	2254.66268	<0.00188	0.17272433	850.289908	862.08533	<0.00991	0.2219238	939.251613	3.46112537	0.50135405	14.8415912	9.78948616
PM18AJ275	E19JN26a434.csv	179208.094	2.80206474	1603.13315	0.00324498	<0.00236	596.092425	609.715842	<0.0105	0.12883347	788.413979	0.69797641	0.06124861	9.88213028	8.34034104
PM18AJ275	E19JN26a436.csv	179798.251	1.84284492	1144.82479	<0.00191	<0.00237	137.638199	141.357057	<0.0115	0.02974002	505.782192	0.09279329	0.01357588	5.13840317	0.1145226
PM18AJ275	E19JN26a437.csv	173246.328	2.03063538	1438.1167	0.0032437	<0.00306	163.715106	165.591778	<0.0157	0.02285465	306.778826	0.02065814	<0.00936	4.48136073	0.01319499
PM18AJ275	E19JN26a438.csv	178637.203	3.16495873	871.031637	<0.00184	<0.00228	1057.58768	1058.28042	<0.0123	0.12670319	1315.04265	2.91897504	0.26525198	20.2024138	5.68652724
PM18AJ275	E19JN26a439.csv	173529.996	2.03158044	1761.50543	0.00518213	0.02999221	438.449937	463.548824	<0.0207	0.15577854	766.556687	6.06907355	0.61336382	10.8657387	19.3311434
PM18AJ275	E19JN26a440.csv	179575.633	2.90392621	2386.7631	<0.00193	0.04575334	858.70187	856.901445	<0.0146	0.18086967	598.217489	2.50658276	0.31571218	5.81796864	26.201097
PM18AJ275	E19JN26a442.csv	178905.48	2.37237263	1250.42824	0.00320633	0.20914959	286.529	287.233975	<0.0165	0.26522372	555.009085	1.31521775	0.12440327	8.82030298	19.6473871
PM18AJ275	E19JN26a443.csv	171950.911	1.79826419	1471.79803	<0.00221	0.00380401	392.534797	383.884702	<0.0204	0.12392194	782.476464	2.34370499	0.21322285	4.41557869	23.2679442
PM18AJ275	E19JN26a444.csv	179749.176	2.59411563	2178.0902	<0.00194	0.03314512	801.132439	818.848314	<0.0194	0.67267784	475.155932	8.99327659	1.0665707	10.814985	13.0427003
PM18AJ275	E19JN26a445.csv	184989.151	2.04705813	1031.43227	0.00458958	0.07301057	419.349091	431.952331	<0.037	0.31406609	594.997058	5.52336683	0.62397974	15.1945247	15.4158986
PM18AJ275	E19JN26a446.csv	176033.253	1.71725543	2173.31399	0.0063094	0.01055899	440.183552	443.097968	<0.0242	0.14808042	571.829706	0.81627202	0.10266364	7.37663703	25.4128095
PM18AJ275	E19JN26a447.csv	178709.481	2.19723458	1248.19774	<0.00188	5.39529038	1019.78708	1034.84881	<0.0238	0.34512304	582.20016	5.26169524	0.68692053	13.5103339	28.6674391
PM18AJ275	E19JN26a448.csv	177611.938	3.50602001	1565.15843	<0.00187	0.00302724	377.115967	384.363938	<0.0256	0.25416314	922.086664	1.77819847	0.18577281	12.4139275	3.16793911
PM18AJ275	E19JN26a449.csv	177461.474	1.92565782	1055.3478	<0.00199	0.00513578	227.699968	219.65227	<0.0292	0.08042128	619.143837	0.31743157	0.03103072	23.1533151	0.29361579
PM18AJ275	E19JN26a450.csv	178279.554	2.3965373	1215.71489	0.00651683	0.02165199	790.150108	784.652399	<0.0303	0.15142223	886.453889	0.21870796	0.05354736	17.7160386	0.27558882
PM18AJ279	E19JN26a241.csv	176054.451	3.01572314	1042.19284	0.02220775	<0.00226	497.471574	492.268001	<0.0176	1.00232613	567.633337	12.1095245	1.40757459	10.2045865	0.42839531
PM18AJ279	E19JN26a242.csv	177090.239	2.4339849	1099.42102	0.00465609	<0.00226	402.195806	396.965804	<0.0175	0.29464883	460.46244	0.46101643	0.02566839	6.77111709	<0.00459
PM18AJ279	E19JN26a243.csv	182989.633	2.55127687	755.6148	<0.00288	<0.00369	94.5837423	99.1137959	<0.0283	0.02884843	418.839172	0.15399063	0.02391013	6.78783535	0.22243783
PM18AJ279	E19JN26a244.csv	176971.907	2.15980337	909.237237	<0.00181	<0.00227	223.517979	218.654513	<0.0174	0.12220411	533.979579	0.9409074	0.12867065	4.44886613	<0.00462
PM18AJ279	E19JN26a245.csv	175295.19	2.33094919	552.098158	0.02030423	<0.00223	513.795559	518.86762	<0.017	0.16945542	764.035909	4.57523594	0.61079695	3.56388024	0.2029934
PM18AJ279	E19JN26a246.csv	177121.987	2.84160612	1264.82697	0.00662101	0.00588234	809.399513	805.91346	<0.0178	0.93425951	544.409961	14.6963261	1.9916513	5.89030251	25.1499621
PM18AJ279	E19JN26a247.csv	179405.326	2.95572892	1173.01927	0.01142279	0.00387919	713.337744	708.823866	<0.0177	1.08550046	508.071221	14.4647305	1.81642678	6.51059755	21.9481879
PM18AJ279	E19JN26a248.csv	176487.218	2.66573549	1776.87865	<0.00198	0.1245756	423.973463	416.788468	<0.0188	1.16865819	273.508597	18.56016	1.98135721	6.65703812	18.664582
PM18AJ279	E19JN26a249.csv	176070.817	2.51860051	824.347845	0.02034745	<0.00223	1722.22763	1714.65978	<0.0167	0.29443343	1093.16798	1.62577201	0.47850211	4.50588948	9.62252051
PM18AJ279	E19JN26a250.csv	178298.031	2.08404947	1506.87513	0.00907468	0.29994179	312.295324	306.887925	<0.0186	1.30785404	276.439026	11.0587839	1.60035411	6.79720138	72.8437485
PM18AJ279	E19JN26a251.csv	183365.056	2.3176387	1613.19532	<0.00231	0.00530397	257.539178	248.403088	<0.0214	0.51340923	371.024105	1.98577675	0.33552052	3.84015163	18.6638998
PM18AJ279	E19JN26a252.csv	175850.545	1.84169192	637.662715	<0.00194	<0.00244	67.0112289	69.9009865	<0.0179	0.08667301	535.414544	0.03181874	0.00783722	3.12209945	<0.00504
PM18AJ279	E19JN26a253.csv	177683.852	1.93088809	904.105099	<0.00187	<0.00234	245.315154	250.239273	<0.0171	0.24160878	471.282917	0.66022345	0.08671884	4.04785862	0.87534908
PM18AJ279	E19JN26a254.csv	178207.329	1.99147793	1231.23782	<0.0019	<0.00238	227.207988	225.535054	<0.0173	0.37680381	356.514543	1.20606558	0.16461162	6.6029238	1.03034033
PM18AJ279	E19JN26a255.csv	176040.975	2.11040224	1337.60794	0.01222756	0.00275503	205.805429	206.233496	<0.0178	0.22175566	367.396725	1.27556508	0.23893675	4.02507111	2.41229249
PM18AJ279	E19JN26a256.csv	177062.44	1.80360788	726.951072	<0.00183	<0.00229	63.7701036	63.5968803	<0.0164	0.01653511	879.063232	0.05695781	0.01956292	2.99062915	0.01328441
PM18AJ279	E19JN26a257.csv	177599.627	2.07433712	527.121374	0.05829126	0.00273023	1579.30389	1565.94924	<0.0169	0.17049541	895.697177	0.45702603	0.11780229	6.22631783	0.33780435
PM18AJ279	E19JN26a258.csv	181644.248	2.00491391	1675.07363	<0.00235	<0.00296	303.521154	306.900156	<0.0208	0.3976499	296.029678	0.77779418	0.07163454	5.89853476	0.00840725
PM18AJ279	E19JN26a259.csv	181859.068	2.16203402	976.183165	<0.00237	<0.00298	86.8440352	88.8031074	<0.0208	0.20409758	389.796922	0.79846573	0.07922836	3.86540975	0.16891877
PM18AJ279	E19JN26a260.csv	178806.465	2.67521494	747.544195	0.0333845	0.00331578	1037.06902	1046.25196	<0.0174	0.75361907	519.847386	11.8357709	1.27950853	10.0289229	1.38202773
PM18AJ279	E19JN26a261.csv	176424.918	2.02153373	820.320477	0.01291282	<0.0023	620.293283	617.604603	<0.016	0.20361157	634.26005	0.30209082	0.04919309	5.59530077	0.0252664
PM18AJ279	E19JN26a262.csv	178608.865	1.92370647	1128.39904	<0.00188	<0.00235	137.888396	132.651886	<0.0162	0.35077922	331.794502	1.63446409	0.18404671	6.14929702	0.11101776
PM18AJ279	E19JN26a263.csv	172928.884	1.81174867	973.016261	<0.00197	<0.00248	457.457913	461.215715	<0.0169	0.07280738	429.807569	0.1388215	<0.00726	7.18193905	0.95904108

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ279	E19JN26a265.csv	177622.872	2.13710177	1188.41112	0.00481099	<0.00233	237.00721	228.364354	<0.0157	0.78372716	396.910137	1.56543305	0.22460524	5.12621703	3.81199271
PM18AJ281	E19JL11a020.csv	178233.609	2.88941029	1784.33863	0.03541534	0.13642786	919.661982	933.829754	<0.0533	0.56854812	213.763569	3.60229604	0.9126084	2.67439207	51.571132
PM18AJ281	E19JL11a021.csv	182177.734	4.45122223	1084.15455	0.01612405	2.4107284	359.842492	370.52123	<0.052	1.01656328	129.60623	9.49242562	1.53201672	3.42858502	101.083522
PM18AJ281	E19JL11a052.csv	178498.617	5.28952201	698.430621	0.0018487	0.31554882	290.877113	290.447303	<0.0245	6.61637249	324.668938	73.584865	5.38895692	10.5823453	6.43118116
PM18AJ281	E19JL11a053.csv	175311.655	2.80530133	1075.32353	0.00409002	1.53616724	295.226748	300.00287	<0.0263	1.77735408	96.2627982	8.77896619	1.72017798	4.11042012	169.758802
PM18AJ281	E19JL11a054.csv	178413.908	2.50811471	890.936613	0.07071553	0.38443992	627.615577	637.196142	<0.0312	0.89850005	81.7521753	5.38704076	0.50525078	4.13267606	33.4994166
PM18AJ281	E19JL11a055.csv	178657.187	3.48896578	848.712232	0.0667316	6.24767287	608.634285	613.29764	<0.0259	3.66908574	162.694026	71.3537691	4.10965921	7.21147653	86.086237
PM18AJ281	E19JL11a056.csv	180082.912	2.1743941	760.802983	0.01681419	<0.00403	540.289453	557.557618	<0.0391	0.04892278	75.6710949	0.1665939	0.02924296	6.1047973	1.59155179
PM18AJ281	E19JL11a058.csv	176447.007	2.75711702	1971.7351	0.00350057	0.3336119	747.959208	756.473134	<0.0255	0.47115282	153.316577	3.04362758	0.86944534	1.7104703	34.0027062
PM18AJ281	E19JL11a059.csv	171380.967	2.12885546	1177.02539	0.00350749	0.13235093	808.696014	791.555152	<0.0331	0.42403738	167.468331	4.43672871	0.69625669	2.13821641	34.9148547
PM18AJ281	E19JL11a060.csv	179025.852	4.02077056	1187.50053	0.00534815	0.80177688	634.139376	635.06681	<0.0263	2.2661959	255.325403	65.8093694	10.537926	3.73411686	25.1848168
PM18AJ281	E19JL11a061.csv	172186.584	2.06778593	576.863904	<0.00244	<0.00357	354.744076	347.14719	<0.0362	0.17567568	42.2538207	0.56265809	0.25741202	12.737488	27.6121221
PM18AJ281	E19JL11a062.csv	177927.453	2.36608905	1132.05071	0.0216432	0.33566343	737.344527	739.661729	<0.0273	0.38351879	146.136635	6.59895053	1.07889577	4.06377377	82.4917177
PM18AJ281	E19JL11a063.csv	174081.873	2.717626	1107.76881	0.01026467	<0.0025	1179.95085	1204.47186	<0.0257	0.3615268	166.617929	2.20453264	0.56170141	1.64297122	40.2608699
PM18AJ281	E19JL11a064.csv	176187.457	2.47063956	1797.63033	0.00882402	0.13399437	809.02245	810.702842	<0.0262	0.4461364	165.328624	3.40963006	0.71631736	2.37295838	44.0080056
PM18AJ281	E19JL11a065.csv	181961.296	4.06061194	872.178293	0.00372956	<0.00272	630.530067	634.982571	<0.0281	0.05077102	215.348303	0.84307539	0.2179595	2.98814207	17.4030521
PM18AJ281	E19JL11a066.csv	179562.817	4.15112919	630.216176	0.00962577	0.52604251	408.592132	420.274125	<0.0288	1.19468135	163.384031	54.6948563	2.49112662	5.00460902	2.25159449
PM18AJ281	E19JL11a067.csv	178288.943	4.62548638	892.819118	0.01065245	1.9128159	273.069986	271.967283	<0.0269	6.45301145	148.303701	102.012328	4.51549111	6.02916955	5.04171878
PM18AJ281	E19JL11a069.csv	178997.183	5.25816946	1047.22494	<0.00183	1.17606358	266.815083	270.379601	<0.0273	5.73744613	100.769677	100.386061	4.12306972	6.13244405	2.22261866
PM18AJ282	E19JN26a102.csv	170155.839	2.00921112	565.069981	<0.00188	<0.00238	184.067696	184.421847	<0.0189	0.0668067	102.948575	0.05911776	0.01413228	1.31148482	0.12354356
PM18AJ282	E19JN26a103.csv	178508.517	2.46081182	779.723336	<0.00282	<0.0036	178.437024	180.027228	<0.028	0.06289087	68.2620918	0.22093108	0.024593	2.52691441	0.01515246
PM18AJ282	E19JN26a104.csv	170122.246	2.07875776	1369.64404	0.00404262	<0.00254	179.672363	173.278255	<0.0199	0.18568724	79.0017719	0.46313031	0.05148668	2.97422336	0.46660719
PM18AJ282	E19JN26a105.csv	177861.472	2.45008884	1050.62871	0.00755171	0.08462651	339.548354	331.679293	<0.0267	0.11921243	113.744167	4.37814401	0.50372429	2.06050938	3.83990773
PM18AJ282	E19JN26a106.csv	176823.79	2.01758497	950.309013	0.00237563	0.02020255	152.423482	151.619984	<0.0194	0.15604422	68.5907662	1.16145723	0.15612231	3.17329825	2.62760095
PM18AJ282	E19JN26a107.csv	173482.076	1.91272833	798.448258	<0.00192	<0.00244	68.4868271	67.3406922	<0.0185	0.04397593	39.6680657	0.32565308	0.03640595	4.00826393	1.67781808
PM18AJ282	E19JN26a108.csv	183024.103	2.33827228	1353.33171	<0.00205	0.00351876	1010.82874	1005.02285	<0.0195	0.19661802	145.025892	8.14674036	1.16561807	6.2408848	45.8515945
PM18AJ282	E19JN26a109.csv	174312.658	2.23689533	1388.6308	<0.00181	<0.00231	72.1745901	74.6319248	<0.0171	0.37356929	95.7196605	7.76902679	0.72787442	3.02978731	5.07650307
PM18AJ282	E19JN26a110.csv	174300.964	2.40768485	1223.15406	0.00655495	0.06577904	643.040857	645.671152	<0.017	0.27416904	74.5367919	4.25044685	0.37298691	3.85614226	9.19646721
PM18AJ282	E19JN26a111.csv	173508.212	2.60370316	1652.93909	0.01424015	0.33826468	1499.811	1497.84584	<0.0167	0.64427925	83.3197763	14.9412274	1.8258063	3.75284204	48.5934305
PM18AJ282	E19JN26a112.csv	172614.319	2.24947198	812.107746	0.02024637	<0.00224	402.321401	394.701264	<0.0163	0.13580903	92.2339941	12.5411916	2.3279584	1.17577864	1.3001264
PM18AJ282	E19JN26a113.csv	176807.676	2.26693774	1679.82654	0.00321825	0.0198576	288.27421	282.912643	<0.0171	0.48843316	72.4316699	6.9225771	0.71869963	4.86617755	6.6477377
PM18AJ282	E19JN26a114.csv	172364.727	2.3891964	1407.29802	<0.00173	<0.0022	19.5605066	20.2778796	<0.0157	0.27916535	269.946302	0.88232379	0.15167557	1.09857254	0.47728691
PM18AJ282	E19JN26a115.csv	174988.738	2.38773804	772.372521	<0.0018	<0.00229	42.2978302	42.1885994	<0.0162	0.04293889	150.086815	0.05809968	<0.0066	2.65437613	0.03157637
PM18AJ282	E19JN26a116.csv	175175.433	2.41025459	1304.41053	<0.00179	0.00302207	139.657503	139.49817	<0.0159	0.16841791	85.7972449	0.78412735	0.0811783	2.89768014	0.44624968
PM18AJ282	E19JN26a117.csv	169570.944	3.51180288	1293.96247	<0.00197	0.02328371	245.679074	250.335451	<0.0173	0.61460613	353.078026	5.2083419	0.36358223	4.67132002	4.63263819
PM18AJ282	E19JN26a118.csv	176537.591	4.2835822	1428.47048	0.01029464	1.328092	545.837488	542.516814	<0.0161	3.80057786	597.91964	57.1412998	4.57349709	7.77627843	13.9561525
PM18AJ282	E19JN26a119.csv	177264.264	2.21278262	1070.62637	0.00973337	0.02217252	672.561283	674.634177	<0.0161	0.57826825	131.540183	5.37533512	0.64817206	6.71985195	13.1829924
PM18AJ282	E19JN26a120.csv	178687.063	2.37279794	1769.26297	<0.00252	<0.00321	100.722411	96.2904996	<0.0217	0.06994074	70.3763244	1.32118733	0.13667578	3.62643392	0.32185422
PM18AJ282	E19JN26a121.csv	175823.698	2.21939063	2200.22505	<0.00186	0.00913699	47.5333722	43.9986576	<0.016	0.40172908	89.1382975	8.20703183	0.54993981	2.32021051	1.56135646
PM18AJ282	E19JN26a122.csv	173155.18	2.64063404	1322.03919	<0.00175	0.01912935	194.594197	193.036211	<0.0149	0.2535271	291.489216	1.99080939	0.19650302	5.21501245	1.26937374
PM18AJ282	E19JN26a123.csv	173524.581	2.79247829	1158.99928	<0.00177	0.03458945	127.296315	124.58589	<0.015	0.16750015	357.334281	0.64910343	0.07926355	9.54176685	0.60393728
PM18AJ282	E19JN26a124.csv	175051.589	2.50450399	1596.7054	<0.00183	<0.00233	219.559399	222.95887	<0.0154	0.73975702	119.640011	16.3934475	2.20335944	2.46652707	1.67424928
PM18AJ282	E19JN26a125.csv	174897.304	2.24192646	1518.04714	<0.0018	0.02333162	73.9293485	75.8094137	<0.015	0.25057051	89.9318593	8.75181342	0.93106249	2.43779117	0.79133428
PM18AJ283	C19AU08C309.csv	179407.776	0.52095748	820.271788	0.01913591		487.504129	478.489488	<0.0218		400.063805	2.1011888	0.31980841	3.19964496	8.97245485
PM18AJ283	C19AU08C310.csv	179504.361	0.41235217	997.861378	0.01967476		475.557019	481.547537	<0.0222		376.47001	1.67666236	0.18773961	4.41360594	4.60451821
PM18AJ283	C19AU08C317.csv	180774.983	0.39868955	1151.2573	<0.0027		521.508375	517.685152	<0.0207		287.460785	2.99127985	0.42208648	5.2520158	5.99796108
PM18AJ283	C19AU08C320.csv	178628.425	1.36741226	1373.51603	<0.00293		973.259604	992.872616	<0.0216		399.614565	47.8231626	5.80609283	5.16551758	52.8152666
PM18AJ283	C19AU08C321.csv	180569.965	0.87308017	1518.36227	0.00295037		587.04055	589.333283	<0.0194		392.347731	10.1552641	1.27999177	2.87002086	15.4341502
PM18AJ283	C19AU08C287.csv	179797.496	0.28174974	638.192061	<0.00256		246.974709	250.308534	<0.0234		669.080832	0.08965905	0.02476488	2.77038756	0.14946146
PM18AJ283	C19AU08C288.csv	178466.951	0.40656193	1027.7607	<0.00254		160.505115	164.172548	<0.0232		339.255037	0.16497637	0.01399933	2.12155548	0.2835756
PM18AJ283	C19AU08C289.csv	177191.137	0.28265576	667.816956	0.00284857		1087.41332	1095.9588	<0.0228		1024.00619	0.1331843	0.02923173	3.41037251	0.22901999
PM18AJ283	C19AU08C290.csv	182109.44	0.3368894	623.362555	0.02213692		438.088924	425.330816	<0.0273		266.960191	0.80171084	0.12088005	4.13224396	0.85174544

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ283	C19AU08C291.csv	178293.406	0.2292937	622.115265	0.00837604		321.176335	329.560313	<0.0235		400.484383	0.55966534	0.11466283	3.64795393	1.43208804
PM18AJ283	C19AU08C292.csv	178835.717	0.40298756	654.779933	0.0555171		1640.73001	1661.99156	<0.0227		695.793975	1.88566841	0.20790787	4.24978447	2.98451064
PM18AJ283	C19AU08C293.csv	181631.047	0.61828329	1767.11862	0.0142034		600.656457	601.564097	<0.0241		322.029913	0.81141636	0.10145354	4.32188072	0.36401014
PM18AJ283	C19AU08C294.csv	180116.643	0.18783528	478.986277	0.00293978		467.589285	477.176473	<0.0237		296.054799	0.91121046	0.16906302	3.75889703	1.01264204
PM18AJ283	C19AU08C295.csv	178531.013	0.29457085	434.252622	0.00290185		412.989206	429.741966	<0.0234		653.158186	0.5280555	0.0772658	2.79988423	0.88167705
PM18AJ283	C19AU08C296.csv	175867.167	0.31832184	507.257252	<0.00274		335.157299	328.025441	<0.025		716.650312	0.4021417	0.07683472	3.07982345	0.62623337
PM18AJ283	C19AU08C297.csv	179164.801	0.36521629	823.517891	0.01364988		664.249313	669.716093	<0.0231		511.055879	3.03997236	0.26501868	4.66863738	2.96577252
PM18AJ283	C19AU08C298.csv	180211.769	0.32831926	1136.72406	0.00300051		463.531003	463.958535	<0.0241		345.278636	1.05759735	0.09093289	5.37888974	0.08365976
PM18AJ283	C19AU08C299.csv	180320.697	0.48477801	1069.40139	<0.00409		205.873605	219.194399	<0.0376		458.399875	0.12199196	0.01328299	2.26224272	0.12812312
PM18AJ283	C19AU08C300.csv	177795.196	0.70192279	1644.71968	0.00284046		189.431389	187.727949	<0.0227		473.571807	0.10020633	0.00842296	2.84972139	0.06264269
PM18AJ283	C19AU08C301.csv	177558.644	0.50280251	1056.28088	<0.00251		213.136657	203.462332	<0.0226		361.481659	0.39407807	0.0497362	2.37238122	0.79618213
PM18AJ283	C19AU08C302.csv	178693.103	0.38803121	1050.90727	<0.00258		202.21001	200.467927	<0.023		302.132698	0.52314209	0.05092344	2.67335635	1.36152301
PM18AJ283	C19AU08C303.csv	179085.655	0.30302471	1693.77737	<0.00257		200.371304	192.177562	<0.0228		218.497543	1.58484982	0.16170541	3.37010549	1.76670153
PM18AJ283	C19AU08C304.csv	176092.386	0.26736401	1027.96126	0.0085933		626.029024	631.617956	<0.026		376.679312	3.30990531	0.45926324	4.32594323	20.1289467
PM18AJ283	C19AU08C305.csv	180631.954	0.31576866	675.549265	<0.00264		335.366356	336.364243	<0.0231		274.55019	1.56364049	0.31173695	4.47013092	7.35032508
PM18AJ283	C19AU08C306.csv	173738.512	0.24679416	911.570162	0.0090309		404.184206	409.704222	<0.0262		285.575205	3.08606108	0.35760256	3.75399681	16.3360183
PM18AJ283	C19AU08C307.csv	181960.374	0.31654238	1645.8294	<0.00268		431.405307	424.950652	<0.0231		213.285735	3.05098433	0.32810741	4.37428869	1.62662555
PM18AJ283	C19AU08C308.csv	177707.422	0.27620538	2097.67605	0.01345613		489.5113	485.936512	<0.0216		626.832807	0.32728073	0.07555357	3.54186347	0.51225445
PM18AJ285	E19JL11a167.csv	181014.116	2.15450347	1448.33675	0.00336937	<0.00289	210.532062	217.249439	<0.0203	0.18925105	228.468971	0.21027322	0.04826116	3.49306951	5.44703459
PM18AJ285	E19JL11a168.csv	184856.311	1.82764819	684.219391	<0.00232	0.00303523	2.46575935	2.0894709	<0.0206	<0.00265	69.4689409	0.00359984	<0.00969	5.12274062	0.03514459
PM18AJ285	E19JL11a169.csv	182688.008	1.89601706	1827.49066	<0.00222	0.00491241	162.324177	172.625178	<0.0197	0.03518583	84.7260721	1.42227717	0.1736534	2.64856234	0.36053314
PM18AJ285	E19JL11a170.csv	181757.937	2.24201361	2341.40342	<0.00313	<0.00396	47.5285125	45.4732855	<0.0278	0.05014245	210.720826	1.58575587	0.18286176	2.11357161	0.03047503
PM18AJ285	E19JL11a171.csv	184049.804	1.93347811	604.370976	<0.00229	<0.00288	8.0494644	7.56132394	<0.0203	<0.0026	214.876309	0.0068453	<0.00949	5.47889778	0.04763131
PM18AJ285	E19JL11a172.csv	180214.214	2.78399424	3189.41583	<0.0022	<0.00278	47.2570824	44.2747753	<0.0195	<0.0025	92.4442779	0.01319985	<0.00911	0.55501584	<0.0051
PM18AJ285	E19JL11a173.csv	182142.796	2.93303272	2333.24964	<0.00229	<0.00287	333.187806	335.173723	<0.0203	0.68410737	302.098496	34.6615725	3.40343282	1.25452193	1.43433576
PM18AJ285	E19JL11a174.csv	181071.449	2.46095116	2011.33461	0.00321069	<0.00278	65.7498042	71.1866413	<0.0196	0.04903773	177.95332	0.95570853	0.09820279	1.21510809	0.12855718
PM18AJ285	E19JL11a175.csv	180484.647	2.54647694	2205.91445	0.00746549	<0.00483	40.3421465	41.878622	<0.0339	0.00971498	86.4725688	0.09115337	0.03060959	1.42969499	0.02934305
PM18AJ285	E19JL11a176.csv	184619.114	1.8604047	2392.77147	<0.0024	<0.00302	9.6183724	10.4576284	<0.0213	<0.00272	32.2931858	0.23100267	0.0257932	1.13249551	0.04018224
PM18AJ285	E19JL11a177.csv	181889.172	2.08462094	1796.0134	<0.00221	<0.00277	25.0319842	23.7862262	<0.0195	<0.0025	82.3006282	0.00335118	<0.00905	1.12042911	0.02653977
PM18AJ285	E19JL11a178.csv	183684.6	1.54038494	2379.60744	<0.00231	<0.00289	80.4133309	74.6794718	<0.0203	0.00338553	81.1953446	0.05148529	<0.00945	2.27706738	0.02770801
PM18AJ285	E19JL11a179.csv	184266.684	1.65760034	2257.62971	0.00335824	0.01320444	395.785643	399.480144	<0.0207	0.16447461	122.098252	6.50291115	0.61360931	3.14875227	1.16499794
PM18AJ285	E19JL11a180.csv	184057.363	1.69635368	2569.54071	<0.0023	<0.00288	57.0138026	53.5709943	<0.0203	0.03366703	70.5352353	0.26228508	<0.00941	1.6981432	0.04070389
PM18AJ285	E19JL11a181.csv	183098.008	1.81451174	2602.35062	0.00882911	<0.00288	59.1336135	62.2203139	<0.0203	0.06064108	125.526789	1.13569796	0.10498685	1.89545838	0.03414682
PM18AJ285	E19JL11a182.csv	182316.211	1.869717	1886.84149	<0.00313	0.02902793	29.0993857	29.8750397	<0.0275	0.87361336	28.9463253	4.33823394	0.34662056	1.52094697	1.62278332
PM18AJ285	E19JL11a183.csv	182999.35	1.51618628	1115.8221	<0.00236	<0.00295	10.8748524	10.0878403	<0.0207	<0.00265	57.3643526	0.04463733	<0.0096	6.23274118	0.0422547
PM18AJ285	E19JL11a184.csv	182120.306	1.62713763	1663.97977	<0.00271	0.00378812	4.14729097	2.8142921	<0.0237	<0.00302	13.447518	0.02808249	0.01650078	1.32161331	0.07373728
PM18AJ285	E19JL11a185.csv	182706.06	1.7921918	1589.59808	<0.00231	<0.00288	0.7988613	1.60289571	<0.0202	<0.00259	4.78837705	0.00356395	<0.00936	1.44374971	0.06114345
PM18AJ285	E19JL11a186.csv	179109.774	1.82459738	600.536584	0.0036196	<0.00417	25.6243799	22.130863	<0.0285	0.00600058	6.98993042	0.12368506	0.01615091	2.38862301	0.08266559
PM18AJ285	E19JL11a188.csv	178796.452	1.94971964	2227.49204	<0.00268	<0.00329	70.6217016	75.3523095	<0.0229	0.06303033	136.972345	2.49009663	0.2080324	5.98501512	0.22619066
PM18AJ286	E19JL11a016.csv	177678.547	2.66012782	583.197672	<0.0034	<0.00517	33.5932156	32.1867598	<0.0592	0.61669809	1188.31784	1.1568275	0.12069622	3.52451209	0.17795126
PM18AJ286	E19JL11a017.csv	179010.642	1.50569377	967.483844	<0.0034	<0.00518	12.7781282	11.3350744	<0.0568	0.03704711	998.596398	<0.00588	<0.0193	7.66252893	<0.0107
PM18AJ286	E19JL11a215.csv	178914.831	4.28552326	1169.18925	0.00309144	0.05539128	517.861132	521.569038	<0.0184	6.63614239	475.778881	38.6925061	3.80977494	4.78558504	18.7093394
PM18AJ286	E19JL11a216.csv	178219.535	3.92227286	1087.48403	<0.00239	0.00857677	508.500223	511.483858	0.02509589	6.56598437	479.975866	35.5667422	3.78070432	4.79092527	5.15763365
PM18AJ286	E19JL11a217.csv	178687.193	3.15130461	1212.8815	0.00666375	0.00470508	456.792362	450.26594	<0.0181	5.76705597	519.947437	45.0108923	4.65819786	5.00092524	21.4018595
PM18AJ286	E19JL11a218.csv	173645.764	2.17015196	980.9098	<0.00285	<0.00339	187.944687	179.954348	<0.0215	2.28690271	488.945268	17.9920174	1.47509175	3.81082246	3.53501532
PM18AJ286	E19JL11a219.csv	176405.02	2.03014298	742.930597	0.00475105	0.0245508	179.386574	177.771168	<0.0175	1.2007406	269.429731	3.11091561	0.30756604	1.91039773	3.31769851
PM18AJ286	E19JL11a220.csv	178070.772	2.62812101	836.285127	<0.0024	0.04522551	259.362997	251.608636	<0.018	2.51353723	633.106113	19.4549438	1.57221093	3.65221935	11.8128487
PM18AJ286	E19JL11a221.csv	177778.162	1.8974144	896.17884	<0.00242	0.02677933	54.596124	52.067771	<0.018	0.24934091	566.361514	5.51383842	0.49804451	5.66682065	0.32954674
PM18AJ286	E19JL11a222.csv	178604.297	3.70013542	802.905406	<0.0028	0.03271214	302.228835	298.104373	<0.0207	4.73255913	965.355434	59.1900147	4.76709036	3.97074665	1.29448088
PM18AJ286	E19JL11a224.csv	178684.345	1.99259691	1449.06552	<0.00237	<0.00283	575.125669	560.091547	<0.0174	0.09624512	283.710739	2.64166732	0.52312405	2.37552281	1.13828123
PM18AJ286	E19JL11a225.csv	175660.882	3.14872459	775.58638	<0.00238	0.02242552	419.716696	413.889463	<0.0173	2.53385173	832.685425	31.7314416	2.81848902	9.07621903	28.2046084
PM18AJ286	E19JL11a226.csv	177731.031	1.54745584	920.351334	<0.00241	<0.00286	160.408539	154.592154	<0.0175	0.0549215	845.581905	3.53041724	0.30350322	8.46358646	0.54318411

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ286	E19JL11a227.csv	177860.357	2.17582901	1268.74238	0.01301278	0.05112691	810.115406	807.413157	<0.0196	7.72471279	555.572649	45.7585639	3.5364088	6.0643203	21.1769076
PM18AJ286	E19JL11a228.csv	176036.018	1.56260507	461.639546	<0.00232	0.01631296	51.1469853	51.1537998	<0.0166	0.1902374	1210.14083	23.7408552	2.42081921	11.9698795	0.3615366
PM18AJ286	E19JL11a229.csv	179734.566	1.72665855	713.046663	0.00295312	0.00573402	18.1976234	18.9259457	<0.0204	0.06344597	975.431756	6.80999397	1.12944642	11.5895263	0.32230739
PM18AJ286	E19JL11a230.csv	174859.811	2.01978039	537.208965	<0.00227	<0.00268	55.942414	56.8330756	<0.0161	0.0466781	1391.98781	0.158601	0.0193052	7.00614848	0.04298179
PM18AJ286	E19JL11a231.csv	178984.543	2.89878065	958.711915	0.00311739	0.22052814	591.195209	584.555302	<0.0165	2.50119138	841.556839	25.1177623	2.42428677	11.2463353	64.5430534
PM18AJ286	E19JL11a232.csv	181352.209	2.962903	1010.66479	0.00642156	0.29725878	508.488074	502.850726	<0.0167	3.51553167	770.602254	37.6902057	2.84208782	8.30152511	35.3575366
PM18AJ286	E19JL11a233.csv	182062.079	3.82573327	861.596175	<0.00312	0.02004283	233.606235	228.448543	<0.0219	2.74729953	765.568292	21.7064657	1.77004917	4.27639435	2.62115021
PM18AJ289	E19JN26a216.csv	184363.482	16.3743776	511.408925	0.13195894	0.22218433	1381.2183	1379.82387	<0.0205	7.19521282	72.6813772	33.7997667	5.40834401	36.5256402	41.0498293
PM18AJ289	E19JN26a218.csv	182624.95	4.13249741	621.550867	0.74533494	2.8552983	242.757875	242.328572	<0.0204	8.0226587	20.0854737	19.3402623	2.48928765	19.9167358	12.3000763
PM18AJ289	E19JN26a219.csv	181683.426	15.2526728	1036.48605	0.35973656	4.34077939	542.195015	542.048685	<0.0204	2.67210187	35.7067459	8.30039571	1.08197822	16.1109125	3.09237429
PM18AJ289	E19JN26a220.csv	183714.12	3.16574849	709.150363	0.1294388	1.62351181	129.585491	126.411264	<0.0207	1.01083332	24.1038835	3.28469038	0.56546413	18.0085267	0.34761665
PM18AJ289	E19JN26a221.csv	180187.841	5.24540334	1016.96287	0.0674948	0.88603042	219.525031	221.737947	<0.0197	3.05754863	80.7086725	9.14722571	1.04607784	25.1520452	10.2935006
PM18AJ289	E19JN26a222.csv	181895.359	4.16002885	722.535153	0.20310151	2.66210658	174.199633	176.007363	<0.0195	4.79183613	44.382314	9.76151078	1.44195557	17.0833338	10.7071894
PM18AJ289	E19JN26a223.csv	183806.1	56.2808988	1071.80526	0.28116273	0.01540116	581.674249	579.663728	<0.0204	15.9059152	88.2678465	115.23084	16.7405687	17.5083722	10.6382356
PM18AJ289	E19JN26a226.csv	182504.054	16.823859	689.220291	0.54182075	4.9068622	896.074678	872.730029	<0.0206	6.91482557	85.0703228	30.5795795	4.31982016	26.4759039	31.2242069
PM18AJ289	E19JN26a227.csv	183777.959	17.4368762	655.84438	0.5895237	1.61514583	911.923185	911.978655	<0.0205	4.18071852	72.8927589	27.3406676	3.90160049	15.6811694	10.4515745
PM18AJ289	E19JN26a228.csv	184295.714	4.31663673	1240.12485	0.31842842	1.3323238	404.185983	410.189643	<0.0206	3.32805487	35.8126779	12.6529347	1.14438752	17.5254898	48.6515356
PM18AJ289	E19JN26a229.csv	184356.026	14.908191	1191.31217	0.27682849	145.453045	498.205407	492.790145	<0.0201	5.99456364	59.4491411	34.1824455	4.27730873	24.8041227	31.2590688
PM18AJ289	E19JN26a230.csv	178950.876	10.3792773	398.002536	0.18551338	0.05136408	2306.88759	2327.94387	<0.0211	6.66011032	227.595101	13.5737209	3.84266421	9.65225466	43.306596
PM18AJ289	E19JN26a231.csv	183787.936	4.91161128	1225.46821	0.13230304	0.1101317	288.040683	285.417365	<0.0205	3.8891216	85.7346914	16.1894939	7.48839458	15.6622098	4.75448824
PM18AJ289	E19JN26a232.csv	181859.872	5.16110367	1117.21705	1.62198526	0.01372789	1001.55522	986.680236	<0.022	2.55793488	49.9192857	14.4009123	1.29706324	14.64921	5.78658809
PM18AJ289	E19JN26a233.csv	185339.432	4.3908905	1029.73159	0.19606553	8.46363744	410.478538	406.830866	<0.0212	3.78202931	37.1559611	19.2672523	1.77861599	19.0799657	26.6550459
PM18AJ289	E19JN26a235.csv	185515.323	7.42580256	1414.41716	0.23608426	0.23820407	495.349831	487.839678	<0.0206	1.7599016	50.7981003	4.40275359	0.78716341	24.1812044	17.6084556
PM18AJ289	E19JN26a236.csv	183346.668	3.96214762	666.857696	0.68039814	1.23007014	1423.60914	1412.04669	<0.0197	1.440108	38.7274461	7.08654713	1.52515489	15.5333194	6.48755002
PM18AJ289	E19JN26a237.csv	182494.531	2.91417935	993.862624	0.31872165	0.02025981	137.612667	139.186448	<0.0199	1.99082807	14.5269173	4.92479198	0.47819962	20.4942495	0.94444168
PM18AJ289	E19JN26a238.csv	182382.868	6.72120715	1205.05117	0.04548581	12.3670837	431.99796	427.598128	<0.0189	5.4820601	55.3568893	6.55744581	0.73165327	30.8613272	43.0579673
PM18AJ289	E19JN26a240.csv	183463.167	4.19681435	1231.96308	0.06376989	0.07331801	306.546818	302.559273	<0.0197	4.82770346	52.5835899	6.54686461	0.786302	13.273907	19.1497941
PM18AJ290	E19JL11a100.csv	176307.471	2.59060986	1559.88314	0.02461381	0.4515743	218.787787	224.755123	<0.024	1.37624119	210.616566	34.9840592	2.14741507	10.7383599	15.6734929
PM18AJ290	E19JL11a101.csv	171136	1.8938664	1506.19651	<0.00217	0.06489072	149.982968	145.378323	<0.0259	0.54416504	45.3877992	8.98017929	0.58756847	7.05766253	1.31677092
PM18AJ290	E19JL11a102.csv	177236.862	2.71438969	454.369868	0.00738164	0.01386387	233.190252	238.679917	<0.0275	0.09965786	257.903196	0.87648943	0.12540337	5.64488298	0.17035069
PM18AJ290	E19JL11a104.csv	175805.558	2.02845954	1288.66179	<0.00185	0.00990227	69.1306283	73.3487178	0.02677921	0.60639783	53.5241428	11.2296106	0.50957967	7.01403415	0.25558007
PM18AJ290	E19JL11a105.csv	175735.914	3.35669896	1266.3813	0.02195307	0.04584137	161.720673	157.489451	<0.0284	0.1932931	220.442136	2.46355878	0.20661637	6.19906392	2.35172105
PM18AJ290	E19JL11a106.csv	179963.064	4.65396338	2564.22157	0.0073882	0.02915841	232.829799	235.600933	<0.0226	0.81078091	110.247165	13.3157501	1.09248203	3.02720625	2.0112452
PM18AJ290	E19JL11a107.csv	178158.577	6.80399948	690.042984	0.01012602	0.00522874	294.360601	294.266021	<0.0232	2.66481122	196.28802	71.4909024	7.11912542	3.00778234	0.79107536
PM18AJ290	E19JL11a108.csv	180791.583	4.07463457	1716.43791	0.01497519	<0.0032	211.285289	218.215592	<0.026	1.32627655	534.609576	43.249761	2.79844034	3.49459979	0.24527566
PM18AJ290	E19JL11a109.csv	175538.903	3.65219404	1853.66361	<0.00302	0.01384861	325.08542	337.41759	<0.0333	0.95627693	638.44628	4.19888424	0.50964642	4.6381165	1.68555777
PM18AJ290	E19JL11a110.csv	177991.067	2.75013228	1168.94106	0.00328916	0.00732463	188.041767	181.028908	<0.0207	0.12818399	10.2944666	3.69848436	0.20015825	7.75137228	0.09316008
PM18AJ290	E19JL11a111.csv	183647.331	1.80877428	1175.29562	<0.00316	0.40816991	229.784012	233.198087	<0.0342	0.68414367	63.3697026	12.8940664	0.69136052	9.04278331	2.6306566
PM18AJ290	E19JL11a112.csv	180368.574	8.38010079	1858.28304	<0.0021	0.00567834	759.261628	771.129711	<0.0225	0.99589012	601.562866	7.85223833	1.18093758	10.8744108	13.8018978
PM18AJ290	E19JL11a113.csv	169605.867	5.23057453	1841.33725	0.05427378	0.00515194	523.643212	565.839858	<0.031	1.47213358	574.671079	222.405538	11.68915	3.43493253	2.40468506
PM18AJ290	E19JL11a117.csv	176735.475	1.80422031	1345.54904	<0.00352	<0.00476	83.309071	89.3799988	<0.0362	0.05696367	16.461617	1.26885595	0.06646983	3.1401945	0.02802372
PM18AJ290	E19JL11a118.csv	177146.465	2.62476739	1154.232	<0.00211	0.15852633	306.871215	310.64695	<0.0215	1.29755627	125.194502	20.6479981	1.2226861	6.56530856	1.33441291
PM18AJ290	E19JL11a119.csv	181220.22	2.8283803	1450.98763	<0.0036	<0.00495	70.1110602	71.2798705	<0.0363	0.51492766	82.2266203	4.35344682	0.13060242	5.02651765	1.41968386
PM18AJ290	E19JL11a120.csv	179950.089	3.29834692	1698.53145	0.00386881	0.45275973	308.116787	303.036514	<0.0271	1.59283924	177.380036	22.6730671	1.17976441	8.37556177	5.99392025
PM18AJ297	E19JL11a189.csv	181533.556	3.69334502	409.391698	<0.00376	0.08534511	10.7494505	9.45267002	<0.0325	0.06759948	65.2458396	0.43140466	0.04433872	4.41261923	0.69572552
PM18AJ297	E19JL11a190.csv	173482.425	3.8241321	690.158835	0.0118094	1.16121944	128.137856	132.335965	<0.022	2.27364941	102.129757	9.02084222	0.96588166	4.32254839	9.80662194
PM18AJ297	E19JL11a191.csv	177578.521	2.8214008	376.383317	<0.00224	0.0529211	18.0316	16.2632044	<0.0193	0.13255869	117.751906	0.82861278	0.10829645	3.98900232	0.49026343
PM18AJ297	E19JL11a192.csv	178184.065	2.29026888	460.749997	<0.00253	0.12779501	21.9835513	22.7092189	<0.0217	0.17593848	134.170959	0.49887357	0.02869239	6.95191763	0.35219886
PM18AJ297	E19JL11a193.csv	177090.386	2.11416697	425.767688	<0.00234	2.01222349	30.9384352	28.9437678	<0.02	0.16130055	78.5093578	0.47668296	0.05944851	7.20657894	2.28724722
PM18AJ297	E19JL11a194.csv	174490.868	1.99190987	300.309417	0.00379402	0.48374995	32.0874798	29.0132404	<0.0191	0.40101465	54.4300118	0.64476276	0.06047984	3.8237723	0.63350852
PM18AJ297	E19JL11a195.csv	169479.863	1.93451117	603.045853	<0.00385	<0.00461	53.7700234	61.351957	<0.0326	0.06548593	44.9792087	0.06067924	<0.0153	6.13192819	<0.00859
PM18AJ297	E19JL11a196.csv	170822.676	1.67207678	493.47371	<0.00284	0.02490051	107.441806	113.914541	<0.024	0.41731535	77.9438008	5.74627652	0.44269208	4.94706711	0.32874599

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ297	E19JL11a197.csv	171338.821	2.55681511	587.569833	<0.00295	1.04616121	118.164544	111.592391	<0.0248	1.50486165	111.627874	7.47748148	0.90104509	3.59652954	2.4852276
PM18AJ297	E19JL11a198.csv	178967.62	2.01513417	253.934616	<0.00304	0.00479988	18.24252	18.9109038	<0.0255	0.01933161	94.7721742	0.05323496	<0.012	4.5454443	<0.00667
PM18AJ297	E19JL11a199.csv	181173.584	1.68121221	455.017304	0.00289372	0.93032507	78.9338578	79.6990645	<0.0222	0.17091323	62.3041766	1.62833603	0.11547628	5.07669773	2.1503868
PM18AJ297	E19JL11a200.csv	178805.142	4.77974345	928.763455	0.14924484	0.13570395	865.499911	854.139034	<0.0197	3.92295992	215.075897	20.8307155	1.74189887	8.16224189	18.9479623
PM18AJ297	E19JL11a201.csv	170161.73	2.96863741	1015.53348	0.06150259	1.81258195	471.056929	448.097005	<0.0295	2.89634889	122.835689	13.1468989	1.10112733	6.2551057	10.3844115
PM18AJ297	E19JL11a202.csv	176647.501	1.78583806	754.581582	0.00594634	0.02844529	107.797735	106.721109	<0.0209	0.56530464	125.289997	1.72214901	0.23175663	3.91029768	0.64589357
PM18AJ297	E19JL11a203.csv	181052.389	4.35667734	780.311434	0.06164671	0.10838597	420.882148	402.010446	<0.0201	5.88652884	104.187269	33.8668716	2.48311167	7.94048917	16.2798413
PM18AJ297	E19JL11a204.csv	178406.142	1.66978886	470.06884	<0.00269	0.01333755	8.83586613	8.50092547	<0.0219	0.03520872	59.7218539	0.28619422	0.02211234	4.39863813	<0.00584
PM18AJ297	E19JL11a205.csv	183041.669	1.98535932	546.682012	0.08440069	0.20766115	142.196526	140.988686	<0.0263	0.66419011	85.7259255	4.18067762	0.37419329	5.35732852	1.10341817
PM18AJ297	E19JL11a207.csv	177100.992	1.59035782	432.803801	<0.00234	<0.00283	59.8830707	59.2539609	<0.0188	0.0121649	22.8638831	0.27388088	0.00941576	7.4513687	0.01409765
PM18AJ297	E19JL11a208.csv	179403.952	2.60803748	273.887171	0.0410416	0.05909817	91.8686153	92.0291983	<0.0261	0.27016821	127.930055	0.83160539	0.06361968	5.68801246	0.09911758
PM18AJ299	E19JL11a246.csv	183845.84	2.70892911	2299.52864	<0.00375	0.0044173	490.954903	494.467813	<0.0256	0.49030376	629.65595	5.55004512	0.47078608	10.4459138	0.93798171
PM18AJ299	E19JL11a247.csv	181193.7	2.58075781	2222.05532	0.00343848	0.03216033	717.733712	713.388795	0.0488375	0.92189867	372.863095	10.9381166	1.14984206	13.8689421	11.7281867
PM18AJ299	E19JL11a248.csv	174281.784	2.17071066	2434.44026	0.01261832	0.01850739	596.93582	611.386906	<0.0223	0.85540076	358.898064	6.89891189	0.78032474	9.13388225	3.25221614
PM18AJ299	E19JL11a250.csv	174310.198	2.05687005	1924.91131	0.01431244	0.0209716	856.745561	833.426765	<0.0183	0.58365229	400.291325	2.74736263	0.36280867	13.2283246	5.15911183
PM18AJ299	E19JL11a251.csv	180698.344	1.9008286	2322.14938	<0.0032	0.0129099	573.891943	565.485337	<0.0218	0.26696276	323.091719	1.06550472	0.09359545	6.0977254	1.5129687
PM18AJ299	E19JL11a252.csv	176722.678	1.76109064	2264.55144	<0.00281	0.03479144	681.731784	688.724389	<0.0192	0.25039682	332.688424	1.2379764	0.06852328	42.3166888	1.51723801
PM18AJ299	E19JL11a253.csv	178132.422	2.00329125	2096.96991	<0.00253	<0.00292	309.032565	311.227042	<0.0173	0.17172254	262.245319	1.28618936	0.04340992	5.63143867	0.75348938
PM18AJ299	E19JL11a254.csv	178838.113	1.93519253	2439.34786	<0.00278	<0.00322	609.004067	597.364199	<0.0191	0.36639034	310.55617	1.66723773	0.13374491	7.9203729	1.80439561
PM18AJ299	E19JL11a255.csv	173787.065	1.89432177	2375.33574	<0.0031	<0.00355	566.465643	544.306888	<0.0213	0.89289845	308.296679	5.34230161	0.3781901	8.58871079	3.18661215
PM18AJ299	E19JL11a257.csv	176413.574	3.40556233	2623.35915	0.01426464	0.00461218	1008.78765	1001.98348	<0.0191	1.00646683	382.727147	19.9984195	1.59441999	17.5364247	2.99447086
PM18AJ299	E19JL11a258.csv	178921.997	1.75610607	2590.30933	<0.00258	0.64883634	808.327951	799.158588	<0.0179	0.56407533	361.772066	2.68299936	0.25292132	11.5210258	4.06527155
PM18AJ299	E19JL11a259.csv	180269.144	1.98427075	2140.6622	<0.00303	0.02604675	508.626706	491.149485	<0.021	0.7389313	299.283323	3.08094402	0.27725597	7.6381523	9.34354316
PM18AJ299	E19JL11a260.csv	173946.644	3.65006846	2891.82061	0.0064578	0.02781499	690.928394	673.193109	<0.0296	1.57589139	315.084436	42.5868232	3.94355901	10.3619326	5.58375326
PM18AJ299	E19JL11a261.csv	176439.197	2.67611412	2911.64669	<0.00366	<0.00414	842.208206	844.565889	<0.0256	1.3522602	320.810333	30.2210691	2.85450654	11.5085265	4.60259867
PM18AJ299	E19JL11a262.csv	184231.982	1.89416338	2837.27969	0.00468608	0.04283978	705.074329	693.400723	<0.0242	1.06922214	349.638925	13.308735	0.63951783	9.10929808	0.6863376
PM18AJ299	E19JL11a263.csv	179009.353	3.8248901	2888.80579	<0.00259	0.00681092	767.120678	750.201346	<0.0183	2.10909768	324.948953	81.2106526	7.75475222	18.2056369	11.5730901
PM18AJ302	E19JL15a007.csv	180528.386	3.7803381	1895.49118	<0.00633	12.8775059	605.253003	603.547537	<0.0965	10.1663812	232.458644	64.0183634	4.84699312	2.71001014	14.4045847
PM18AJ302	E19JL15a009.csv	176892.089	12.4249753	1722.36259	<0.00651	0.04319146	1128.36993	1137.14866	<0.0857	1.00349196	261.134624	9.07878077	1.20039447	4.72214922	5.75377059
PM18AJ302	E19JL15a011.csv	179412.702	4.16014376	1389.49522	<0.00633	<0.00622	999.93761	1030.86415	<0.0713	0.96969751	157.379678	15.7204786	1.33606684	3.10036531	7.64878548
PM18AJ302	E19JL15a012.csv	178974.132	4.4020418	1426.21298	0.0132256	0.16416839	2341.63614	2349.78553	<0.0652	0.29436382	179.098681	5.11298321	0.60887173	4.5795699	7.65273416
PM18AJ302	E19JL15a013.csv	182307.715	7.74266843	1050.34861	0.01870456	<0.00899	1238.425	1256.34103	<0.0892	0.70007038	214.278987	7.01653502	1.03547786	4.69253292	14.7387645
PM18AJ302	E19JL15a014.csv	170879.221	4.6222262	874.305533	<0.00697	18.2296475	652.988471	657.789037	<0.0644	22.004308	305.78351	239.003426	19.5555942	3.81390838	32.7839556
PM18AJ302	E19JL15a015.csv	177765.353	3.08518119	1141.1475	<0.00614	55.9072115	142.084888	146.899272	<0.0527	13.4115139	231.630102	20.2087085	1.40168949	1.8655008	22.6961891
PM18AJ302	E19JL15a016.csv	174389.153	11.8359121	2346.77517	<0.00704	0.99793826	522.495273	520.803657	<0.0563	2.32670943	125.393019	27.8777384	2.56455271	1.92418468	4.93507762
PM18AJ302	E19JL15a018.csv	180707.109	4.42449401	1980.04256	<0.00647	2.93855274	790.662941	806.140294	<0.0469	3.24825612	122.387907	27.8344175	2.27924799	4.79281189	6.77873061
PM18AJ302	E19JL15a019.csv	179644.802	5.97228522	1180.05017	<0.0064	22.4169035	574.926691	573.873252	<0.0443	33.3402641	168.507805	83.762218	7.28764124	5.56367478	20.1566739
PM18AJ302	E19JL15a020.csv	176034.837	6.16844265	809.236376	<0.00633	2.19442492	269.527695	281.376999	<0.0419	9.81462333	117.219831	15.2498816	1.32715759	5.14906955	22.3710766
PM18AJ302	E19JL15a021.csv	174136.239	5.7391566	2318.25704	<0.00763	0.43520507	464.465485	434.617716	<0.0488	2.76940139	104.413459	1659.74185	149.043098	3.2819472	20.206264
PM18AJ302	E19JL15a022.csv	178579.626	12.2773487	1284.95926	<0.00627	17.7681	302.313191	305.060305	<0.0386	7.19377252	174.714338	37.9407694	3.1841551	3.91187761	43.6361511
PM18AJ302	E19JL15a023.csv	181560.555	2.93434623	1665.92826	<0.0065	0.8363557	258.546877	256.653129	<0.0389	8.35366326	196.546602	54.5566147	3.98351118	3.32695634	4.11038412
PM18AJ302	E19JL15a024.csv	181856.858	1.82980911	1879.60694	<0.00656	0.00655185	84.5473134	83.7480234	<0.0384	0.45631864	54.6942958	4.2595328	0.19941464	2.32889613	0.15731894
PM18AJ304	E19JN25a061.csv	176955.674	4.8275572	3142.09127	0.03797004	0.00774947	403.368094	409.124056	<0.0299	1.80470685	695.682579	71.7713559	7.0620085	10.0772271	11.3514924
PM18AJ304	E19JN25a062.csv	182710.861	3.61761037	899.850313	0.05988682	0.04023961	234.156284	240.403093	<0.0273	0.39708331	252.920065	7.71359473	0.55342385	14.8605919	6.39190343
PM18AJ304	E19JN25a063.csv	179853.437	3.10431388	1120.80712	0.04796175	3.10726342	310.811098	317.277912	<0.0265	2.66265768	246.085854	6.99832756	0.6431903	7.52320804	42.6011365
PM18AJ304	E19JN25a064.csv	179842.578	3.83225518	1774.59407	0.14974029	0.36947863	689.913436	701.060104	<0.0262	1.76396728	489.692048	24.9159589	1.83570822	10.6482784	20.9956629
PM18AJ304	E19JN25a079.csv	180753.341	3.50658912	1993.25094	0.04422594	0.31016428	763.421805	760.509011	<0.0247	2.50278953	280.276002	10.0409885	0.86522206	10.3341153	12.4341784
PM18AJ304	E19JN25a083.csv	181460.821	3.10264593	1779.70782	0.05848839	0.04042378	366.197145	364.622146	<0.0249	2.48363053	209.347205	13.0709405	0.94732976	8.54532614	24.0721023
PM18AJ304	E19JN25a084.csv	179058.915	3.06283008	1385.8758	0.02095699	0.09076442	403.537186	400.433819	<0.0241	3.14884153	240.303225	10.5896758	0.97899586	6.39976182	34.110679
PM18AJ304	E19JN25a085.csv	174925.377	3.58104732	2102.683	0.02693907	0.60157499	913.631946	929.825358	<0.0274	8.14861712	313.826585	27.3127424	2.47957518	5.92810742	15.8933652
PM18AJ304	E19JN25a106.csv	179501.91	4.08767846	1034.38989	0.12320061	0.03882569	987.130268	981.191641	<0.022	1.21079523	503.949673	46.3591328	5.76026854	14.0437285	24.0412673
PM18AJ304	E19JN25a107.csv	181233.848	4.1954401	2391.23455	0.05085757	1.29765022	608.476394	609.496373	<0.0198	6.72449708	1286.20433	66.2801287	5.14074528	10.3123874	40.1003571

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix F:
Pemberton Hills Epidote Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ304	E19JN25a108.csv	180393.61	4.16202626	2355.8534	0.0837534	0.03049514	318.116551	324.208872	<0.0194	2.61749099	565.74945	59.9894056	4.3437106	11.227104	28.4545796
PM18AJ304	E19JN25a109.csv	178145.042	4.59799264	1440.65077	0.03351978	0.64389139	1324.14353	1325.27488	<0.019	4.87968646	448.587544	21.0379903	2.16504594	8.7888265	22.525416
PM18AJ304	E19JN25a110.csv	181110.312	3.49918244	1544.0268	0.06851231	0.00601597	452.994082	445.659405	<0.0236	0.50631755	1108.44863	2.11823809	0.21960391	13.6634273	0.61014
PM18AJ304	E19JN25a114.csv	178007.784	2.99748845	1238.15517	0.08797009	0.03876532	1397.63329	1373.34011	<0.018	0.90385467	416.770572	4.38978393	0.48022858	6.59144373	11.0071065
PM18AJ304	E19JN25a115.csv	177242.736	3.66752066	2062.96386	0.09236318	0.38107943	544.642457	550.689295	<0.0205	2.58875942	244.476577	20.0351421	1.47368301	9.44642185	12.9961821
PM18AJ304	E19JN25a116.csv	173223.1	5.73435838	1908.37474	0.05750834	0.15244059	716.592052	709.511862	<0.0241	1.51527688	1489.54074	32.6941873	3.03378566	11.0952927	18.7311394
PM18AJ309	E19JL15a288.csv	176149.654	1.86944371	262.529958	<0.00243	<0.00248	739.80179	721.53168	<0.0174	0.00591965	218.082622	1.14480156	0.50380228	7.6024244	0.01954043
PM18AJ309	E19JL15a290.csv	176491.411	1.48488909	1908.99184	0.01008992	<0.00265	677.989624	665.235208	<0.018	<0.00247	84.8382336	0.41104205	0.06366604	8.66510214	0.15791115
PM18AJ309	E19JL15a291.csv	176116.764	1.51725362	1883.23858	0.01451862	0.00291798	246.603052	245.966728	<0.0164	0.01392593	44.3708944	0.26749439	0.01608283	8.56736414	0.66332085
PM18AJ309	E19JL15a292.csv	175180.603	1.38563245	3552.97925	0.00440637	<0.00244	83.6902751	77.5065177	<0.0161	<0.00229	46.1437875	0.02724225	0.01259307	8.6239456	0.02542398
PM18AJ309	E19JL15a293.csv	174145.237	1.51375444	1888.08451	0.00594253	<0.00238	300.513374	296.099113	<0.0155	0.01201705	128.452008	1.52105799	0.21042686	6.49571219	1.02193291
PM18AJ309	E19JL15a294.csv	174966.823	1.56861554	1669.4831	<0.00239	0.00382969	582.573982	575.624432	<0.0156	0.03024253	354.117456	0.81310591	0.05826243	8.93359929	0.26169548
PM18AJ309	E19JL15a295.csv	174845.828	1.43871956	2329.72513	0.00774638	<0.00243	206.790305	202.853506	<0.0152	0.00983431	208.135633	0.26037957	0.01947321	13.3395462	0.26597937
PM18AJ309	E19JL15a296.csv	173972.652	1.81183282	1976.13964	<0.00264	0.08143474	602.527597	599.928706	<0.0167	0.18372359	273.45315	6.25849468	0.75829612	15.1160244	11.5972374
PM18AJ309	E19JL15a297.csv	180134.766	1.70349515	2033.33173	<0.00251	0.05325742	442.068581	437.849762	<0.0155	0.05494697	141.572852	2.75247076	0.2388501	11.2059895	1.88628092
PM18AJ309	E19JL15a298.csv	180670.036	1.45063043	2209.81402	0.00666327	<0.00262	485.718405	467.417362	<0.0154	0.02135671	76.2715288	0.38552733	0.02897932	14.2471849	0.47916058
PM18AJ309	E19JL15a299.csv	177078.655	1.58942404	2194.61919	0.00277195	0.00389469	520.476875	517.354596	<0.0143	0.12569266	273.222237	4.7470197	0.32655	9.61563235	4.78239941
PM18AJ309	E19JL15a300.csv	178159.305	1.78423921	2688.04967	0.00629099	<0.00251	511.830407	508.338022	<0.0142	0.12987241	222.67061	4.28223488	0.41395929	7.81517053	2.68088395
PM18AJ309	E19JL15a301.csv	181496.634	1.48745503	1540.77089	0.00483523	<0.00267	688.695698	675.858197	<0.0147	0.01437578	105.430442	1.27661337	0.16340402	15.6998608	0.31320446
PM18AJ309	E19JL15a302.csv	178093.113	1.29583318	883.792422	<0.00243	<0.00249	397.621489	389.670939	<0.0134	0.00761251	226.216949	0.20565896	0.00919537	9.89977601	0.03860018
PM18AJ309	E19JL15a303.csv	177823.933	1.26539076	2066.50815	<0.00247	<0.00253	305.579894	308.557775	<0.0133	<0.00238	257.286439	0.88769537	0.17391937	6.49272324	0.09311767
PM18AJ309	E19JL15a304.csv	176411.416	1.48225761	2546.68438	<0.00244	<0.00249	128.10838	124.864754	<0.0129	0.00958338	275.818302	0.8500309	0.09356784	9.89156858	0.18599372
PM18AJ309	E19JL15a305.csv	177870.286	1.57139367	2804.47694	<0.00245	<0.00251	157.055569	153.99684	<0.0127	0.00696516	200.16219	0.6492848	0.04975144	11.5992779	0.16253938
PM18AJ309	E19JL15a306.csv	181528.702	1.63715194	1468.9322	<0.0026	<0.00267	262.683932	263.584289	<0.0132	<0.00251	124.703303	2.3797546	0.50110844	3.83149209	0.04279099
PM18AJ309	E19JL15a307.csv	178786.817	1.4128988	2531.42196	0.0030153	<0.00254	473.488849	457.351514	<0.0124	0.01389369	28.4040099	0.44621632	0.01744104	17.4803076	0.15397379

Samples PM18AJ212 and PM18AJ283 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ209	E19JN26a319.csv	<0.0249	<0.0246	100464.014	2.04525308	<0.00503	69.9272491	3.13410733	<0.014	237.575787	1.09096604	26.5293587	11.9656381	11.9663638	0.05079021	164548.544
PM18AJ209	E19JN26a321.csv	<0.0209	<0.0208	96443.3528	0.52866261	<0.0042	78.3338452	0.46926512	<0.0119	302.574134	0.9205009	18.6020353	31.0781088	8.35636419	0.0423084	152971.15
PM18AJ209	E19JN26a322.csv	<0.03	<0.0301	94288.9998	<0.336	<0.00594	30.4937079	12.8055708	<0.017	793.20689	0.45957256	13.0757547	25.0336775	3.75926261	0.01937384	98377.475
PM18AJ209	E19JN26a323.csv	<0.0222	<0.0222	98730.2538	0.34871846	<0.00445	70.1638468	0.53040672	<0.0126	391.211373	0.69929592	19.1124	33.8425185	5.58906142	0.04884226	149790.143
PM18AJ209	E19JN26a325.csv	<0.0209	<0.0211	96405.5031	0.66597014	<0.00418	60.5485696	0.5851709	<0.012	252.822263	0.91130802	22.3269545	34.195978	9.56326359	0.05724684	149644.14
PM18AJ209	E19JN26a326.csv	<0.0205	<0.0208	99671.3011	0.59278697	<0.00409	114.452634	0.53787366	<0.0118	260.142714	1.39572696	25.28327	45.3282141	12.1360955	0.09738955	160683.235
PM18AJ209	E19JN26a327.csv	<0.0257	<0.026	101007.755	0.42965153	<0.00502	39.549988	0.60528211	<0.0148	270.1612	0.49521374	16.0024204	14.9510597	10.5769209	0.03770797	151963.2
PM18AJ209	E19JN26a329.csv	<0.0208	<0.0213	100224.694	1.14101193	<0.00412	85.4901297	1.40140535	<0.0122	442.151911	1.14636378	29.2106835	30.3455025	24.8088302	0.07528849	177699.572
PM18AJ209	E19JN26a330.csv	<0.0476	<0.0488	98489.5632	1.09787365	<0.00944	56.8717496	0.82358709	<0.0285	208.280658	0.73529644	24.0462954	19.8262982	14.5331656	0.054525	159574.38
PM18AJ209	E19JN26a331.csv	<0.0239	<0.0246	100772.19	1.4742777	<0.00475	78.7547018	0.81546376	<0.0144	333.872358	0.83078618	30.9885837	33.6815546	21.4186902	0.04947467	173456.123
PM18AJ209	E19JN26a332.csv	<0.0232	<0.0239	100066.885	2.0180111	<0.00456	107.533955	1.48864548	<0.0138	391.391038	1.15340563	29.9762729	54.69904	29.1621251	0.07802766	171747.774
PM18AJ209	E19JN26a341.csv	<0.0229	<0.0243	102220.064	0.68629081	<0.0044	35.2116102	0.34812972	<0.0142	165.313047	0.37526387	20.3257448	19.3168887	7.18992367	0.02131422	137803.196
PM18AJ209	E19JN26a345.csv	<0.0399	<0.0428	93572.6368	1.78512851	<0.00774	52.292785	0.76958253	<0.0259	244.288907	0.53992418	18.9529083	12.036317	34.0231412	0.02284544	155541.104
PM18AJ209	E19JN26a346.csv	<0.0219	<0.0235	95328.256	0.74104998	<0.00413	65.1507434	0.60980141	<0.0138	348.469921	0.63581822	23.9541954	22.629888	9.34425247	0.04979987	148158.539
PM18AJ209	E19JN26a348.csv	<0.0313	<0.0339	100878.291	0.57828213	0.0061063	55.8638187	0.35653386	<0.0202	277.263335	0.6178462	21.846178	18.9677558	12.3724416	0.03999091	155035.453
PM18AJ212	C19AU08C227.csv	<0.0506	<0.0539	96378.4479	0.60685595	<0.0109	2.91725123	1.91716986	0.01032286	877.43943	<0.00263	97.599477	1.68440588	0.54148759	<0.00433	134172.064
PM18AJ212	C19AU08C229.csv	<0.0384	<0.041	96150.1299	<0.318	<0.00821	2.28776418	2.0658512	0.01621296	626.675722	0.01725795	102.342678	5.402823	0.47757031	0.02037742	129229.84
PM18AJ212	C19AU08C230.csv	<0.0417	<0.0446	99343.9574	0.68027699	0.01268978	2.72409147	2.48833872	0.01437413	1001.48267	0.04715041	101.404261	2.90801555	0.49964565	<0.00364	135452.65
PM18AJ212	C19AU08C231.csv	<0.0393	<0.0421	95859.7575	<0.331	<0.00845	3.17934649	0.83143214	0.0079586	663.245106	0.05337542	98.699774	1.56195834	0.61142026	<0.0034	144231.153
PM18AJ212	C19AU08C232.csv	<0.0343	<0.0367	96216.0576	0.70063699	<0.00748	3.08266944	1.33188225	0.00371505	814.4462	0.01197525	106.013066	1.6401311	0.60543084	0.00709466	140523.071
PM18AJ212	C19AU08C233.csv	<0.0625	<0.0669	94529.9625	1.24299743	<0.0135	3.0013385	2.56708828	<0.00281	365.221118	0.02838118	88.8343826	2.03880341	0.53827058	0.04854468	146911.303
PM18AJ212	C19AU08C234.csv	<0.0426	<0.0456	94045.6204	0.42619682	<0.00946	3.09199595	3.16912614	0.00982405	605.963033	0.13148455	76.731129	2.23192851	0.45122177	0.0258806	138324.598
PM18AJ212	C19AU08C235.csv	<0.0446	<0.0477	95667.0466	<0.382	<0.00987	1.83097074	2.52387208	0.00903939	695.06335	0.30237969	71.6387993	2.50993386	0.79533919	0.0616283	137777.327
PM18AJ212	C19AU08C236.csv	<0.0816	<0.0871	88754.9113	<0.692	0.0190593	2.54367351	2.63888103	<0.0036	6632.90731	0.24273459	83.7200063	5.13055794	<0.522	<0.00711	182044.718
PM18AJ212	C19AU08C243.csv	<0.0407	<0.0428	93396.6351	<0.373	<0.00921	2.47613248	2.81043263	<0.00191	802.530718	0.06625506	82.9521728	3.81058141	0.32199352	0.05955155	131702.242
PM18AJ212	C19AU08C244.csv	<0.0431	<0.0462	97565.3198	<0.397	0.01009532	2.0915073	2.16371596	0.01223864	481.312171	0.02941653	94.3202063	6.39906911	0.56837484	<0.00388	139796.964
PM18AJ212	C19AU08C245.csv	<0.0386	<0.0404	96852.112	0.81091089	<0.00874	3.50987995	1.31107825	<0.00178	618.181375	0.02222668	99.5666918	2.02020072	0.47886334	0.00416183	149481.496
PM18AJ212	C19AU08C246.csv	<0.0365	<0.038	91183.7923	0.40525626	<0.00836	2.58639081	2.26780431	0.0045663	507.911161	0.02124109	107.711303	1.60374254	0.45194165	<0.00323	124660.182
PM18AJ212	C19AU08C249.csv	<0.0493	<0.0508	91749.1035	0.52375133	<0.0113	2.48275282	2.38212403	0.01395989	1727.51627	0.46845932	103.881593	2.66059189	0.44411146	0.01408912	131118.008
PM18AJ212	C19AU08C250.csv	<0.0381	<0.0391	89976.5138	0.43834078	<0.00865	2.71100025	2.42623682	0.01497008	670.797954	0.01717478	93.5238083	<0.781	0.34261536	<0.00339	125512.364
PM18AJ212	C19AU08C251.csv	<0.0419	<0.0429	98019.4846	0.52766857	<0.00992	2.07901373	2.61257275	0.00836897	962.957424	0.00772588	102.551339	1.85776845	0.45793399	<0.00373	133355.336
PM18AJ212	C19AU08C253.csv	<0.0469	<0.0477	92639.1725	<0.457	<0.0112	1.77153475	1.78366899	0.03872579	496.992554	0.08857673	101.749679	4.29640517	0.5310348	0.00895923	130636.488
PM18AJ212	C19AU08C255.csv	<0.0337	<0.0341	96909.2139	0.41627043	<0.00787	2.55066238	2.60928745	0.00518779	897.695865	0.13876471	102.539114	1.48439268	0.47512216	0.01246699	136031.683
PM18AJ212	C19AU08C256.csv	<0.0367	<0.037	96816.9396	0.43737771	<0.0086	2.88523167	1.59047106	0.00535587	559.597582	0.04067679	101.849529	13.3210757	0.47087215	<0.00334	164957.006
PM18AJ212	C19AU08C257.csv	<0.0342	<0.0344	94120.2829	0.85637689	<0.00802	2.25530713	3.61303439	0.00856697	2884.45117	0.63998919	75.2488484	1.22075222	0.533634	0.01536711	131580.1
PM18AJ215	E19JN26a403.csv	<0.0195	<0.0216	105826.14	0.52540321	<0.00411	4.86697493	3.54103039	<0.0106	689.84647	0.78201496	1.68978883	5.88821816	0.39909891	0.0297363	188729.236
PM18AJ215	E19JN26a404.csv	<0.0205	<0.0226	106644.928	0.6652084	0.00590919	4.97081404	5.04160532	<0.0111	904.50785	0.37909994	1.72550459	5.43810208	0.61928493	0.02956495	193309.728
PM18AJ215	E19JN26a405.csv	<0.0186	<0.0205	105584.89	0.52880348	<0.00399	4.65217858	6.11568374	<0.00991	1009.45543	0.41661375	1.5146546	3.46941862	0.34326892	0.025002	188985.258
PM18AJ215	E19JN26a406.csv	<0.0198	<0.0217	102290.591	0.42091954	<0.00429	6.8600928	4.57190876	<0.0105	623.860703	0.25519707	4.35611516	1.6459789	0.75370281	0.01377303	206801.299
PM18AJ215	E19JN26a407.csv	<0.019	<0.0207	103712.216	0.82452612	<0.00408	4.1548171	4.91714771	<0.0098	796.493171	0.21631274	1.38435382	4.97335326	0.3940673	0.00988126	191665.266
PM18AJ215	E19JN26a408.csv	<0.0192	<0.0208	108478.996	0.52143465	<0.00419	3.2529714	3.58379242	<0.00977	709.292359	0.03022823	2.16215757	58.9422934	0.33036177	0.00507854	189028.595
PM18AJ215	E19JN26a409.csv	<0.0188	<0.0203	107640.777	0.415716	<0.00416	2.75251284	3.14375902	<0.00946	702.027633	0.16793242	2.25488159	6.75478731	0.37639548	0.01188643	189411.233
PM18AJ215	E19JN26a410.csv	<0.0189	<0.0203	107356.444	0.54270394	<0.00419	2.81048918	2.1632891	<0.00935	610.231364	0.19460018	2.00944001	3.28644861	0.38116119	0.01592577	190263.037
PM18AJ215	E19JN26a411.csv	<0.0191	<0.0204	107178.75	0.44095936	<0.00428	4.22316564	2.33447332	<0.00932	649.142456	0.22053182	2.0352723	4.04515777	0.46107093	0.02244255	194493.052
PM18AJ215	E19JN26a412.csv	0.0246192	<0.022	108554.283	<0.273	<0.00468	6.88705561	2.20121596	<0.00992	761.455566	0.18814682	2.19786338	4.47098453	0.6493446	0.00338975	196017.527
PM18AJ215	E19JN26a413.csv	<0.0182	<0.0192	105566.819	0.65604749	<0.00412	4.48626299	2.90129988	<0.00858	844.315567	0.02279352	1.50981593	5.7121298	0.42488253	0.0026306	188651.115
PM18AJ215	E19JN26a414.csv	<0.0193	<0.0203	105439.477	0.47473971	<0.00445	3.68730881	3.719397	<0.00901	1057.05409	0.03384224	1.51172589	12.0333172	0.53257127	<0.00235	195496.374
PM18AJ215	E19JN26a415.csv	<0.0214	<0.0223	103226.31	0.54268807	<0.00493	5.40794126	3.0615093	<0.00992	1003.99586	0.02585682	1.42611709	5.82230074	<0.299	<0.00261	187622.346
PM18AJ215	E19JN26a416.csv	<0.0178	<0.0184	106079.958	0.52272891	<0.00409	5.25396411	3.7948007	<0.00801	954.962007	0.03654109	1.30983103	9.3925919	0.46411734	<0.00217	187823.126
PM18AJ215	E19JN26a417.csv	<0.0177	<0.0182	104393.795	0.5211539	<0.00408	4.54004756	2.57500994	<0.00785	682.527847	0.02088358	1.32953291	8.46121444	0.27417256	0.00378084	190093.18
PM18AJ215	E19JN26a418.csv	<0.0247	<0.0252	109668.965	<0.319	<0.00596	3.76642479	3.52522822	<0.0113	1103.21728	<0.00228	1.51578385	16.2788392	0.38456349	<0.00317	194137.906
PM18AJ215	E19JN26a419.csv	<0.0177	<0.0179	107001.558	0.45872369	<0.00411	3.28855766	3.32368408	<0.00762	619.388719	0.01754286	1.73089022	13.9562199	<0.248	0.00498144	190946.996

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ215	E19JN26a420.csv	<0.0265	<0.0267	102618.333	0.72797294	<0.00613	2.70172188	6.29344311	<0.0113	3667.74897	5.97935046	3.77267278	117.665306	<0.374	0.18900003	199913.077
PM18AJ215	E19JN26a421.csv	<0.0172	<0.0171	104012.752	0.50784075	<0.004	4.98213081	3.14650955	<0.00723	777.032632	0.38485144	1.48457542	5.08514915	0.35214383	0.0209528	190154.157
PM18AJ215	E19JN26a422.csv	<0.0177	<0.0175	105755.544	0.4077744	<0.00412	3.14839163	3.06525268	<0.00737	691.777282	0.06232655	2.1018788	13.4538704	0.43552875	0.00787476	195672.013
PM18AJ215	E19JN26a423.csv	<0.0176	<0.0173	107206.204	0.52513994	<0.0041	4.9835206	2.06253615	<0.00729	681.809312	0.20079702	1.95958552	4.54795925	0.48507634	0.01173865	192714.914
PM18AJ215	E19JN26a425.csv	<0.0178	<0.0172	104531.424	0.38321134	<0.00408	3.51894529	3.31175001	<0.00728	749.725093	0.01568037	1.67137181	10.837952	0.39911787	0.00493938	193691.432
PM18AJ215	E19JN26a426.csv	<0.0176	<0.0168	105163.505	0.66240411	<0.00404	3.77857689	2.7614553	0.00826924	825.28796	0.02741518	1.15323015	11.7052596	0.35754956	<0.00214	190516.062
PM18AJ215	E19JN26a427.csv	<0.0179	<0.017	105401.197	0.82222088	<0.00409	5.05416416	3.85393196	<0.00731	977.554985	0.59680865	1.48659467	4.51515325	0.83031475	0.02917477	191610.097
PM18AJ220	E19JN25a314.csv	<0.0232	<0.0177	100797.823	1.22304335	<0.00466	19.4759193	0.88790126	<0.0107	978.705725	0.01865961	30.7941379	0.56524053	1.38170573	<0.00283	90063.2072
PM18AJ225	E19JN26a077.csv	<0.0312	<0.0313	93026.7265	0.49262433	<0.00429	4.19492983	1.14160015	<0.0149	1105.04411	0.00877383	17.1655361	4.03157108	0.53720976	0.00609915	145731.493
PM18AJ225	E19JN26a078.csv	<0.0312	<0.0313	92063.9977	0.49495545	<0.00429	2.88391746	1.10142758	<0.0149	961.775028	0.00706947	18.2775635	23.9185925	0.41370498	0.0096059	144106.828
PM18AJ225	E19JN26a079.csv	<0.0311	<0.0312	92673.7849	0.51142888	<0.00429	2.46528236	1.1853371	<0.0149	836.912302	0.01222598	20.4233105	45.5492761	0.69462978	<0.00215	144787.065
PM18AJ225	E19JN26a080.csv	<0.031	<0.0311	92093.5744	0.82318186	<0.00429	2.57743506	1.060479	<0.0149	871.46274	0.01392581	17.9974988	38.8785556	0.53634852	<0.00215	143232.811
PM18AJ225	E19JN26a081.csv	<0.031	<0.0311	93667.6833	0.38913506	<0.0043	2.20850042	0.88536445	<0.0149	919.646777	0.00193941	17.2826615	4.89429008	0.4932828	<0.00216	146430.401
PM18AJ225	E19JN26a082.csv	<0.0309	<0.0311	92368.0982	0.54196397	<0.00431	2.70901519	1.22933586	<0.0149	919.811522	0.00435963	17.5421631	311.520294	0.37835941	0.00459491	144514.32
PM18AJ225	E19JN26a083.csv	<0.0307	<0.0309	92209.016	0.64757929	<0.0043	2.62679043	1.18785713	<0.0149	997.917035	<0.00158	16.8272029	14.1641944	0.44706202	0.00261308	145233.425
PM18AJ225	E19JN26a084.csv	<0.0303	<0.0305	91568.922	<0.295	<0.00426	3.04251562	1.42279483	<0.0147	979.135522	0.01044241	16.6594076	114.52657	0.35343168	0.00258962	143384.259
PM18AJ225	E19JN26a085.csv	<0.0305	<0.0307	92486.8121	0.46787858	<0.0043	2.51551414	1.38367224	<0.0148	977.599214	0.00883854	15.7906586	19.4869509	0.35667777	<0.00216	143257.058
PM18AJ225	E19JN26a086.csv	<0.0301	<0.0304	93812.7443	0.32494566	<0.00427	3.58014854	1.15319977	<0.0147	964.755116	0.00876478	16.9158325	575.937715	0.53310377	<0.00214	147242.7
PM18AJ225	E19JN26a087.csv	<0.03	<0.0303	93846.0544	0.74939343	<0.00427	2.98937115	1.29432036	<0.0146	1094.1597	0.00424372	16.666465	616.315691	0.74553656	<0.00215	145898.6
PM18AJ225	E19JN26a088.csv	<0.0297	<0.0299	93740.6011	0.45211969	<0.00424	3.19722167	0.9146873	<0.0145	963.753021	0.00191596	16.2067225	808.683952	0.40628144	0.00373774	146849.215
PM18AJ225	E19JN26a089.csv	<0.0357	<0.0358	94649.9365	<0.348	<0.00517	3.62077572	1.26103328	<0.0175	1056.1225	0.015052	16.8516689	568.806196	0.51696148	0.00470228	146229.421
PM18AJ225	E19JN26a090.csv	<0.0297	<0.03	92206.6066	0.29072916	<0.00428	3.57580908	1.18693828	<0.0145	846.312644	0.00193936	20.8717072	317.919233	0.44418937	<0.00216	142102.017
PM18AJ225	E19JN26a091.csv	<0.0304	<0.0307	93077.0553	0.60011633	<0.00441	2.89806827	1.04342853	<0.0149	1820.36775	0.65645003	19.6589421	434.217475	0.49805716	0.02083388	144596.96
PM18AJ225	E19JN26a092.csv	<0.0295	<0.0299	91956.3229	0.40835957	<0.0043	2.47634772	1.36928845	<0.0145	789.025718	0.01745868	20.6568792	585.084363	0.56962049	0.00261879	142441.842
PM18AJ225	E19JN26a093.csv	<0.0291	<0.0295	92462.5861	<0.285	<0.00426	2.32255648	1.20710591	<0.0143	945.377171	0.03439941	20.7599006	197.678771	0.38480814	0.00725207	141201.476
PM18AJ225	E19JN26a094.csv	<0.0329	<0.0333	95224.2386	<0.323	<0.00485	2.73068687	0.69258434	<0.0161	966.344345	0.06876497	21.6076223	319.188198	0.5117171	0.01992463	146242.28
PM18AJ225	E19JN26a095.csv	<0.0289	<0.0293	91452.0072	0.56559054	<0.00426	2.78297481	1.2792473	<0.0142	830.180568	0.00536332	20.0185555	1848.07588	0.35135774	0.00260442	144200.372
PM18AJ225	E19JN26a097.csv	<0.029	<0.0295	92706.851	0.36271587	<0.00433	2.67173616	1.425992	<0.0143	904.299566	0.00196715	17.3141074	145.424505	0.379459	0.0038354	143406.775
PM18AJ225	E19JN26a098.csv	<0.0284	<0.0288	92035.5249	0.37236815	0.00631872	2.47834591	0.9359245	<0.014	912.19305	0.00878925	17.0012278	133.709427	0.31678202	0.00610428	142186.96
PM18AJ225	E19JN26a099.csv	<0.0283	<0.0288	93398.584	<0.281	<0.00428	2.85568991	0.99619066	<0.014	963.692855	0.01056178	16.6842644	46.8930142	0.37497205	0.00379105	144595.774
PM18AJ225	E19JN26a100.csv	<0.034	<0.0346	96917.3517	0.54126285	<0.00518	2.59118295	1.50420861	<0.0166	977.881134	<0.00192	18.581015	19.8021754	0.85950734	<0.00262	153321.753
PM18AJ225	E19JN26a101.csv	<0.0278	<0.0284	92174.8949	0.48873749	<0.00425	2.20532704	1.11408714	<0.0137	812.685223	0.00364922	17.2299604	61.5341121	0.55241576	0.00377133	144495.621
PM18AJ228	E19JL11a343.csv	<0.0215	<0.0202	100802.174	0.28361509	<0.00488	14.1739548	20.4072802	<0.0101	440.649213	0.54138771	71.3025539	0.44905531	116.397778	0.07010171	237933.229
PM18AJ228	E19JL11a344.csv	<0.0208	<0.0197	101786.458	0.41652197	<0.00477	20.2318016	44.265482	0.0151634	377.706717	0.65607982	68.7743611	<0.436	136.004528	0.09060516	233463.245
PM18AJ228	E19JL11a345.csv	<0.0211	<0.0202	102238.892	0.35259792	<0.00479	30.0172864	19.3925442	<0.00988	441.414016	0.49057721	69.20915	<0.443	127.571247	0.06907919	231489.107
PM18AJ228	E19JL11a346.csv	<0.0239	<0.023	105025.348	0.41939292	<0.00548	21.8057291	25.5834048	<0.0113	386.10756	0.40364562	61.2759962	<0.495	104.01815	0.06408759	232127.057
PM18AJ228	E19JL11a347.csv	<0.0212	<0.0206	102447.941	0.30957435	<0.0048	27.1237921	26.757797	<0.00992	495.69991	0.59923673	64.2831712	<0.444	124.295158	0.08680781	228592.4
PM18AJ228	E19JL11a348.csv	<0.0235	<0.0231	104882.419	0.30628314	<0.00541	23.3755601	18.0413319	0.01488924	380.585698	0.4438686	72.2841454	<0.488	82.5135472	0.06695067	236396.317
PM18AJ228	E19JL11a349.csv	<0.0213	<0.0212	102566.72	0.19535749	<0.00484	13.4300253	23.7474626	<0.0101	297.998817	0.42711219	66.2684169	<0.442	91.6102983	0.05119063	236445.057
PM18AJ228	E19JL11a350.csv	<0.0272	0.02929315	112263.568	0.88497504	<0.00614	61.5772879	87.8101567	<0.0129	658.529442	0.57857403	55.4335267	<0.56	205.776438	0.07098537	241979.438
PM18AJ228	E19JL11a351.csv	<0.0222	<0.0226	105795.363	0.62407463	<0.00494	20.9696627	87.9455088	0.01221635	655.248468	0.68942481	58.1802327	<0.453	156.947355	0.10284081	234075.265
PM18AJ228	E19JL11a352.csv	<0.0215	<0.0221	101307.346	<0.174	<0.00481	4.74494404	21.1201799	<0.0103	408.964352	0.41146052	73.0016764	<0.434	66.1745358	0.05283606	236482.097
PM18AJ228	E19JL11a353.csv	<0.0219	<0.0227	103675.643	0.21298888	<0.00486	33.9480107	29.266426	<0.0105	352.811022	0.52044465	71.4100798	<0.436	148.46063	0.04572965	236730.82
PM18AJ228	E19JL11a354.csv	<0.0247	<0.0259	104680.236	<0.202	<0.00546	16.3395553	9.52561464	<0.0118	236.861086	0.26610265	70.4922399	0.55815359	60.9675079	0.02570661	232352.359
PM18AJ228	E19JL11a355.csv	<0.0282	<0.03	109476.578	0.39964137	<0.00617	257.288851	175.865985	<0.0136	6302.8513	0.41156654	50.711995	<0.537	246.29489	0.06133642	212463.943
PM18AJ228	E19JL11a356.csv	<0.024	<0.0259	102879.098	0.23082026	<0.0052	39.9198135	25.4167601	<0.012	518.275212	0.40870533	62.2467193	<0.454	123.951847	0.06670075	232791.9
PM18AJ228	E19JL11a357.csv	<0.0453	<0.0495	100434.903	0.80026166	<0.00966	57.5192904	49.118549	<0.0229	3478.77278	1.67336453	57.5538271	<0.817	156.989348	0.05435526	221290.41
PM18AJ228	E19JL11a358.csv	<0.024	<0.0261	102362.811	<0.204	<0.00501	51.7534076	24.7462998	<0.0122	571.96298	0.49099294	61.1543182	<0.433	132.727281	0.05733667	228850.759
PM18AJ228	E19JL11a359.csv	<0.025	<0.0278	103010.376	0.31359277	<0.00521	17.2267947	15.0148207	<0.013	245.480188	0.40747423	67.9714728	1.15474103	94.7496193	0.04630231	230059.97
PM18AJ228	E19JL11a360.csv	<0.027	<0.0303	104807.284	<0.233	<0.00555	38.7353496	88.1162023	<0.0141	9439.77697	0.26108645	53.6344351	<0.461	68.6838268	0.04972047	211517.406
PM18AJ228	E19JL11a361.csv	<0.0363	<0.0412	102329.879	<0.316	<0.00729	60.0983511	46.2007928	<0.0193	1103.18019	0.6015221	64.6865999	<0.598	181.139884	0.06402016	228634.526
PM18AJ228	E19JL11a362.csv	<0.0279	<0.0319	105421.107	0.36942397	<0.00555	42.7321153	120.880407	<0.0151	7139.532	0.94511732	60.9005175	0.79470709	139.171473	0.10703726	208498.496

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ228	E19JL11a363.csv	<0.0286	<0.033	101250.001	<0.253	<0.0056	14.0133839	19.7497717	<0.0159	273.776228	0.37534548	74.2934139	0.8291929	76.5163923	0.04894533	226619.602
PM18AJ228	E19JL11a365.csv	<0.0637	<0.0757	99431.3194	40.7347969	<0.0122	93.6293773	157.64131	1.04874768	2341.03337	18.5361291	60.7301008	<0.914	415.092177	0.82725955	219697.486
PM18AJ229	E19JN25a007.csv	<0.0511	<0.0538	80542.8024	10.6611316	<0.00419	28.6351209	2.98606427	<0.0263	3752.31254	0.02086096	81.5635865	3845.72694	1.51467516	0.00277118	104718.003
PM18AJ229	E19JN25a008.csv	<0.0485	<0.0516	81417.3229	6.82652352	<0.00418	22.4481699	2.34944826	<0.025	3140.39284	0.00496567	73.3578609	2761.85395	1.03691678	<0.00208	105631.332
PM18AJ229	E19JN25a009.csv	<0.0475	<0.051	83084.8751	9.50636685	<0.00429	12.7823014	2.85352751	<0.0243	3361.68539	0.01054935	75.5813743	1185.67019	1.00851264	<0.00214	104589.847
PM18AJ229	E19JN25a010.csv	<0.047	<0.051	82932.7089	3.99211085	<0.00442	11.2782079	1.98665832	<0.0238	4383.59829	0.00857307	65.7905259	455.015789	1.94101375	<0.00221	103808.458
PM18AJ229	E19JN25a011.csv	<0.0438	<0.0479	81641.2855	6.12891588	<0.0043	16.2869453	2.87914306	<0.022	5385.15179	<0.00182	70.6087424	3174.44202	1.64955722	<0.00216	103739.499
PM18AJ229	E19JN25a019.csv	<0.0338	<0.0383	81977.3437	5.7802543	<0.00429	23.0212993	2.00310654	<0.0159	5376.61793	0.00860115	71.9462055	282.153189	0.71241963	0.00860293	102479.019
PM18AJ229	E19JN25a021.csv	<0.0308	<0.0348	58188.9591	12.9011278	<0.00406	90.9313092	3.20714127	<0.0143	25659.5905	0.00486846	28.0464185	2.01847188	1.58547739	<0.00206	97236.9735
PM18AJ229	E19JN25a022.csv	<0.031	<0.0348	81335.343	9.87205783	<0.00413	133.08534	2.88280747	<0.0143	4896.18622	0.01495435	73.7434837	2330.2926	2.73834473	0.00598784	105313.33
PM18AJ229	E19JN25a023.csv	<0.0376	<0.0421	84222.1611	10.5667739	<0.00508	195.590547	3.90054303	<0.0174	4375.31875	0.04983192	79.03232	1763.70792	0.57098157	0.00905481	107070.551
PM18AJ229	E19JN25a024.csv	<0.0499	<0.0556	69780.2167	17.9448403	<0.00681	509.841067	2.79936871	<0.0231	9056.2667	0.00770409	60.1956483	240.465799	114.620878	0.00418189	108408.466
PM18AJ229	E19JN25a025.csv	<0.0319	<0.0354	83207.252	4.8432348	<0.00439	63.839728	1.44717934	<0.0145	4066.32125	0.00728238	68.2591297	1115.92799	0.78131031	0.00533348	105631.196
PM18AJ229	E19JN25a040.csv	<0.0318	<0.0307	83519.2295	8.37619344	<0.0042	84.1683365	2.44310732	<0.0143	3695.70112	0.00677475	76.2554084	2346.78229	11.3687711	<0.00218	106691
PM18AJ229	E19JN25a054.csv	0.10465343	0.11053557	68877.4291	14.2831672	<0.00413	105.626372	2.81357501	<0.0152	18696.5899	0.03505902	69.5328959	7.25825925	1.04600721	0.01402263	97976.885
PM18AJ229	E19JN25a056.csv	<0.037	<0.0326	81114.0464	8.07865541	<0.00456	27.9148637	3.47705456	<0.017	4063.18494	0.03247654	74.1024712	3326.55227	0.52953356	0.00255224	104771.876
PM18AJ229	E19JN25a057.csv	<0.0405	<0.0357	82686.852	9.02548313	<0.00494	36.3899999	4.40865611	<0.0183	5954.22205	0.02002101	75.07942	638.93106	0.43572358	0.00770756	102346.551
PM18AJ231	E19JL15a125.csv	<0.0272	<0.0264	97869.3227	1.05345234	<0.00528	11.4888978	2.59446294	<0.0124	521.306181	1.26390739	110.222109	20.2660229	5.12929413	0.07497807	187904.794
PM18AJ231	E19JL15a126.csv	<0.0249	<0.0242	99616.3034	0.59118865	<0.0049	10.901342	2.51488114	<0.0115	466.830904	1.24507353	101.347088	9.52519027	5.64467917	0.05821485	175049.946
PM18AJ231	E19JL15a127.csv	<0.0249	<0.024	98703.8431	0.42713076	<0.00487	11.328779	3.72932349	<0.0114	676.376476	1.29322813	104.734592	7.7185349	6.39384877	0.03267011	172915.726
PM18AJ231	E19JL15a128.csv	<0.0252	<0.0242	97364.8772	0.40086964	<0.00491	12.4791544	2.248003	<0.0116	750.186556	0.88636022	114.613305	10.0367146	4.92736334	0.02659457	185512.468
PM18AJ231	E19JL15a129.csv	<0.0246	<0.0236	95616.3195	0.54726821	<0.00477	11.7379278	1.78007066	<0.0113	499.184027	1.35786757	122.353836	7.06645317	2.03036419	0.02957284	184674.037
PM18AJ231	E19JL15a130.csv	<0.0257	<0.0246	97739.8156	1.06380845	<0.00497	52.0222099	5.37852719	<0.0117	1069.30852	3.19500679	108.051923	1.8523075	8.6672764	0.05531843	188855.465
PM18AJ231	E19JL15a131.csv	<0.0253	<0.0242	100004.806	0.67732169	<0.00489	14.0360616	4.06475865	<0.0116	671.566705	2.19031743	104.291757	8.08222861	6.94016789	0.04297132	178472.465
PM18AJ231	E19JL15a132.csv	<0.025	<0.0238	98038.0111	2.28850126	<0.0048	16.9772869	1.95232482	<0.0114	417.363642	1.61631049	109.673253	22.921827	4.5344681	0.04121888	192248.916
PM18AJ231	E19JL15a133.csv	<0.0299	<0.0284	98291.6856	<0.187	<0.00572	6.80652303	5.54064935	<0.0136	1366.24983	1.92373918	114.376877	12.1938419	4.44482345	0.05521063	168109.419
PM18AJ231	E19JL15a134.csv	<0.0254	<0.0241	99870.4327	0.22031704	<0.00485	9.88568995	4.65268216	<0.0116	1406.58282	2.4028358	111.895985	6.88954961	4.54116179	0.11687077	166768.195
PM18AJ231	E19JL15a135.csv	<0.0269	<0.0255	100081.01	0.17094054	0.00882306	3.93085168	1.64354832	<0.0121	794.831715	1.01252075	104.326776	4.49365375	2.22408678	0.04693469	175748.485
PM18AJ231	E19JL15a136.csv	<0.0304	<0.0287	96265.512	0.21217927	<0.0057	9.07451213	1.57029484	<0.0137	921.138726	1.43962676	185.704417	4.85171242	1.89013345	0.05886682	163047.114
PM18AJ231	E19JL15a137.csv	<0.0291	<0.0274	100181.846	0.37665462	<0.00557	7.97834317	10.3455662	<0.0134	1347.52082	3.60262502	112.314717	12.3221012	3.67111237	0.28516417	158392.694
PM18AJ231	E19JL15a138.csv	<0.0261	<0.0245	96847.2409	0.44275861	<0.00491	11.1062548	9.20405529	<0.0119	765.168763	2.23568383	123.174722	17.4480396	2.40256949	0.10306072	158913.642
PM18AJ231	E19JL15a139.csv	<0.0386	<0.0361	99628.1564	0.64786729	<0.00712	7.37441146	10.5296046	<0.0172	965.435727	2.21921633	94.2764639	16.9983	3.92212789	0.10881672	180272.918
PM18AJ231	E19JL15a140.csv	<0.0269	<0.0252	101616.826	0.78084316	<0.00506	11.8034042	3.82512267	<0.0123	724.672897	1.30661221	91.9375486	4.8959271	9.50960256	0.04369794	180680.602
PM18AJ231	E19JL15a141.csv	<0.0259	<0.0242	102291.105	3.12284653	<0.00484	17.7598302	3.65602429	<0.0118	619.469234	2.1107944	69.8582916	5.64347218	8.56378839	0.09045149	205728.202
PM18AJ231	E19JL15a142.csv	<0.0301	<0.0281	100440.623	0.64295185	<0.00548	14.347115	2.74008855	<0.0136	358.760671	0.90860491	106.933743	3.53023169	5.25945054	0.06064676	195466.235
PM18AJ231	E19JL15a149.csv	<0.0275	<0.0253	99067.3856	0.19823481	<0.00503	11.8508885	2.75209748	<0.0126	1094.36647	1.81456879	112.408238	14.8572457	3.93750307	0.07813387	184881.648
PM18AJ231	E19JL15a150.csv	<0.0269	<0.0247	100489.917	0.2023774	<0.00491	12.7570409	2.72521736	<0.0123	1047.38348	1.70754943	123.748997	52.0736236	5.2964201	0.08039121	167386.025
PM18AJ233	E19JN25a125.csv	<0.026	<0.0244	95243.2095	0.71312841	<0.00412	13.5398435	3.23825002	<0.0117	1461.07659	0.06315564	217.471651	19.0366391	6.51325859	0.01728769	264785.515
PM18AJ233	E19JN25a126.csv	<0.0258	<0.0242	97608.6666	0.70581213	<0.00409	6.99919613	3.24296161	<0.0116	1161.36234	0.05218829	210.67582	18.9839529	4.01605221	0.01017856	259494.198
PM18AJ233	E19JN25a127.csv	0.20380173	0.21416342	99302.7917	2.75023533	<0.00493	208.495363	8.35445798	<0.0141	7791.734	0.14263782	188.892917	26.2482345	45.3269333	0.02555472	228103.937
PM18AJ233	E19JN25a128.csv	<0.0327	<0.0306	94037.4828	3.20223147	<0.00519	15.166371	4.99374803	<0.0149	638.561664	0.00854268	280.143164	14.5087915	0.27902818	0.02605873	262360.529
PM18AJ233	E19JN25a129.csv	<0.0252	<0.0237	94326.9105	2.81149488	<0.004	1.64130626	2.9167856	<0.0115	343.127593	0.0271348	300.692354	31.4045359	<0.214	0.01654534	287233.623
PM18AJ233	E19JN25a130.csv	<0.027	<0.0253	96009.5158	1.5260263	<0.00429	3.24599724	3.5003443	<0.0124	769.497426	0.07535128	305.176332	11.2710023	15.3347267	0.00757624	274487.548
PM18AJ233	E19JN25a131.csv	<0.0266	<0.025	95719.1246	0.75245166	<0.00423	2.60095001	3.52210711	<0.0122	241.431396	0.06209795	304.310053	25.1426596	41.0882003	0.01412194	295471.463
PM18AJ233	E19JN25a132.csv	<0.0493	<0.0463	103037.552	5.76368612	<0.00778	187.225123	2.47315651	<0.0226	865.845639	0.97569654	257.873503	9.35425301	106.972367	0.22071063	231004.069
PM18AJ233	E19JN25a133.csv	<0.0266	<0.025	101469.623	1.18482077	<0.00423	2.49449959	1.54143845	<0.0123	296.762677	0.01689364	296.157788	23.127967	0.3033102	0.00352571	242368.875
PM18AJ233	E19JN25a134.csv	<0.0261	<0.0245	101210.25	0.9696928	<0.00415	2.01549441	1.72118785	<0.0121	247.130349	0.00831794	333.82701	14.8408329	0.44017359	0.00459384	248722.7
PM18AJ233	E19JN25a136.csv	<0.0261	<0.0246	99429.3863	4.09177241	<0.00416	4.93692157	9.73698063	0.06364858	1020.40846	0.3201507	305.284001	124.561225	2.2262702	0.02397274	232398.047
PM18AJ233	E19JN25a137.csv	<0.034	<0.032	101997.93	2.06635541	<0.00541	4.11126025	2.61516561	<0.016	549.50449	0.92455196	248.528066	15.3406092	25.4836545	0.08220975	247550.342
PM18AJ233	E19JN25a138.csv	0.3769481	0.37258642	129320.577	18.0035668	<0.00777	170.920299	17.9369784	0.03264203	16847.6067	2.45411362	147.280241	39.6670942	161.198837	0.15225381	146607.278
PM18AJ233	E19JN25a139.csv	<0.0413	<0.0388	94192.1833	1.25705824	<0.00657	21.8556476	2.9621417	<0.0198	206.716214	0.04617273	267.287585	11.5292625	31.9363042	0.00814911	266091.279
PM18AJ233	E19JN25a140.csv	<0.0256	<0.0241	97568.1737	0.88715598	<0.00409	6.1225285	7.74760858	<0.0123	1559.59408	0.30587313	362.896631	55.0351675	19.834695	0.03424151	251617.907

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ233	E19JN25a142.csv	0.08024467	0.11012609	120620.615	19.2319667	<0.00786	525.302257	17.3764099	<0.0239	574.115452	7.08180433	274.314821	67.096364	277.887042	0.33461138	179785.519
PM18AJ233	E19JN25a143.csv	<0.0361	<0.034	91700.8234	0.91145245	<0.00574	6.63171579	7.27035498	<0.0173	2108.25745	0.27438847	360.075783	42.2303233	142.149602	0.03616099	241135.189
PM18AJ233	E19JN25a168.csv	<0.0262	<0.0247	97711.033	3.45133849	<0.00424	5.59428883	10.7383729	0.19651726	1602.33206	0.1902915	284.549835	304.091133	1.23886545	0.02253985	219588.072
PM18AJ233	E19JN25a169.csv	<0.0351	<0.0331	98245.1018	1.54088917	<0.0057	1.79517452	2.55475439	<0.0191	7256.93002	18.1953341	245.310456	1.67215433	9.04051346	0.88018214	253653.359
PM18AJ233	E19JN25a170.csv	<0.025	0.02848461	96192.798	<0.3	0.00435511	39.0402465	1.92571792	<0.0135	889.358978	0.02420648	206.117916	16.7613606	17.7285112	0.00552687	267160.034
PM18AJ242	E19JL15a058.csv	<0.0381	<0.0395	88938.4421	0.59332368	<0.00632	9.56100668	0.90285123	<0.0185	4367.62967	0.042309	91.2001205	8.84347294	<0.281	0.03645247	195232.294
PM18AJ242	E19JL15a059.csv	<0.0413	<0.0429	90771.9597	<0.246	<0.00686	25.8771415	1.14877242	<0.0202	3840.70572	0.0553041	88.5217454	6.07380441	0.5812463	0.04375712	202590.897
PM18AJ242	E19JL15a060.csv	<0.0596	<0.0618	84252.9092	0.77501312	<0.00984	45.0995564	1.38981437	<0.0291	3643.54077	0.04221348	89.779528	53.9843553	0.79435189	0.05160532	196972.564
PM18AJ242	E19JL15a073.csv	<0.0455	<0.0476	91918.8208	<0.283	<0.00787	5.81130879	1.84353363	<0.0237	5805.11938	0.04096856	97.2009923	44.7982491	<0.333	0.02787214	191575.033
PM18AJ242	E19JL15a076.csv	<0.0483	<0.0505	86118.7929	0.70006552	<0.00871	9.97448106	5.59902127	<0.026	3541.73972	0.03817693	91.9238617	12.0625692	<0.375	0.01528768	186520.971
PM18AJ244	C19AU08C169.csv	<0.047	<0.0647	87303.1651	<0.517	<0.0082	889.656706	49.150176	0.06608515	3128.83334	0.76160282	92.6681048	5.91044333	49.9470462	0.05602211	226000.202
PM18AJ244	C19AU08C170.csv	<0.0444	<0.0617	86191.3587	<0.492	<0.00801	949.404113	50.3725157	0.05165333	2784.82023	0.76148053	89.511965	5.9505162	50.7683604	0.0332016	227465.803
PM18AJ244	C19AU08C171.csv	<0.0451	<0.063	87739.3295	<0.5	<0.00836	802.04047	45.6087906	0.03467972	2741.67426	0.67667681	91.2228302	4.75709907	49.8016049	0.04812408	225779.656
PM18AJ244	C19AU08C173.csv	<0.0433	<0.0604	89398.2892	<0.479	<0.00838	788.806462	47.7162684	0.05061715	2727.47707	0.70536949	89.8753734	2.49816571	39.5161208	0.0417985	229014.421
PM18AJ244	C19AU08C174.csv	<0.0416	<0.0579	87247.3219	<0.458	<0.00823	803.88937	53.0821392	0.05386454	2859.56483	0.66737948	87.9890226	3.54630375	94.6244003	0.03008359	229663.191
PM18AJ244	C19AU08C175.csv	<0.0432	<0.0594	84425.1206	<0.471	<0.00868	762.095711	49.1666337	0.04781912	3015.85963	0.58536879	88.8540629	4.23786662	410.749956	0.03496565	226160.918
PM18AJ244	C19AU08C176.csv	<0.04	<0.0545	89565.0177	<0.432	<0.00813	934.619093	49.8900904	0.05730577	3063.77811	0.6800322	87.5692547	1.8372035	303.054446	0.02792714	228799.921
PM18AJ244	C19AU08C177.csv	<0.0392	<0.0528	87587.6202	<0.419	<0.00809	1058.02106	53.2821923	0.05415138	3034.57208	0.5897608	87.5439282	3.77657645	61.3569503	0.04648499	229465.97
PM18AJ244	C19AU08C178.csv	<0.038	<0.0503	86559.1367	<0.399	<0.0079	733.662559	52.8529177	0.06352748	3284.54685	0.77599611	89.9412453	4.64196578	33.4854571	0.04027193	225604.713
PM18AJ244	C19AU08C181.csv	<0.0381	<0.0477	82515.7758	<0.38	<0.00804	1085.73868	32.9459183	0.08162598	4084.78775	0.8875603	87.1081345	<0.794	32.0884716	0.05030956	230705.453
PM18AJ244	C19AU08C185.csv	<0.0413	<0.048	82847.087	<0.383	0.00883408	995.754971	32.6443864	0.07375101	3829.74947	0.76891752	81.1242813	0.89640086	47.4885022	0.04076728	234457.059
PM18AJ244	C19AU08C186.csv	<0.0388	<0.0442	85437.2094	<0.353	0.00990095	1590.81731	41.1697309	0.04328285	2982.96282	0.6126136	88.057285	2.85871	46.8986594	0.03802998	229646.451
PM18AJ244	C19AU08C187.csv	<0.0376	<0.0421	85499.4605	<0.336	<0.00787	1148.67635	32.2836972	0.04924493	2889.04942	3.38478349	93.374087	1.5239689	37.3026086	0.1381168	230333.377
PM18AJ244	C19AU08C189.csv	<0.0383	<0.0415	86755.2875	<0.33	<0.00794	1522.11948	38.2497074	0.06851999	3004.94162	0.68182362	91.8485249	1.60484918	38.8002118	0.0430407	232638.002
PM18AJ244	C19AU08C190.csv	<0.038	<0.0406	87761.5788	<0.322	<0.00788	1640.18964	49.7270325	0.0508588	2862.79605	0.59373995	89.6805231	1.74588328	41.4084707	0.03827963	233416.796
PM18AJ244	C19AU08C191.csv	<0.0335	<0.0352	72822.1068	<0.279	<0.00692	584.023132	32.9775895	0.04578774	3394.08774	1.12278435	82.6658094	1.3785275	13.7204847	0.05650618	232154.182
PM18AJ244	C19AU08C194.csv	<0.0379	<0.0384	86651.0183	<0.302	<0.00776	984.111271	48.2290612	0.07302539	3467.94393	0.64370154	93.2685053	2.88812248	31.2362794	0.04670214	230751.151
PM18AJ244	C19AU08C195.csv	<0.0375	<0.0378	86468.2481	<0.296	<0.00768	901.741757	42.1551808	0.05000704	2987.33876	0.62001698	92.067892	0.93428019	11.1779567	0.06062581	233127.178
PM18AJ244	C19AU08C196.csv	<0.0425	<0.0425	85824.8024	<0.331	<0.00879	768.628189	54.5932786	0.07037212	2992.06128	0.78301853	91.6181086	1.54945124	45.9363174	0.02500633	231774.675
PM18AJ249	E19JN25a256.csv	<0.0246	<0.0241	98714.4567	1.00436534	<0.00454	2.66898411	9.26832179	<0.0134	1149.40609	0.06381695	24.3170492	34.884795	0.33720784	0.01198367	137502.806
PM18AJ249	E19JN25a258.csv	<0.0338	<0.0316	93976.0173	0.79359728	<0.00605	2.43035774	8.16447542	<0.0181	4879.07172	0.10803037	23.4473953	26.3794924	<0.342	0.01135625	140360.558
PM18AJ249	E19JN25a261.csv	<0.0301	<0.0289	100728.973	0.58282533	<0.00532	3.2539563	9.26630207	<0.0162	1086.58223	0.00307094	21.0579486	14.849895	<0.299	0.00383659	145530.778
PM18AJ249	E19JN25a262.csv	<0.028	<0.0265	100067.36	0.61397957	<0.00487	3.20589805	9.16503885	<0.0149	1257.41057	0.29507297	24.4314021	57.3644399	0.56263504	<0.00287	146179.415
PM18AJ249	E19JN25a263.csv	<0.0507	<0.0477	97572.7985	<0.542	<0.00905	4.31382727	7.11163925	<0.0279	1225.73407	0.06714246	25.730783	30.9816097	0.78104139	0.01306689	138507.332
PM18AJ249	E19JN25a264.csv	<0.0256	<0.024	98721.8575	0.74980903	<0.00438	3.92209558	8.24173848	<0.0136	913.96082	0.0802451	24.7921339	36.4311301	0.35724923	0.01152911	143407.412
PM18AJ249	E19JN25a265.csv	<0.0436	<0.0405	94570.4652	<0.457	<0.00722	3.2366566	8.51638456	<0.0228	915.707528	0.03595738	24.4508987	15.8524787	<0.412	0.01168654	144487.207
PM18AJ249	E19JN25a267.csv	<0.0348	<0.032	97108.9215	0.8272188	<0.00578	2.45856906	3.29114277	<0.0181	285.932006	0.00725441	64.6500844	24.0914462	0.63977493	<0.00342	139773.056
PM18AJ249	E19JN25a268.csv	<0.0275	<0.0252	98454.3623	0.41985397	<0.00454	2.92079241	2.89732925	<0.0144	319.732893	0.00374072	62.3046193	35.1761765	0.70077756	<0.00269	141962.867
PM18AJ249	E19JN25a270.csv	<0.0321	<0.0294	93487.6547	1.12930586	0.00613994	5.16544073	3.86056812	<0.0166	4151.64033	0.3633853	44.0726976	45.366581	4.53395203	0.03242358	131419.378
PM18AJ249	E19JN25a277.csv	<0.0341	<0.0297	99134.4776	0.9786959	<0.00513	3.16603548	8.69722127	<0.0169	1344.32603	0.30118139	23.7945768	42.786623	0.32085839	0.01173541	142975.909
PM18AJ249	E19JN25a278.csv	<0.0379	<0.0329	88799.5844	1.05384829	<0.00595	3.94946009	6.56840749	<0.0197	12614.1453	2.73522195	43.907625	225.414887	0.59691804	0.12339738	144053.4
PM18AJ249	E19JN26a007.csv	<0.261	<0.304	92215.5636	<2.63	<0.0249	413.741137	3.68914477	<0.145	18521.2584	0.10364598	18.1465074	1201.19272	22.497872	<0.0133	76489.0811
PM18AJ249	E19JN26a026.csv	0.27364294	0.31475551	99128.5501	1.55146616	<0.0118	22.5254289	2.51779009	<0.038	11773.4211	0.5501383	73.8211256	424.834188	3.39661736	0.07706296	152347.404
PM18AJ249	E19JN26a028.csv	0.59820341	0.56955879	96517.4592	1.2161411	<0.00996	132.467747	12.112317	<0.0307	9014.49495	0.18019797	25.7816395	259.660613	4.57218064	0.02611775	75675.841
PM18AJ249	E19JN26a033.csv	0.093172	<0.0927	102645.699	1.09325885	<0.012	14.2352419	9.47884919	0.06770471	7147.00511	0.0378007	16.571024	49.1560734	1.70191842	<0.00642	73546.2687
PM18AJ252	E19JL15a234.csv	<0.0254	<0.0242	94879.1756	0.623584	<0.00576	8.31598207	8.10362673	<0.0115	2485.86327	2.08391981	57.1582683	76.4955717	<0.269	0.31247771	130646.303
PM18AJ252	E19JL15a236.csv	<0.0278	<0.0263	93459.7925	0.20827623	<0.00617	3.86893797	16.0817213	<0.0123	2390.43362	1.38118543	38.9435133	227.420512	0.50274832	0.1708389	92746.6707
PM18AJ252	E19JL15a237.csv	<0.0242	<0.023	95211.8075	0.50496291	0.00721053	3.14481008	5.7702126	<0.0108	2228.60039	1.54248689	55.4544847	190.776522	0.44039799	0.12622529	99544.3174
PM18AJ252	E19JL15a238.csv	<0.0255	<0.0244	94454.2914	<0.158	0.00746187	7.08509381	9.5762323	<0.0113	2210.26739	2.34601945	39.829229	154.122733	0.71298963	0.30819793	89775.6212
PM18AJ252	E19JL15a240.csv	<0.0275	<0.026	85848.4752	<0.169	<0.00591	3.95581071	8.56828487	<0.012	1892.90072	2.09183596	39.5199146	243.696494	0.46057592	0.21611122	92632.8338
PM18AJ252	E19JL15a244.csv	<0.0393	<0.0371	88594.3427	0.27302127	<0.00803	5.25583845	6.39253726	<0.0166	1562.70062	1.8817275	55.5639939	279.591019	0.47204033	0.16417484	98269.3827
PM18AJ252	E19JL15a330.csv	<0.0424	<0.0428	95982.2274	2.13526603	0.00963181	12.6391325	12.3283674	<0.0256	8308.18627	5.57285735	13.9639279	86.5100882	0.42958928	0.35426605	142244.246

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ264	E19JL15a078.csv	<0.0351	<0.0368	107756.926	0.51260503	<0.00625	30.0309011	9.64133219	<0.0185	1563.20277	1.35118593	124.807493	2.41006874	71.4090643	0.02140009	169367.421
PM18AJ264	E19JL15a079.csv	<0.027	<0.0283	102250.916	0.44621159	<0.00485	63.4235922	6.68568204	<0.0142	1452.23677	1.81497956	125.805213	5.696776	222.732353	0.03460029	168992.812
PM18AJ264	E19JL15a080.csv	<0.0354	<0.0372	101383.148	0.60863949	<0.00628	45.618294	7.30164095	<0.0184	1593.9688	1.60763549	125.331549	5.1680156	193.035809	0.02771869	168187.245
PM18AJ264	E19JL15a081.csv	<0.0261	<0.0274	96052.5921	0.43756519	<0.00475	60.7094111	6.25805989	<0.0138	1732.54453	1.83042188	136.274082	0.7503436	95.528601	0.03509368	165950.723
PM18AJ264	E19JL15a082.csv	<0.0266	<0.0279	102081.795	0.46558311	<0.00487	110.432506	7.0855164	<0.0141	1430.19949	1.52902013	130.884953	1.06524574	92.3048446	0.03362582	172015.211
PM18AJ264	E19JL15a083.csv	<0.0266	<0.0279	99359.1018	0.63371472	<0.00489	94.2700767	5.95915305	<0.0141	1539.61702	1.61038711	131.40308	0.80713916	66.956085	0.03586909	168077.745
PM18AJ264	E19JL15a084.csv	<0.0258	<0.0271	94604.3302	0.42228428	<0.00477	94.9973879	8.32631479	<0.0136	2938.95431	1.51220447	128.566475	<0.366	147.651874	0.02839804	164902.943
PM18AJ264	E19JL15a087.csv	<0.0253	<0.0266	98775.5383	0.57162617	<0.00476	197.185165	6.72503911	<0.0133	1663.33972	1.22404864	140.236092	1.16405939	45.5904897	0.02919698	168504.12
PM18AJ264	E19JL15a088.csv	<0.0248	<0.026	94675.6021	0.72948304	<0.00468	100.637546	5.18477525	<0.013	1625.34656	2.12237154	139.573911	0.44217687	36.9341609	0.0382886	169525.408
PM18AJ264	E19JL15a089.csv	<0.0249	<0.0261	91828.1115	1.17435136	0.00505853	68.9297378	6.96246861	<0.0131	1931.90471	2.59099574	142.357695	0.44684968	52.6542385	0.0387418	168371.19
PM18AJ264	E19JL15a092.csv	<0.0261	<0.0274	105233.909	1.12700182	<0.00505	242.24171	16.1255236	<0.0136	2310.59251	1.97490885	120.469544	22.9470534	138.586718	0.05479784	175238.569
PM18AJ264	E19JL15a093.csv	<0.0255	<0.0267	109485.87	0.71622851	<0.00495	91.6697906	23.9255197	<0.0133	2037.56601	1.25534945	116.891694	6.82853768	42.5227632	0.01514213	165930.639
PM18AJ264	E19JL15a095.csv	<0.0306	<0.032	104037.04	0.90861231	<0.006	98.7829428	24.8256708	<0.0158	2413.13781	6.20336763	129.892239	2.73780032	52.1089101	0.07868508	172912.486
PM18AJ264	E19JL15a096.csv	<0.0241	<0.0251	101171.524	0.75922446	<0.00474	156.087993	21.8384777	<0.0124	2078.59597	2.49495329	124.224954	3.20648254	76.5495527	0.03276401	171460.286
PM18AJ264	E19JL15a097.csv	<0.0236	<0.0246	94737.1824	0.83106708	<0.00466	77.827495	4.73299139	<0.0121	1637.16167	1.98074506	140.264612	1.47983949	27.3046748	0.04063589	169948.573
PM18AJ267	E19JL15a169.csv	<0.0275	<0.0249	101726.06	1.36642796	<0.00507	1.51371707	17.0873191	<0.0131	1218.44837	1.36060801	38.1416159	13.6485448	7.25810881	0.05712868	202443.115
PM18AJ267	E19JL15a171.csv	<0.0422	<0.0383	94845.4784	167.992202	<0.00769	6.127642	25.1353233	0.03513442	1892.61165	2.78375616	95.2499904	6.98256857	60.6020724	0.10627402	205891.108
PM18AJ267	E19JL15a172.csv	<0.025	<0.0227	96029.7622	176.078465	<0.00468	4.40797739	26.5802588	<0.012	2217.75885	2.99563763	91.6494509	7.02865502	54.7539109	0.12060384	206613.246
PM18AJ267	E19JL15a173.csv	<0.0277	<0.0252	103862.898	26.2058671	0.0075983	3.71287124	13.3633687	<0.0133	1485.33455	0.87986438	63.7235301	8.30810292	20.9166725	0.03059616	201147.858
PM18AJ267	E19JL15a174.csv	<0.0277	<0.0251	95879.4712	103.880648	<0.00519	2.68850798	22.2749903	<0.0133	1802.41166	2.69639181	83.4086561	5.26023663	50.7013193	0.10028428	208823.508
PM18AJ267	E19JL15a175.csv	<0.0388	<0.0352	97785.9351	1.22938823	<0.00719	3.24124929	13.5176162	<0.0184	1565.42766	1.42228484	37.075343	18.5370963	9.00861202	0.06240317	197626.744
PM18AJ267	E19JL15a177.csv	<0.0256	<0.0233	98951.2237	0.29338879	<0.00487	2.33355929	4.24131333	<0.0124	1246.68716	1.42823533	35.8433557	10.2179231	0.49500785	0.05380694	207235.545
PM18AJ267	E19JL15a181.csv	<0.0383	<0.0349	104712.513	23.4662125	<0.00742	3.15243018	28.4633498	<0.0187	1872.1708	1.95800701	56.7718875	33.6521682	17.5047477	0.06579062	203871.602
PM18AJ267	E19JL15a182.csv	<0.0303	<0.0276	98814.5512	33.6605835	<0.00585	3.30938492	24.2071853	0.033225	6680.29468	12.4104616	66.0423572	15.1548743	28.1925109	0.28589529	203961.951
PM18AJ267	E19JL15a184.csv	<0.0371	<0.0338	104537.766	31.8997048	<0.00729	6.17460529	29.1517851	<0.0181	1925.55834	1.72835166	58.2608077	32.7947206	20.0046242	0.07807724	205365.831
PM18AJ267	E19JL15a187.csv	<0.0271	<0.0251	102433.665	0.87902945	<0.00552	2.58939928	9.52006158	<0.0135	13353.9138	4.2201929	28.8510754	15.4399717	10.0332193	0.24889066	198918.536
PM18AJ268	E19JL11a294.csv	<0.0377	<0.0366	102041.866	8.46996952	<0.00836	6.93302748	4.24354868	<0.0195	726.899356	0.01612974	55.7085295	1942.02255	0.52138962	<0.00408	145937.354
PM18AJ268	E19JL11a296.csv	<0.0287	<0.0277	105158.011	5.90595856	<0.00638	8.93926398	2.17463179	0.08147857	367.51052	0.01075259	55.1819852	373.922743	0.99792447	<0.00309	148887.41
PM18AJ268	E19JL11a302.csv	<0.026	<0.0248	88080.5914	85.1442725	<0.00577	12.2695024	5.50363958	<0.0139	14084.2901	0.14269889	60.8097486	1139.45636	1.13510389	0.03071325	135369.922
PM18AJ268	E19JL11a313.csv	<0.0325	<0.0301	99744.5731	20.1978777	<0.00718	1.87934832	6.77111735	<0.0175	1212.43125	0.02181246	50.9663227	949.115795	0.62221972	<0.00357	140375.885
PM18AJ270	E19JN26a160.csv	<0.0205	<0.022	101105.812	0.65473784	<0.00411	14.7899488	0.40814863	<0.011	2358.48976	0.02109038	101.358619	<0.406	0.55849236	0.00670802	229061.22
PM18AJ270	E19JN26a162.csv	<0.0262	<0.0281	96832.7321	0.85721856	<0.00527	6.39992983	0.90268177	<0.0143	300.316311	0.12170558	91.6067902	16.2920049	7.60110114	0.03251746	224611.988
PM18AJ270	E19JN26a165.csv	<0.0484	<0.052	79995.5166	0.91058513	<0.0098	8.87503724	5.29886438	<0.0269	13911.8329	1.30091684	83.4828576	13.0158407	12.7023629	0.31664666	200041.794
PM18AJ270	E19JN26a166.csv	<0.0231	<0.0249	102790.32	0.61250827	<0.00466	21.617866	0.53655741	<0.0128	288.15024	0.06267347	104.588123	<0.47	1.47447135	0.00711171	228950.875
PM18AJ270	E19JN26a167.csv	<0.0197	<0.0212	98545.7625	0.72692195	<0.00395	12.0280406	0.57501177	<0.0108	351.245618	0.03611458	105.744008	0.51260004	2.5512318	0.00451438	221814.589
PM18AJ270	E19JN26a168.csv	<0.0194	<0.0209	99099.9061	0.45515871	<0.0039	8.21875218	0.4669709	<0.0106	321.680178	0.04117293	102.677876	<0.384	2.04375311	0.01547821	228727.289
PM18AJ270	E19JN26a170.csv	<0.0328	<0.0352	105499.596	0.6127583	<0.00656	25.1426161	1.10993278	<0.0182	12092.7222	0.08261594	101.555728	4.01842681	2.65412035	0.06801822	201461.242
PM18AJ270	E19JN26a171.csv	<0.0224	<0.024	101847.342	0.5882991	<0.00448	33.9417787	1.47549015	<0.0123	801.439097	0.03153955	111.931569	2.90465332	4.24368776	0.00826628	211187.957
PM18AJ270	E19JN26a172.csv	<0.0206	<0.0221	99150.5891	0.874885	<0.0041	25.4034718	0.62495186	<0.0114	985.133924	0.0576286	123.123115	<0.404	1.93391386	0.00945398	193457.275
PM18AJ270	E19JN26a173.csv	<0.0325	<0.0349	100532.851	0.69872979	<0.00639	58.8614289	0.53579733	<0.0179	22592.4414	0.10778759	110.723941	<0.633	1.42823745	0.05653746	161109.389
PM18AJ270	E19JN26a174.csv	<0.0199	<0.0213	99046.8448	0.49566709	<0.00396	12.7135505	0.58834065	<0.011	471.685825	0.0391936	110.152428	<0.389	2.16462148	0.0124086	222294.464
PM18AJ270	E19JN26a175.csv	<0.0211	<0.0226	99923.0852	0.40165816	<0.00421	7.09765866	0.16470767	<0.012	2145.63016	0.00808465	94.2086818	<0.413	1.31409593	0.00887266	237624.366
PM18AJ270	E19JN26a176.csv	<0.0203	<0.0217	96987.0125	0.47448224	<0.00398	13.1146298	0.33847085	<0.0113	350.546516	0.06217089	105.261512	<0.395	2.54661282	0.00370996	231285.635
PM18AJ270	E19JN26a177.csv	<0.0273	<0.0293	97006.9345	0.50877814	<0.00527	12.1710047	0.508989	<0.0149	328.676583	0.01360662	103.246331	3.22604115	0.78022331	0.00493462	231366.325
PM18AJ270	E19JN26a179.csv	<0.0227	<0.0243	100122.346	0.64208435	<0.00454	25.3028642	1.06361956	<0.0128	619.162409	0.08497596	121.004181	5.79488713	2.60734869	0.02244741	204785.412
PM18AJ270	E19JN26a181.csv	<0.0258	<0.0276	102551.318	0.40395415	<0.0051	27.4398846	0.44186063	<0.0147	8323.15796	0.02134053	100.874513	<0.517	<0.349	0.02519059	223593.406
PM18AJ270	E19JN26a182.csv	<0.0197	<0.0211	97894.2489	0.35264871	<0.00388	7.95166001	0.30942091	<0.0111	255.049341	0.01773251	94.8704167	<0.379	1.44900766	0.00241599	236093.843
PM18AJ270	E19JN26a183.csv	<0.0203	<0.0217	99557.1874	0.49708601	<0.00399	19.1832617	0.55526583	<0.0115	2282.81881	0.01497873	98.9271066	<0.39	1.28563213	0.00918438	223839.196
PM18AJ270	E19JN26a184.csv	<0.0202	<0.0216	99707.1279	0.46669446	<0.00398	26.7390992	0.65174177	<0.0114	383.078308	0.21103643	107.447391	<0.388	4.27391892	0.00941894	228066.757
PM18AJ272	E19JL15a262.csv	<0.032	<0.0299	100386.746	0.39961122	0.00603304	3.23093252	22.4576336	<0.0131	741.72505	1.52512344	79.0675646	1.97486511	36.3060904	0.13400202	214290.525
PM18AJ272	E19JL15a263.csv	<0.0262	<0.0244	90321.6935	0.44006976	<0.00452	3.29740203	15.4636289	<0.0106	6544.70349	1.45381779	86.3853603	7.174381	25.7927926	0.21005107	197637.97
PM18AJ272	E19JL15a264.csv	<0.0263	<0.0245	96771.3846	0.31858122	<0.00449	2.71102187	23.2170069	<0.0106	745.925384	1.0960619	79.4979364	1.18207625	31.1965384	0.13818964	216393.51

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ272	E19JL15a265.csv	<0.0269	<0.0251	98271.2318	0.53730759	<0.00458	2.1865088	21.8267598	<0.0109	424.285821	0.77003652	60.0177933	1.78616075	17.8971539	0.08368157	216483.611
PM18AJ272	E19JL15a266.csv	<0.0272	<0.0254	99156.6324	0.86858032	<0.00463	4.45237784	12.2702157	<0.011	610.935765	0.53378088	58.939132	1.86314507	14.9968802	0.06160799	221920.78
PM18AJ272	E19JL15a269.csv	<0.0304	<0.0284	95517.0107	0.43561639	<0.00507	2.12670311	21.9434731	<0.0122	406.768008	0.7382988	100.789404	0.50122488	85.0802627	0.10447702	190368.081
PM18AJ272	E19JL15a270.csv	<0.0298	<0.0279	99175.7132	0.29652578	<0.00498	4.88414857	22.1645274	<0.012	371.692973	0.78931962	94.5947374	0.82227111	80.7795608	0.09574822	190016.699
PM18AJ272	E19JL15a271.csv	<0.0287	<0.0269	94501.8112	<0.152	0.00639591	1.4358656	23.6817438	<0.0115	381.113034	0.76139779	91.9708321	<0.37	23.2764956	0.06802172	182598.715
PM18AJ272	E19JL15a272.csv	<0.0306	<0.0287	96847.485	<0.163	0.00762003	3.29380365	25.8516344	<0.0124	223.555913	0.49734233	94.7210905	1.40717627	20.4335558	0.03747556	200222.365
PM18AJ272	E19JL15a274.csv	<0.0276	<0.0259	93034.2227	<0.147	<0.00455	3.62662815	18.3031698	<0.0111	291.449	0.83694827	87.2149751	<0.352	11.5498459	0.09735016	191520.412
PM18AJ272	E19JL15a281.csv	<0.028	<0.0265	95061.1572	0.75963382	<0.00471	7.86639193	21.8948952	<0.0113	499.138488	1.19207846	85.1810143	<0.362	20.7977526	0.15421375	214224.852
PM18AJ272	E19JL15a282.csv	<0.0281	<0.0267	97861.8875	<0.158	<0.00475	5.36716183	24.4938833	<0.0114	382.734164	0.73106036	95.3865142	<0.361	58.4306277	0.08358026	189240.519
PM18AJ272	E19JL15a283.csv	<0.0273	<0.026	99242.4631	<0.154	<0.00465	6.69405728	22.284264	<0.0111	569.76006	1.11798644	84.6146963	0.69373583	66.8229464	0.12772084	196769.484
PM18AJ272	E19JL15a284.csv	<0.0274	<0.0261	92759.5688	0.35294038	<0.00465	3.18808378	22.0658808	<0.011	2600.66665	1.15178628	79.5309859	2.26186116	63.2835872	0.1204589	197824.163
PM18AJ272	E19JL15a286.csv	<0.0327	<0.0314	100012.537	0.52510277	<0.00573	3.35572296	21.3041072	<0.0134	339.781508	0.77736733	105.617414	0.45992038	94.8475008	0.06270232	198100.873
PM18AJ272	E19JL15a287.csv	<0.0354	<0.0341	95727.8591	0.28138417	<0.00617	1.00972419	15.753709	<0.0144	299.429727	0.8736073	88.0455998	<0.471	47.9673545	0.07761728	198705.5
PM18AJ274	E19JN25a171.csv	<0.0268	<0.0254	109275.706	0.60805341	<0.00438	190.665828	1.15920609	<0.0146	189.675103	0.00356547	156.788476	<0.462	1.37557005	0.0035503	296158.749
PM18AJ274	E19JN25a172.csv	<0.029	<0.0274	107527.792	0.69588111	0.0064363	313.701155	3.2808866	<0.0159	340.36231	0.03988009	195.828675	<0.502	4.81624334	0.01225192	258411.905
PM18AJ274	E19JN25a173.csv	<0.0289	<0.0274	105769.522	1.7952114	<0.00475	358.411595	3.56252325	<0.0158	493.66194	0.10247314	218.662475	<0.5	5.59674509	0.01776761	265355.446
PM18AJ274	E19JN25a174.csv	<0.0312	<0.0296	105112.466	0.88706594	<0.00516	330.070862	2.28816507	<0.0169	265.419965	0.024552	191.949844	<0.542	4.35640691	0.00759463	281102.552
PM18AJ274	E19JN25a181.csv	<0.0379	<0.0362	111098.555	1.40714795	0.01286561	409.390335	2.92620422	0.07202721	1321.57474	0.19645266	208.490244	<0.679	5.7192114	0.01746872	261292.853
PM18AJ274	E19JN25a186.csv	<0.0285	<0.0275	104825.732	2.34005954	<0.00495	1195.01109	5.37903941	0.91368815	22363.7575	2.49312751	181.747919	<0.52	7.81536438	0.25978343	217488.275
PM18AJ274	E19JN25a187.csv	<0.0267	<0.0259	109895.817	1.09654656	<0.00468	201.560254	8.03531576	<0.0153	8949.04791	0.02859067	143.408736	<0.489	3.14966706	<0.00265	263613.977
PM18AJ274	E19JN25a188.csv	<0.0511	<0.0496	102908.91	0.89768023	<0.00875	290.157195	1.2020184	<0.0289	400.437406	0.01482191	156.505137	<0.944	2.25996095	<0.00511	290562.504
PM18AJ274	E19JN25a189.csv	<0.0374	<0.0363	101983.442	0.66418559	<0.00661	295.53923	1.39195493	<0.0215	315.893968	0.02666761	156.739238	<0.703	5.07048156	0.00544367	290069.528
PM18AJ274	E19JN25a191.csv	<0.0264	<0.0257	106978.235	1.53633197	<0.00472	156.53443	17.7866986	<0.0152	13767.4991	0.12921144	149.90406	9.52286015	4.97920957	0.0242508	176272.29
PM18AJ274	E19JN25a192.csv	<0.028	<0.0274	100844.665	0.97435934	<0.00504	54.2797885	3.22062441	<0.0161	579.489121	0.06949157	245.832782	8.08107688	0.35366446	0.01240891	187185.401
PM18AJ274	E19JN25a193.csv	<0.0311	<0.0305	96827.9603	1.85625104	<0.00554	124.609966	3.72006551	<0.0177	1769.69015	2.84046157	246.649508	24.0402968	0.6326302	0.1245087	183240.111
PM18AJ274	E19JN25a194.csv	<0.024	<0.0236	97140.4136	1.74090431	<0.00438	117.803774	5.66060281	<0.0139	1070.83675	0.12059845	230.809003	2.7725906	1.11740065	0.02132867	187053.908
PM18AJ274	E19JN25a195.csv	<0.023	<0.0226	100243.129	0.68023695	<0.0042	63.0927906	3.04300185	<0.0134	382.937892	0.11267542	199.962026	14.4613896	1.19204252	0.01503483	207463.436
PM18AJ274	E19JN25a196.csv	<0.0495	<0.0488	106219.431	3.33297576	<0.00895	1024.56689	9.07373077	0.41285793	24899.6939	4.0080019	199.541045	<0.954	6.25312684	0.3651221	198356.871
PM18AJ274	E19JN25a222.csv	<0.0299	<0.0314	108308.213	1.53401389	<0.00636	565.872621	3.89074467	<0.0177	1005.70509	0.51271775	171.224001	11.090101	14.2393137	0.04853114	222770.281
PM18AJ274	E19JN25a223.csv	<0.0215	<0.0226	99686.6657	1.21103223	<0.00458	182.80904	4.64449223	<0.0127	419.943633	0.06742127	151.724775	10.8610841	10.2918456	0.01540905	235313.518
PM18AJ274	E19JN25a224.csv	<0.0224	<0.0236	106542.975	0.74921171	<0.0048	367.950147	7.88561573	0.04393461	4184.60619	0.20221779	152.416659	<0.472	6.09259578	0.0392539	286436.883
PM18AJ275	E19JN26a041.csv	0.11202069	<0.07	97292.743	1.9189579	<0.00929	232.181972	1.33665303	<0.028	399.798874	0.00578118	226.962295	39.4147045	2.07070005	<0.00498	150792.291
PM18AJ275	E19JN26a042.csv	<0.0689	<0.0708	96967.2367	<0.747	<0.0094	186.146804	1.34340669	<0.0285	534.681269	0.02141698	204.542585	61.8099025	<0.55	0.00915628	142845.931
PM18AJ275	E19JN26a043.csv	<0.0699	<0.0717	96947.7198	1.94323523	<0.00949	225.934512	1.05809148	<0.029	679.045227	<0.0037	242.756534	78.0299397	1.9816349	<0.00511	154621.329
PM18AJ275	E19JN26a044.csv	<0.0791	<0.0812	98035.4158	1.97458454	<0.0108	607.047349	2.05040379	<0.033	645.864801	0.01126262	235.616259	48.4863908	3.44402949	0.01050606	154706.085
PM18AJ275	E19JN26a045.csv	<0.123	<0.126	92607.7791	<1.32	<0.0168	102.914698	2.46601185	<0.0508	393.300228	<0.00652	229.534267	42.0862898	<0.986	<0.00901	155995.284
PM18AJ275	E19JN26a046.csv	<0.098	<0.1	99060.0518	1.5286056	<0.0133	172.208299	1.99857288	<0.042	704.867518	<0.00519	230.447025	45.4776921	1.84395003	0.01407947	151840.881
PM18AJ275	E19JN26a047.csv	<0.084	<0.0857	100328.929	<0.888	<0.0114	146.838636	1.9819479	<0.0369	398.664028	<0.00444	215.053255	42.6986572	1.7457611	<0.00614	152371.86
PM18AJ275	E19JN26a051.csv	<0.0674	<0.0685	95930.7657	1.05068651	<0.00912	89.7482953	2.45221917	<0.0292	1124.14635	0.00847296	231.886204	22.9591717	0.76008106	0.00775305	174857.276
PM18AJ275	E19JN26a052.csv	<0.0705	<0.0716	94908.6914	0.79554606	<0.00957	332.662614	1.55791817	<0.0313	1087.44216	<0.00372	240.401752	38.7875887	1.45671691	<0.00514	183316.349
PM18AJ275	E19JN26a053.csv	<0.082	<0.0832	97108.2182	<0.837	<0.011	265.041463	1.24991501	<0.0363	710.790603	0.00726968	236.36126	129.39957	2.26079445	0.006157	155958.512
PM18AJ275	E19JN26a054.csv	<0.106	<0.108	94338.0952	<1.08	<0.0145	265.860015	2.25469786	<0.048	938.871838	0.00811277	171.262635	35.6531118	1.0679328	<0.00774	112963.479
PM18AJ275	E19JN26a056.csv	<0.107	<0.109	88073.9941	1.11831983	<0.0144	627.562145	1.21967993	<0.0484	1197.67521	<0.00564	274.581798	14.5598258	2.26092852	0.01962955	196727.924
PM18AJ275	E19JN26a057.csv	<0.075	<0.0759	92491.9593	1.25943725	<0.01	496.028552	1.78141404	<0.0339	1049.64485	0.00716438	258.907886	34.640331	1.38865084	0.0355474	188092.976
PM18AJ275	E19JN26a058.csv	<0.0726	<0.0735	91836.4309	0.93521116	<0.00971	588.724652	2.28567628	<0.033	1079.93854	0.01536995	260.922809	19.0235963	2.44729645	<0.00527	186436.72
PM18AJ275	E19JN26a059.csv	<0.123	<0.124	86768.0264	2.84828744	<0.0161	514.681212	4.6976167	<0.0552	1467.68383	0.00755601	222.08325	29.4031731	3.59473751	<0.00871	159100.18
PM18AJ275	E19JN26a061.csv	<0.0984	<0.0996	85895.4794	1.1395027	<0.0134	2286.81471	3.31184592	<0.0462	1488.25677	0.0180863	298.908314	16.7218079	6.28090057	<0.00722	197431.575
PM18AJ275	E19JN26a062.csv	<0.085	<0.0859	93202.6931	<0.832	<0.0114	291.076824	0.7669341	<0.0387	901.285904	<0.00445	227.572609	31.1887464	2.23587849	<0.00617	166580.586
PM18AJ275	E19JN26a066.csv	<0.102	<0.103	93700.6969	1.26132649	<0.0136	344.571974	2.17617068	<0.0482	794.735365	0.01437244	238.109403	44.3931936	1.4350639	0.03268197	157198.107
PM18AJ279	E19JN26a266.csv	<0.0216	<0.0205	84704.6057	0.51417333	<0.0041	6.99322439	0.54994355	<0.0113	1896.38548	0.06911167	195.880271	7.20727945	0.50993425	0.01175927	145072.335
PM18AJ279	E19JN26a267.csv	<0.0228	<0.0217	85804.4659	0.82910471	<0.00437	6.65165827	1.32950126	<0.0121	10269.8165	18.6412906	189.479968	9.20619865	0.49791794	0.74098803	144317.499
PM18AJ279	E19JN26a268.csv	<0.0224	<0.0212	86147.4896	0.79183867	<0.00431	7.82586233	0.27005827	<0.0117	2033.91438	0.03391063	187.651931	3.60408086	0.34897202	<0.00221	147754.065

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ279	E19JN26a275.csv	<0.0282	<0.0265	89788.5373	0.57043347	<0.00548	7.07914149	0.14860069	<0.0152	2362.03968	0.00547887	180.121301	5.67984213	<0.356	<0.00284	149390.14
PM18AJ279	E19JN26a276.csv	<0.022	0.02404153	86980.1184	5.08086651	<0.0043	8.12847993	0.89927749	<0.0113	10052.9958	0.2689084	177.190632	5.95566701	0.36642283	0.011958	137375.388
PM18AJ279	E19JN26a277.csv	<0.0241	<0.0227	79759.5766	0.86156816	<0.00471	19.2593663	0.69852275	<0.0125	2120.52417	0.24370759	182.94091	3.97912865	0.56746791	0.00407633	133327.001
PM18AJ279	E19JN26a278.csv	<0.0249	<0.0234	88285.9893	0.7321932	<0.00478	10.0818126	0.58031429	<0.0129	2552.66085	0.00756373	186.401856	3.70392323	0.67570345	<0.00247	153659.043
PM18AJ279	E19JN26a279.csv	0.02629804	<0.0219	85658.8158	4.00981091	<0.00464	7.90476113	1.6647205	<0.0123	26853.4274	47.7304178	167.857086	9.35133946	0.49245002	1.05630749	136116.641
PM18AJ279	E19JN26a280.csv	<0.0205	<0.0193	87064.3707	0.34135975	<0.00402	8.43328978	0.27831242	<0.0105	1949.31606	0.04321794	195.201676	16.6288336	0.38999807	0.00591255	153206.382
PM18AJ279	E19JN26a281.csv	<0.0207	<0.0194	85575.5653	0.742416	<0.00407	22.0802399	1.72818163	<0.0106	2394.2193	0.0486632	162.796879	7.25419564	62.9387057	0.02196508	145257.037
PM18AJ279	E19JN26a282.csv	<0.0239	<0.0225	83485.1584	0.90686396	<0.00473	13.8833703	1.98482764	<0.0124	3602.20547	0.05604294	160.116551	7.51209625	3.95509238	0.01197809	144709.738
PM18AJ279	E19JN26a283.csv	<0.0239	0.03127894	79994.974	1.4691943	0.00795355	13.3756397	1.74600524	<0.0124	1615.34775	0.06252884	147.203736	17.3208592	6.89465651	<0.00245	133187.777
PM18AJ279	E19JN26a286.csv	<0.0437	<0.041	79417.0502	4.51279484	<0.00894	14.1408924	0.54900748	<0.0224	18565.0126	0.12217989	165.864456	9.10843238	<0.566	0.03966947	123721.393
PM18AJ279	E19JN26a287.csv	<0.0208	<0.0195	87216.9886	1.12456712	<0.00418	6.42597368	0.44906959	<0.0109	2774.96352	0.01167179	170.761373	6.01680007	0.66600556	0.00280809	152289.925
PM18AJ279	E19JN26a288.csv	<0.0203	<0.0191	85896.4214	0.79993417	<0.00405	5.86554014	0.76778221	<0.0104	2196.56698	0.13114844	203.424635	7.12082705	0.43993708	0.00370043	145139.703
PM18AJ279	E19JN26a289.csv	<0.0265	<0.0249	80536.0805	0.48471427	<0.00532	6.18290698	0.7943387	<0.0138	2200.90958	0.01005049	172.526776	4.29748567	<0.345	<0.00276	137162.468
PM18AJ279	E19JN26a290.csv	<0.0301	<0.0283	84157.4361	0.97428373	<0.00608	25.4532668	1.35902706	<0.0157	2298.74934	0.12491465	174.35758	10.7108658	0.70202645	0.00583117	147076.436
PM18AJ279	E19JN26a291.csv	<0.0276	<0.026	94793.9469	8.28467188	<0.00575	9.39402091	1.32368096	<0.0148	25429.0863	0.15963631	139.989179	7.97183452	0.57919479	0.30046301	131167.145
PM18AJ279	E19JN26a292.csv	<0.0221	<0.0208	86648.5742	1.33533284	<0.00449	11.7551669	1.58812288	<0.0116	3129.30846	0.04461515	164.375897	6.8393727	0.34821483	0.02241808	152643.722
PM18AJ279	E19JN26a293.csv	<0.0204	<0.0192	88621.3059	0.97997607	0.00488502	15.5757563	1.66641036	<0.0105	2367.73626	0.10586388	160.871681	8.52654585	0.51117153	0.0092979	153239.566
PM18AJ279	E19JN26a294.csv	<0.0291	<0.0274	84573.9355	0.47063414	<0.0059	34.0040463	0.65598407	<0.0153	2209.9535	0.08242592	185.758369	8.31944025	<0.394	0.00418865	142967.493
PM18AJ279	E19JN26a295.csv	<0.0201	<0.019	84428.536	0.44491702	0.00428908	7.53662062	0.78648152	<0.0103	2165.69111	0.09046037	183.212786	18.7411022	0.72529749	0.00254235	148135.279
PM18AJ281	E19JL11a317.csv	<0.0312	<0.0286	102151.298	0.37419912	<0.00697	185.358515	0.67963032	<0.0164	174.694844	0.31611154	42.0697916	76.553601	16.523155	<0.0035	220276.787
PM18AJ281	E19JL11a318.csv	<0.0339	<0.031	98743.1648	0.28041411	<0.00757	222.801751	28.261684	<0.0182	1264.12652	0.25815312	30.4161941	58.7850567	9.72061571	<0.00381	159410.705
PM18AJ281	E19JL11a320.csv	<0.0546	<0.0497	97678.8151	0.81916736	<0.0118	730.686201	1.35421902	<0.0282	390.168777	0.51056237	44.1595165	1245.47365	15.9204038	<0.00604	218028.502
PM18AJ281	E19JL11a327.csv	<0.0276	<0.0249	101863.343	1.01560775	<0.00621	430.908382	1.38092395	<0.014	188.91301	0.3480844	42.2250653	140.132118	8.45170729	<0.00328	226337.042
PM18AJ281	E19JL11a328.csv	<0.026	<0.0234	98459.3102	1.31498389	<0.00584	1005.40202	1.09097339	<0.0134	302.815659	0.74744218	43.2025943	137.295398	11.363233	0.00405225	224929.077
PM18AJ281	E19JL11a329.csv	<0.0318	<0.0286	102080.02	1.62736885	<0.00717	209.25726	5.84981805	<0.0158	418.232461	1.22109293	42.392388	143.716159	9.61690688	0.0138276	218173.203
PM18AJ281	E19JL11a330.csv	0.05903301	<0.0334	104467.251	2.67653333	<0.0084	97.8748826	3.32486843	<0.0185	304.536089	1.87759705	43.7940807	53.896763	23.8228978	0.02538801	228503.218
PM18AJ281	E19JL11a331.csv	<0.0301	<0.0271	95885.6596	2.34012784	<0.00682	305.263515	3.72287652	<0.0153	266.327402	1.29924973	45.7894827	41.1250371	13.0765979	0.0136249	226571.977
PM18AJ281	E19JL11a332.csv	<0.0286	<0.0257	96567.5145	2.21543611	<0.00638	1068.49303	3.63770848	<0.0142	311.267281	1.00717535	44.4520895	47.7897564	11.563511	0.01913	223929.735
PM18AJ281	E19JL11a333.csv	<0.0279	<0.0251	95147.3289	2.18826256	<0.00633	804.901145	3.25788907	<0.0138	294.425531	1.09638256	44.3657683	45.5299914	11.3251206	0.01587196	223215.956
PM18AJ281	E19JL11a334.csv	<0.0257	<0.0232	100314.47	1.85548198	<0.00584	708.965383	4.47159747	<0.0126	323.082398	1.17524287	44.3546499	19.0372377	7.96574255	0.01059602	227515.153
PM18AJ281	E19JL11a336.csv	<0.026	0.0290096	98365.4985	3.20035996	<0.00584	670.081258	3.63020848	0.22713774	305.283574	2.04479811	47.3262168	56.6985221	16.9823074	0.02473012	223284.449
PM18AJ281	E19JL11a337.csv	<0.031	<0.0282	97808.2999	1.78177998	<0.00706	385.94047	3.64339854	<0.0149	216.662288	0.46774187	44.6553112	26.2831281	5.65783866	0.00524007	223724.551
PM18AJ281	E19JL11a338.csv	<0.0318	<0.029	103883.548	1.3196894	<0.00727	426.655467	5.61482271	0.02475233	268.725484	0.20656841	43.1736261	21.6106822	15.0269838	<0.0041	228004.512
PM18AJ281	E19JL11a339.csv	<0.0259	<0.0237	96812.383	1.74455398	<0.00593	1240.50156	6.29749405	0.09429155	449.313248	0.21695477	44.115037	22.6698513	22.7546926	<0.00336	225420.873
PM18AJ281	E19JL11a341.csv	<0.0256	<0.0238	101134.689	3.65085018	<0.00589	1019.23452	5.26401267	<0.0121	228.655817	1.3808993	44.2735663	118.059696	18.6008032	0.02094996	226500.538
PM18AJ281	E19JL11a342.csv	<0.0269	<0.0251	101931.649	0.38606151	<0.00618	887.434732	3.65222724	<0.0125	469.345689	0.39792553	39.6732878	142.526492	15.3910449	<0.00355	211867.689
PM18AJ283	C19AU08C259.csv	<0.032	<0.032	94590.8628	<0.321	<0.00758	149.163214	0.25427535	0.01173244	879.474551	0.02566966	127.026396	45.6980899	3.14640376	0.0091983	146065.84
PM18AJ283	C19AU08C261.csv	<0.0316	<0.0316	95663.9741	0.33056157	<0.00756	92.3642978	0.25253119	0.01168075	365.672895	0.00356003	132.516578	4.91119127	2.87109722	0.00313392	144889.886
PM18AJ283	C19AU08C262.csv	<0.0318	<0.0318	95244.2427	<0.325	<0.00763	141.284561	0.097375	0.01180109	667.979581	0.00359838	132.270021	145.426963	3.52127038	<0.00289	147375.102
PM18AJ283	C19AU08C264.csv	<0.0317	<0.0316	93466.2193	<0.327	<0.00767	206.854147	0.23367485	0.0166922	680.090187	0.00919322	133.514099	79.5647915	4.11660601	0.00932967	143807.767
PM18AJ283	C19AU08C266.csv	<0.0309	<0.0309	94330.8632	<0.322	<0.00763	84.8024771	0.65199322	0.00297888	311.864104	0.00899419	137.201726	13.7103373	3.44882624	<0.00283	143580.397
PM18AJ283	C19AU08C267.csv	<0.0369	<0.0369	94094.0673	<0.386	<0.00884	20.2319011	0.32255143	<0.00171	4443.83581	0.31055279	117.118925	13.0935129	0.98153348	0.0638481	147327.635
PM18AJ283	C19AU08C268.csv	<0.0321	<0.0321	93480.2771	0.59473256	<0.00799	272.296485	0.30036163	0.02683211	823.726002	<0.00204	135.87543	27.713318	5.3267838	<0.00296	142457.166
PM18AJ283	C19AU08C269.csv	<0.0305	<0.0306	92815.5354	1.21580454	<0.00755	348.961026	0.45043437	0.04827828	3043.27291	0.12344044	125.471801	101.404118	8.59875687	0.02703508	146835.516
PM18AJ283	C19AU08C270.csv	0.05517626	0.03746288	97235.2102	<0.345	<0.00798	116.258817	0.52612288	0.01304474	974.105875	<0.0021	124.821966	66.3353258	3.4055927	<0.00302	148288.725
PM18AJ283	C19AU08C272.csv	<0.0428	<0.0433	91635.7823	<0.461	<0.0109	142.324444	0.29025272	0.02234407	313.777492	0.01668179	140.492126	7.32638463	4.08149166	<0.004	142766.218
PM18AJ283	C19AU08C273.csv	<0.0409	<0.0415	92836.7641	0.54789303	<0.0103	183.737885	0.54113431	0.0372057	895.922958	0.01369314	134.250057	23.2534682	6.56883826	0.01431652	147374.039
PM18AJ283	C19AU08C280.csv	<0.0294	<0.0308	88531.6893	0.91436104	<0.00762	177.815242	0.52166114	0.06631787	5978.22385	0.41650378	127.943692	26.6493656	5.8524521	0.06152108	141641.982
PM18AJ283	C19AU08C281.csv	<0.0293	<0.0308	95924.9861	0.38666949	0.00818351	217.845363	0.20776609	0.02221168	601.10176	0.00213996	135.829107	38.8082234	7.78170566	<0.00282	144427.368
PM18AJ283	C19AU08C284.csv	<0.0369	<0.0395	98965.4419	<0.419	<0.00951	237.65509	1.61791331	0.05113517	3041.26106	0.01752421	123.740557	50.2081638	6.26318144	<0.00359	141512.999
PM18AJ283	C19AU08C285.csv	<0.0286	<0.0308	93782.2049	<0.326	<0.0076	83.5128649	0.91409838	0.00470476	1750.72677	0.03614236	129.372375	29.0293672	6.41860983	0.01354435	142743.06
PM18AJ283	C19AU08C286.csv	<0.0288	<0.0311	93766.3819	<0.329	<0.00766	90.214653	0.97704808	0.00919191	376.023227	0.011824	132.411954	11.4253968	15.8448559	<0.00281	139184.64

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ285	E19JL15a105.csv	<0.0365	<0.0375	101308.041	4.50469759	<0.00737	8.78368715	2.56521618	<0.0179	445.816431	0.0197162	69.454537	247.176562	0.35772389	<0.00395	140226.427
PM18AJ285	E19JL15a106.csv	<0.0307	<0.0314	108173.911	2.17897721	<0.00618	10.7184937	3.7978619	<0.0154	386.241319	0.0025943	68.0951887	192.36737	1.13379487	0.00341887	149252.495
PM18AJ285	E19JL15a107.csv	<0.0299	<0.0306	108269.46	2.26932292	0.01110939	6.31894627	1.13153134	<0.0149	258.576002	0.00253906	65.3533457	328.680475	0.67764475	<0.00324	141615.758
PM18AJ285	E19JL15a108.csv	<0.0309	<0.0315	104328.479	2.06410964	<0.00616	19.5734366	1.6647971	<0.015	492.569123	0.05341564	62.4259825	398.288964	4.02587899	0.0086834	144908.889
PM18AJ285	E19JL15a109.csv	<0.0385	<0.0391	99401.6325	6.44344673	<0.00779	12.1805331	4.81750965	<0.0188	878.778031	0.03233954	99.6811559	828.429177	0.33313614	0.01409017	141696.205
PM18AJ285	E19JL15a110.csv	<0.0304	<0.0308	108635.546	0.96337674	<0.00614	1.90153991	1.63251658	<0.0148	261.239613	0.01816279	50.9616552	365.756512	0.5150977	<0.0033	144734.26
PM18AJ285	E19JL15a112.csv	<0.0456	<0.046	104160.03	5.84441643	<0.00922	10.0888351	0.60936093	<0.022	343.290163	0.00578773	100.180233	2.5826679	<0.405	<0.00496	144289.907
PM18AJ285	E19JL15a113.csv	<0.0264	<0.0265	104909.064	3.50589799	<0.00534	8.38331404	3.30619178	<0.0127	529.026133	0.00601065	71.9551971	315.471538	0.50693691	<0.00286	132453.765
PM18AJ285	E19JL15a114.csv	<0.0251	<0.0252	102092.712	3.77865471	<0.00506	10.9601319	3.02159979	<0.012	4166.41868	0.26498994	72.4219458	580.723032	0.68554299	0.07570453	145754.754
PM18AJ285	E19JL15a116.csv	<0.032	<0.0319	102227.873	4.59121618	<0.00628	17.5393621	4.15310414	<0.0148	1337.45783	0.10274007	102.402977	746.865546	0.83628646	0.01321909	141146.769
PM18AJ285	E19JL15a117.csv	<0.0254	<0.0252	104619.6	1.39246639	<0.00509	6.2649465	2.63878491	<0.012	273.179031	0.01504399	57.9806304	2031.58136	0.34467995	<0.00274	152279.101
PM18AJ285	E19JL15a118.csv	<0.0297	<0.0295	103595.871	2.49561371	<0.00597	21.9334424	6.5448601	0.02032317	2644.8881	0.1940338	75.653635	541.941437	0.78602791	0.04826925	152676.804
PM18AJ285	E19JL15a119.csv	<0.0277	<0.0274	103724.751	2.58720651	<0.00554	15.9574028	2.48403401	<0.013	4739.56122	0.47516451	59.6192208	1199.79815	1.1535071	0.09709935	138575.87
PM18AJ285	E19JL15a120.csv	<0.0282	<0.0278	101842.296	6.38684927	<0.00564	57.3066808	2.02891175	<0.0132	656.511869	<0.00196	99.6632855	1299.54692	0.71476397	0.00686051	142271.939
PM18AJ285	E19JL15a121.csv	<0.0275	<0.027	103520.678	3.43918751	<0.00548	29.2016418	1.60614755	<0.0128	626.168282	0.01630891	91.7819767	884.804916	0.99421633	<0.00296	138796.644
PM18AJ285	E19JL15a122.csv	<0.0256	<0.0251	101917.779	1.60681441	<0.00509	14.4265445	2.53548272	<0.0119	552.288954	<0.00177	83.2603386	2303.94618	1.30238878	<0.00275	152327.757
PM18AJ285	E19JL15a123.csv	<0.0301	<0.0294	103381.004	2.87004332	0.00924736	19.9195606	2.386393	<0.0142	969.796022	0.00382063	85.8919143	1301.6364	1.09222812	<0.00327	146090.673
PM18AJ286	E19JL15a245.csv	<0.0478	<0.0451	114470.818	0.33194967	<0.00934	74.6292711	7.12478868	<0.0195	1630.65807	2.64747257	76.1533716	153.943132	691.971706	0.13694676	204806.871
PM18AJ286	E19JL15a246.csv	<0.0257	<0.0242	111852.893	0.27575409	<0.00521	16.3125702	9.16430502	<0.0109	985.577016	0.07405597	71.7948148	41.6079511	723.533495	0.00393795	189066.3
PM18AJ286	E19JL15a247.csv	<0.0248	<0.0233	110740.305	0.31288232	<0.00496	72.5337724	9.04081619	<0.0105	1054.68761	0.09245791	79.1934255	14.4138953	1186.60777	0.00649997	191798.834
PM18AJ286	E19JL15a248.csv	<0.0247	<0.0232	106857.695	0.23814657	<0.0049	62.8764991	10.2733623	<0.0104	2053.43218	0.11538517	83.0763562	25.056455	2019.38159	0.00966992	185490.026
PM18AJ286	E19JL15a249.csv	<0.0249	<0.0234	107201.652	0.26204142	<0.00489	59.2393931	8.84881411	<0.0105	1897.3592	0.12097502	82.9573968	15.3746236	2095.08796	0.00641479	185301.493
PM18AJ286	E19JL15a250.csv	<0.0254	<0.0238	107844.17	0.25361016	<0.00492	76.3034356	11.9247659	<0.0106	1706.16373	0.13421425	83.0910628	32.342261	2088.21331	0.01074959	185221.473
PM18AJ286	E19JL15a251.csv	0.02865187	<0.0238	107899.259	0.21432144	<0.00486	61.5914293	12.4333426	<0.0105	1565.53507	0.07871598	81.8279963	29.1667048	1773.5817	<0.00277	186960.84
PM18AJ286	E19JL15a253.csv	<0.0258	<0.0242	111578.999	0.25912938	<0.00486	102.881525	9.21761249	<0.0107	1002.30493	0.11127494	77.6268645	23.932425	978.185971	0.00638933	198765.849
PM18AJ286	E19JL15a254.csv	<0.0283	<0.0265	101628.427	0.3969577	<0.00529	94.5453055	15.5403316	<0.0117	1460.69197	0.12702981	85.013566	54.8004037	1300.69276	0.01405557	183909.179
PM18AJ286	E19JL15a256.csv	<0.0271	<0.0253	108859.224	0.38656775	<0.00495	41.5769566	19.4477134	<0.0111	1640.11731	0.08697885	81.6679176	22.411205	1739.08932	<0.00283	186068.961
PM18AJ286	E19JL15a257.csv	<0.0273	<0.0256	102077.814	0.69751704	<0.00496	69.3409318	21.5675236	<0.0112	1838.29334	0.13627289	83.7162311	26.6996478	2022.51662	0.01319644	185786.855
PM18AJ286	E19JL15a258.csv	<0.0276	<0.0258	86334.4182	0.15198748	<0.00495	45.1195288	17.4912009	<0.0113	456.717194	0.10786668	79.2697759	43.3454422	498.834705	0.01185187	160907.351
PM18AJ286	E19JL15a261.csv	<0.0289	<0.027	104522.513	0.61452692	<0.00505	149.510996	16.6268562	<0.0117	1917.9316	0.17379558	102.784847	64.0975887	2094.78991	0.00801711	186706.005
PM18AJ290	E19JL15a188.csv	<0.0521	<0.0477	92646.1826	<0.355	<0.0106	<1.08	3.7360843	<0.0258	537.156545	<0.00362	28.4539817	12.9055321	<0.482	0.01910719	186846.657
PM18AJ290	E19JL15a189.csv	<0.0236	<0.0217	98571.0838	0.2014244	<0.00484	1.14262569	0.82565639	<0.0118	3244.54226	0.08938245	23.2172023	9.74144798	0.31310509	0.09871551	192651.531
PM18AJ290	E19JL15a191.csv	<0.0236	<0.0217	103016.852	0.36888184	<0.00489	1.7292127	2.10140321	<0.0117	307.715826	0.01752089	29.0359838	33.4584416	1.15312174	<0.00271	179504.365
PM18AJ290	E19JL15a192.csv	<0.0231	<0.0212	100438.35	0.36978702	<0.00481	1.23940839	1.61947336	<0.0115	266.915325	0.01136469	23.4502754	9.31726714	<0.219	<0.00267	184381.488
PM18AJ290	E19JL15a194.csv	<0.0368	<0.0339	103972.989	<0.245	<0.00744	1.67005268	1.11956011	<0.0175	318.955923	0.00880483	38.1150069	100.229965	1.4904682	<0.00431	184499.567
PM18AJ290	E19JL15a195.csv	<0.0228	<0.021	100175.098	<0.158	<0.00485	1.44894117	1.67508674	<0.0114	855.452341	0.01121444	25.3805772	50.2634677	<0.221	0.00768026	183982.765
PM18AJ290	E19JL15a196.csv	<0.0316	<0.0292	105971.457	0.28493237	<0.00696	<0.699	0.76797915	<0.0162	304.293812	<0.00231	19.1886059	3.93878795	0.36665121	<0.00387	186686.156
PM18AJ290	E19JL15a197.csv	<0.0218	<0.0201	95046.6846	<0.152	<0.0047	0.61606717	0.64823009	<0.0109	600.370357	0.02828979	31.9501525	31.4733099	0.31496591	0.0085608	195795.482
PM18AJ290	E19JL15a198.csv	<0.0257	<0.0238	103340.678	0.71525151	<0.00558	1.16819848	0.71979147	<0.0128	1221.36333	0.11722998	23.5868188	7.22665909	0.47429452	0.00754448	193088.499
PM18AJ290	E19JL15a199.csv	<0.0239	<0.0222	99455.0062	0.23761706	<0.00528	1.17832727	0.80287344	<0.0121	281.006504	0.03133365	25.0611949	9.02094412	0.48811681	0.0029402	195792.839
PM18AJ290	E19JL15a200.csv	<0.0215	<0.02	98276.2792	0.31150278	<0.00474	1.69633414	0.67713963	<0.0108	359.453668	0.0127842	27.962852	30.9190762	0.25453464	0.00878991	191502.174
PM18AJ290	E19JL15a201.csv	<0.0209	<0.0194	95762.8262	<0.147	<0.00464	0.80687971	0.52932127	<0.0105	372.998764	0.01754316	36.6185014	73.956536	0.32183274	0.0035562	194529.849
PM18AJ290	E19JL15a202.csv	<0.0209	<0.0194	97162.365	0.15144696	<0.00466	1.60073127	0.79363635	<0.0104	347.299587	0.02317527	32.8339189	12.4986987	0.31276603	0.00864716	193335.383
PM18AJ290	E19JL15a203.csv	<0.0207	<0.0193	94372.5084	<0.146	<0.00465	2.27832213	0.88066852	<0.0104	906.315068	0.06292265	44.8792308	6.43000325	0.47073408	0.00480036	199177.075
PM18AJ290	E19JL15a204.csv	<0.0202	<0.0189	91146.3558	<0.143	<0.00457	1.59954041	1.65618453	<0.0101	2494.61907	0.28506298	40.5366056	1.45277461	7.48505917	0.0419652	196422.972
PM18AJ290	E19JL15a205.csv	<0.0239	<0.0223	98893.4303	<0.169	<0.00548	1.3673762	0.59216958	<0.012	296.276269	0.02379793	26.7194686	15.9526138	0.91590497	0.0214783	194764.847
PM18AJ299	E19JL11a271.csv	<0.0447	<0.0436	105757.128	<0.333	<0.00943	<0.777	0.2698796	<0.022	291.429044	0.033923	75.1554448	3.62033103	139.339552	0.00982491	191140.925
PM18AJ299	E19JL11a276.csv	<0.0362	<0.0367	105633.07	<0.272	<0.00822	2.28348704	1.0279786	<0.0192	509.909282	<0.00254	83.4587578	15.2720029	108.936164	<0.00418	200904.401
PM18AJ299	E19JL11a277.csv	<0.026	<0.0255	101512.956	<0.195	<0.00572	2.18466155	0.92832655	<0.0133	690.2422	0.00564356	103.038833	2.8796331	46.1315072	<0.00289	180536.115
PM18AJ299	E19JL11a278.csv	<0.0311	<0.0305	104004.474	<0.234	<0.00675	1.67606876	0.40809112	<0.0158	301.572328	0.00537005	81.7371216	2.03257935	69.2052843	<0.00346	194370.093
PM18AJ299	E19JL11a279.csv	<0.0284	<0.0279	100952.721	0.25748848	<0.00622	2.14580078	0.77286529	<0.0144	461.781904	0.00866566	74.3006175	1.5356802	123.657038	0.00620255	195185.76
PM18AJ299	E19JL11a281.csv	<0.0258	<0.0253	103709.191	<0.195	<0.0057	1.88922549	0.4250496	<0.0133	395.605988	0.27735305	74.8631162	7.34625466	110.706031	0.00736334	205213.287

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ299	E19JL11a282.csv	<0.0254	<0.0249	100670.393	0.39560938	<0.00562	1.89549811	0.81007666	<0.0131	459.707502	0.00551624	82.8115248	47.2057989	160.3075	<0.0028	211178.289
PM18AJ299	E19JL11a283.csv	<0.027	<0.0265	92621.4331	0.35562049	<0.00597	3.5738	2.36371955	<0.0142	2375.29559	0.01584647	66.4091136	83.0753147	396.52365	0.00404706	184246.306
PM18AJ299	E19JL11a284.csv	<0.0262	<0.0257	102094.306	<0.199	<0.00574	1.36534503	0.98417299	<0.0136	597.440253	0.01096183	73.0073131	6.49709651	243.054208	0.00360774	198184.196
PM18AJ299	E19JL11a285.csv	<0.039	<0.0371	104987.015	0.34988624	<0.00839	2.91569378	0.88786778	<0.0203	640.729551	0.17354449	85.4728561	10.5079297	37.9473759	<0.00416	193558.143
PM18AJ299	E19JL11a287.csv	<0.0434	<0.0424	95960.5234	0.45879755	<0.0098	5.29834507	0.89816228	0.05537519	9383.59882	0.65419779	74.4369434	<0.814	94.2266155	0.06821555	166922.21
PM18AJ299	E19JL11a289.csv	<0.0276	<0.0269	104006.47	<0.211	<0.00616	0.6972568	1.97704469	<0.0145	247.200725	0.04420432	83.8665555	7.35859796	119.587668	0.00772905	227003.93
PM18AJ299	E19JL11a290.csv	<0.0268	<0.0262	103433.769	<0.205	<0.00595	0.65409432	1.46173898	<0.0141	290.693706	0.02921063	73.6038752	2.52837594	118.153128	<0.00292	202821.187
PM18AJ299	E19JL11a291.csv	<0.0395	<0.0385	103395.274	<0.302	<0.00878	1.31439068	1.45334405	<0.0212	264.262125	0.12329414	72.5222936	12.6294472	112.306183	<0.0043	203698.434
PM18AJ299	E19JL11a292.csv	<0.0267	<0.0259	101939.806	<0.204	<0.00591	1.56215063	0.95428407	<0.0143	268.884025	0.07897491	48.1724062	1.93188124	88.6684152	<0.00289	225240.19
PM18AJ302	E19JL15a207.csv	<0.0214	0.0273608	84534.5814	0.32312009	<0.0049	15.1973065	24.8390966	<0.0106	8089.98734	19.2855535	63.6864677	8.18896507	16.6042379	1.23292876	185825.029
PM18AJ302	E19JL15a208.csv	<0.0436	<0.0409	70867.5877	1.10154277	<0.0101	34.9952131	23.7428223	<0.0217	8042.28922	27.0944244	68.185403	9.74696682	24.2827592	1.45047194	181208.522
PM18AJ302	E19JL15a215.csv	<0.0221	0.02530673	78834.3899	0.98252007	<0.00524	27.1601171	32.2807633	<0.0105	7835.96282	25.3960771	69.7827828	30.3538678	33.0611853	1.94211591	188251.733
PM18AJ302	E19JL15a216.csv	<0.019	<0.0179	82573.197	0.60322018	<0.00451	30.9164804	39.1515835	<0.00927	7925.701	28.102679	62.6086481	27.4029731	24.6075707	1.84220706	180171.778
PM18AJ302	E19JL15a217.csv	0.01828043	<0.0173	77811.8899	0.67351879	<0.00434	8.36595096	16.5472257	0.01860534	7625.28447	29.0120293	73.0054697	<0.352	69.9304795	1.63691129	179857.151
PM18AJ302	E19JL15a219.csv	<0.0189	<0.018	86601.0102	1.06456938	<0.00452	27.3668501	20.9854743	<0.00915	4223.81391	12.7080666	61.2305428	27.0480007	180.488244	0.76411304	193090.036
PM18AJ302	E19JL15a220.csv	<0.0192	<0.0182	96701.5104	0.42284858	<0.00457	7.66220843	14.2822253	<0.00923	1528.56359	6.47694874	83.7460019	6.78505427	4.19873369	0.35847893	204356.458
PM18AJ302	E19JL15a221.csv	0.02761878	<0.018	95615.5876	0.68842351	<0.00453	8.17605308	13.3263491	<0.00911	1697.62747	8.42224504	82.9864298	14.0154074	3.64371817	0.57132503	209025.611
PM18AJ302	E19JL15a222.csv	<0.0241	<0.0229	98490.2255	<0.166	<0.00572	7.55744993	12.773842	<0.0115	2212.72674	10.9274878	84.402383	9.10611654	4.06829395	0.48592477	207113.187
PM18AJ302	E19JL15a223.csv	<0.0197	<0.0187	96372.7262	0.24620237	<0.00467	5.94740751	6.9974421	<0.00934	664.935907	2.07834847	80.2565034	7.16246011	6.50287835	0.1166824	204025.553
PM18AJ302	E19JL15a224.csv	<0.0209	<0.0198	99239.9395	<0.142	<0.00495	3.66859592	3.37570248	<0.00987	500.001717	1.01072977	62.952711	<0.401	3.31244524	0.02897612	205920.281
PM18AJ302	E19JL15a225.csv	<0.0219	<0.0208	99162.3975	0.27298705	<0.00525	1.05274709	1.63483841	<0.0105	267.074918	0.45746462	82.618536	0.69778463	1.10428079	0.00931041	232608.016
PM18AJ302	E19JL15a226.csv	<0.0245	<0.0233	75999.4549	1.31029139	<0.00578	569.324957	25.2774278	<0.0115	6989.24354	29.3672005	69.5439203	13.6065784	12.7470285	2.15276526	182947.93
PM18AJ302	E19JL15a228.csv	<0.0201	<0.0191	98061.1098	0.27132069	<0.00467	18.0607972	5.15870814	<0.00926	365.270491	2.00566881	82.5536975	9.80448042	3.25168093	0.1255483	211499.998
PM18AJ302	E19JL15a229.csv	<0.02	<0.019	97939.424	0.33385707	<0.00466	3.47132046	6.62682875	<0.00924	452.07068	3.03610686	75.5546097	0.7088569	3.42574685	0.14873624	198907.068
PM18AJ302	E19JL15a230.csv	<0.0201	<0.0191	95463.6753	0.70222147	<0.00466	5.60741031	6.03121402	<0.00923	676.424301	1.9796862	85.0033767	0.51109505	8.45637754	0.10848685	213123.056
PM18AJ302	E19JL15a231.csv	<0.0183	<0.0174	77602.78	0.89527266	<0.00422	24.8920687	24.3668095	0.0092958	7364.55727	26.3096483	67.7183007	23.3143689	24.0316451	1.83513077	183542.784
PM18AJ304	E19JN25a065.csv	<0.0353	<0.0306	98109.4587	0.41208422	<0.00435	36.8692856	8.6268181	<0.016	371.829387	0.01781825	64.0280705	260.031738	0.31764802	0.00634773	169558.713
PM18AJ304	E19JN25a066.csv	<0.0456	<0.0395	96110.2633	0.7291611	<0.00563	48.1659255	12.7701258	<0.0207	1020.13432	0.05594264	71.1999983	59.7590092	0.44666477	0.00709965	165657.212
PM18AJ304	E19JN25a067.csv	0.04273087	0.06341651	92897.2198	0.94250638	0.00640903	417.720154	12.995676	<0.0172	1016.84071	0.5275582	58.6266895	43.6048718	3.40638372	0.01017188	179240.995
PM18AJ304	E19JN25a069.csv	<0.0489	<0.0422	100607.962	0.65321316	<0.00607	41.9647223	3.58134458	<0.0221	354.407275	0.27761354	42.3921816	33.9635641	<0.364	0.00639638	175784.891
PM18AJ304	E19JN25a071.csv	<0.0349	<0.03	101047.846	0.44531812	<0.00435	34.1436078	3.89521182	<0.0157	336.451568	0.01651883	38.5355403	7.50812562	0.38347142	<0.00231	178031.291
PM18AJ304	E19JN25a072.csv	<0.0492	<0.0418	98975.2887	<0.498	<0.00607	41.0395702	5.35579685	<0.0219	295.650032	0.01935917	46.7712252	30.0609953	<0.368	0.0071574	169881.482
PM18AJ304	E19JN25a086.csv	<0.0328	<0.0286	94859.2788	0.87349139	<0.00438	52.142474	5.54823805	<0.0144	762.432334	0.0553131	50.8878248	14.7734892	0.41340962	0.00878602	170368.321
PM18AJ304	E19JN25a087.csv	<0.0315	<0.0276	89447.4776	0.80101679	<0.00424	28.0378899	6.76482713	<0.0138	1029.01779	0.14842698	61.3244213	14.5169664	0.40044302	0.01308377	156345.689
PM18AJ304	E19JN25a088.csv	<0.0309	<0.027	88688.8069	0.77607603	<0.00417	51.113695	9.65162726	<0.0135	947.110278	0.13090119	62.1445876	10.4671274	0.50981356	0.0093908	160159.11
PM18AJ304	E19JN25a089.csv	0.07087194	<0.0467	100953.025	0.69639929	<0.00721	32.230902	5.2039547	0.03717009	648.307746	0.07364397	41.4325035	19.791845	5.59146876	0.01300971	183449.628
PM18AJ304	E19JN25a090.csv	<0.0313	<0.0275	96432.3998	0.51364882	<0.00428	33.1064495	7.47029877	<0.0136	696.737797	0.14291874	47.8961884	10.122628	0.26788418	0.00487541	173025.027
PM18AJ304	E19JN25a091.csv	<0.0567	<0.0498	105104.122	0.71166561	<0.00776	26.3625576	12.2436776	<0.0245	763.386062	0.18446258	39.857299	15.7431823	<0.445	<0.00417	190074.481
PM18AJ304	E19JN25a092.csv	<0.0308	<0.0272	93991.8921	0.85596269	<0.00427	99.6445887	11.0250766	<0.0134	682.079119	0.05657346	62.6986318	7.93698017	0.37478315	0.00366508	171988.928
PM18AJ304	E19JN25a093.csv	<0.0305	<0.027	92863.098	0.69870227	<0.00425	42.0487983	12.0578198	<0.0132	761.466298	0.06804808	65.3779254	7.01634779	3.09021297	0.01162216	171260.517
PM18AJ304	E19JN25a095.csv	<0.0455	<0.0404	90090.1581	0.57302252	<0.00625	49.7028278	11.1242977	<0.0192	1725.5733	1.61406011	69.3647308	5.80089926	<0.362	0.04537608	165793.638
PM18AJ304	E19JN25a096.csv	<0.0299	<0.0266	91394.6028	0.54607128	<0.00424	19.8628453	3.98773648	<0.0129	879.451172	0.03066185	58.7831582	15.461957	0.48148126	0.00363209	161310.313
PM18AJ304	E19JN25a097.csv	<0.0376	<0.0336	91995.3405	1.09707266	<0.00537	24.539939	6.45825329	<0.0163	958.487525	0.06148033	56.5615408	12.913629	<0.302	0.01139002	165707.989
PM18AJ304	E19JN25a101.csv	<0.0339	<0.0304	98987.8268	0.8043442	<0.00499	58.0481758	5.58188329	<0.0148	318.761461	0.10994644	55.167415	<0.547	0.44122728	<0.00269	178846.068
PM18AJ304	E19JN25a102.csv	<0.0289	<0.026	101445.611	0.694197	<0.00424	106.659056	6.02939811	<0.0124	854.726888	0.27152276	19.1407505	0.51057941	0.95858503	0.01884918	181104.621
PM18AJ304	E19JN25a103.csv	<0.0391	<0.0353	100992.59	0.84063647	<0.00576	7.11085439	4.51196485	<0.0168	664.710853	0.00515451	77.5511848	1146.06959	0.76248799	0.00786737	183220.415
PM18AJ304	E19JN25a104.csv	<0.0338	<0.0306	101034.805	<0.364	<0.00501	13.1736318	6.80366343	<0.0146	458.536178	0.03424705	77.3659942	693.497401	0.45077206	0.0074832	179555.772
PM18AJ305	E19JL15a151.csv	<0.025	<0.0229	82740.4293	0.16210467	<0.00455	13.7310344	7.60022426	<0.0115	4263.46744	1.06642091	59.1018429	11.5144618	0.45113591	0.05944809	192078.461
PM18AJ305	E19JL15a152.csv	<0.024	<0.022	80602.5433	0.36405549	<0.00436	11.3084747	5.67902641	<0.011	3316.51371	0.99154625	61.4142822	12.9758774	0.38028394	0.06588855	191269.419
PM18AJ305	E19JL15a153.csv	<0.0249	<0.0228	81209.5944	0.36364654	<0.00453	10.9715227	6.36128357	<0.0115	3329.03904	1.16433705	61.9597322	16.0034229	2.74847313	0.08253546	193151.974
PM18AJ305	E19JL15a154.csv	<0.0276	<0.0252	81658.8292	0.61917711	<0.00507	11.1706514	6.37583352	<0.0127	3693.37914	1.24999693	64.0454714	13.0282508	0.55619868	0.07408979	189812.683
PM18AJ305	E19JL15a155.csv	<0.0256	<0.0234	81541.0882	0.4833991	<0.00465	10.4016157	6.11859536	<0.0119	4037.97853	0.96211983	59.4561754	17.674604	0.21056565	0.03725852	188991.607

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Ag109	Al27	As75	Au197	B11	Ba137	Bi209	Ca43	Ce140	Co59	Cr53	Cu65	Eu153	Fe57
PM18AJ305	E19JL15a156.csv	<0.0358	<0.0327	85603.6979	<0.225	<0.00647	9.05789398	7.34522391	<0.0165	5381.1534	1.2625057	70.8869256	24.9714668	0.43452646	0.0646448	197279.551
PM18AJ305	E19JL15a157.csv	<0.025	<0.0228	83734.7076	0.24530373	<0.00453	14.4642835	8.14090824	<0.0116	4521.53548	1.20734233	69.69837	34.2341081	0.41774264	0.07041856	194527.744
PM18AJ305	E19JL15a158.csv	<0.0254	<0.0232	78509.2615	0.40365668	<0.0046	11.7769833	6.10325572	<0.0118	3048.3005	1.36283806	73.9564043	33.3344587	0.68985788	0.06380416	194197.518
PM18AJ305	E19JL15a159.csv	<0.0276	<0.0251	81120.594	0.41820925	<0.00505	14.3506452	6.60849199	<0.0129	3475.69871	1.22961384	70.5366977	17.1782075	0.33852882	0.0834301	192090.612
PM18AJ305	E19JL15a160.csv	<0.0251	<0.0228	83735.1081	<0.157	<0.00455	13.0105998	7.07303055	<0.0117	4578.39723	1.20108658	69.0714984	17.1048529	0.29201704	0.06238507	192717.014
PM18AJ305	E19JL15a161.csv	<0.0256	<0.0233	83072.4233	0.21071086	0.00519486	13.7662416	6.98343431	<0.012	4632.67395	1.11509206	63.0953293	9.2830875	0.22689952	0.07083346	194749.691
PM18AJ305	E19JL15a162.csv	<0.0248	<0.0225	82695.3171	0.34893761	<0.00451	13.3628307	6.46794852	<0.0116	4186.37323	1.20876587	60.9757011	15.5711164	0.52045016	0.061717	191028.963
PM18AJ305	E19JL15a163.csv	<0.032	<0.0291	68186.0736	0.3432564	<0.00585	10.155056	5.66611742	<0.015	3388.57506	2.31497403	57.3161646	15.0367699	0.53774017	0.10227993	162730.069
PM18AJ305	E19JL15a164.csv	<0.024	<0.0218	79692.8824	0.40461228	0.00605755	14.5329351	5.89527757	<0.0113	4538.18226	2.07063474	64.4267265	17.3544259	0.65337434	0.0928101	185393.605
PM18AJ305	E19JL15a165.csv	<0.036	<0.0326	77961.2854	0.6531447	<0.00646	12.960291	7.00027904	<0.0167	9022.06194	13.0399003	72.5637486	13.9882912	0.84153242	0.4315554	187949.044
PM18AJ305	E19JL15a166.csv	<0.0249	<0.0226	82186.1518	0.23266302	<0.00456	14.519302	7.26330213	<0.0118	5266.01103	1.23359001	66.8051266	17.5646071	0.34017746	0.06298585	193323.869
PM18AJ305	E19JL15a168.csv	<0.0269	<0.0244	84302.0727	0.72235925	<0.00495	8.81176845	5.93310359	<0.0128	2775.25951	1.255134	69.1162407	14.7129674	1.22042375	0.09138949	195684.422
PM18AJ309	E19JL15a308.csv	0.04632539	0.03952366	69605.235	30.9462727	<0.00566	245.588431	5.62150502	<0.00967	7291.40091	0.02625207	1084.03642	148.132614	112.827451	<0.00332	143547.404
PM18AJ309	E19JL15a309.csv	0.07408536	0.08655111	58974.0306	36.3009469	<0.00479	432.938153	5.98336912	<0.00798	6803.91394	0.02739934	932.80584	58.1932313	62.2577855	<0.00282	122313.508
PM18AJ309	E19JL15a310.csv	0.02306996	<0.0178	67025.7774	25.0762441	<0.00485	977.831476	5.14360237	<0.00807	7331.51028	<0.00163	484.503148	73.5070666	12.0746343	0.00890685	137594.305
PM18AJ309	E19JL15a311.csv	<0.0161	<0.0189	64651.3107	27.8695095	<0.00527	333.805668	7.49077922	<0.00869	9043.70522	0.00329567	528.304175	72.9212309	9.84478022	0.00421819	131313.275
PM18AJ309	E19JL15a312.csv	<0.0164	<0.0194	62878.4273	37.94082	<0.00563	736.795514	9.05202099	<0.00924	9164.90199	0.00635926	397.518472	187.497949	5.38944287	<0.00323	128050.062
PM18AJ309	E19JL15a314.csv	0.05686842	0.05931861	60861.0355	49.4251372	<0.00617	1034.73992	7.82917553	0.0111621	8016.29265	0.06001172	427.942743	298.844757	30.5731897	<0.00363	125150.412
PM18AJ309	E19JL15a315.csv	<0.0169	<0.0206	72552.2475	32.7587172	<0.006	958.49167	7.08879447	<0.00995	7504.69058	0.01778389	393.031241	2.68948863	28.5379275	<0.00354	125953.759
PM18AJ309	E19JL15a316.csv	<0.0271	<0.0334	67432.7075	59.3120591	<0.00947	1386.94937	6.81017584	<0.016	7266.62382	0.0350103	449.714916	4.92960644	52.2016632	<0.0056	123494.611
PM18AJ309	E19JL15a317.csv	0.0434134	<0.0176	73251.5592	31.0609948	<0.00515	1121.83691	7.21684797	<0.00882	7738.97717	0.01114281	402.179434	3.44405287	31.3695247	<0.00302	123564.926
PM18AJ309	E19JL15a318.csv	0.08061144	0.07194787	68369.0765	34.7481389	<0.00469	1009.46426	2.31675349	<0.00823	6748.04929	0.00602688	723.65525	4.87693549	44.1948949	0.00808567	149381.371
PM18AJ309	E19JL15a319.csv	0.03019809	0.02322199	66450.5969	38.8764311	<0.00588	2077.57712	4.56953314	<0.0107	7157.17441	0.31795141	681.010119	15.7314523	41.5323037	0.00788713	133464.452
PM18AJ309	E19JL15a323.csv	0.04258481	<0.0308	70406.7748	24.2706266	<0.00793	772.294356	4.93835034	<0.0171	7063.1219	0.33560539	255.317394	61.6681928	12.8361412	0.01111153	141848.975
PM18AJ309	E19JL15a324.csv	<0.0258	0.05041585	64684.2535	22.5866075	<0.00756	598.084584	5.21713791	<0.0173	6979.95639	0.43879674	250.168135	68.529226	11.5101694	0.0170627	128631.024
PM18AJ309	E19JL15a325.csv	0.06445431	0.02386642	69077.6958	27.2025071	<0.00473	1272.61148	6.13672698	<0.0115	8396.35213	0.0060876	486.667903	9.21399311	10.8366376	0.0081593	134224.122
PM18AJ309	E19JL15a326.csv	0.02646829	0.02923855	63716.8645	32.3848188	<0.00488	696.314047	5.80038372	<0.0127	7940.5179	0.00450769	462.811107	11.6834073	11.8620155	0.00378334	134360.617
PM18AJ311	C19AU08C197.csv	<0.0393	<0.0389	87539.3834	1.29041722	<0.00799	9.69767149	49.2279127	0.26971288	2705.09904	3.29108096	85.3885483	7.1086363	0.32703856	0.14018782	194345.223
PM18AJ311	C19AU08C198.csv	<0.0361	<0.0356	85405.8252	1.79515499	<0.00742	12.7799047	50.2823607	0.32640253	2410.66881	6.78122429	84.453873	6.89560694	4.20707134	0.27183579	191795.936
PM18AJ311	C19AU08C199.csv	<0.047	<0.0462	88362.8952	1.19219183	0.03641985	10.8844824	43.1427652	0.21606591	2758.75695	5.16547584	90.6592035	8.79611703	0.67029726	0.21927092	196807.263
PM18AJ311	C19AU08C206.csv	<0.0614	<0.0603	86300.2777	1.96499848	<0.0126	18.4468211	47.2378406	0.34150527	2171.8575	4.13578097	84.7901209	17.9456126	0.45339518	0.21625337	195949.087
PM18AJ311	C19AU08C207.csv	<0.0345	<0.0339	85296.3792	1.41426587	<0.00701	9.9430064	39.785904	0.23087907	2490.94157	2.64232324	90.9016084	177.244564	0.41802113	0.10633148	193692.857
PM18AJ311	C19AU08C208.csv	0.0543103	<0.0503	84328.9675	0.86109157	<0.0107	9.19658609	39.5793876	0.18576398	3041.5581	2.25645048	87.1760458	1269.63851	12.3122912	0.11134667	192467.315
PM18AJ311	C19AU08C209.csv	<0.0349	<0.0346	91507.6206	0.39084159	<0.00712	6.48694864	22.6711758	0.07835184	1856.91426	0.86641145	87.067729	3275.97146	2.09483174	0.04402083	196118.502
PM18AJ311	C19AU08C211.csv	<0.035	<0.035	88903.1259	1.26476354	<0.00717	10.5857514	40.5551777	0.23560595	2286.95262	3.381014	84.1906026	16.7659365	0.37485808	0.16671978	194253.916
PM18AJ311	C19AU08C212.csv	<0.0347	<0.0348	88591.3072	0.92556955	<0.00714	23.363852	33.9396668	0.26880592	2470.01712	3.21940511	82.3692459	10.0664345	0.38967706	0.11583014	194178.516
PM18AJ311	C19AU08C213.csv	<0.0343	<0.0346	88563.9839	1.50303714	<0.00715	22.9446075	41.6192076	0.29582595	3748.39931	8.59444641	80.2228803	13.924183	0.68592051	0.18723164	193705.026
PM18AJ311	C19AU08C215.csv	<0.0358	<0.0365	85475.843	1.60659201	<0.00735	9.16935522	39.3715936	0.24815502	6369.96529	11.1702802	90.0933996	22.8707294	0.26596557	0.35923245	192628.146
PM18AJ311	C19AU08C216.csv	<0.0336	<0.0344	89310.4342	1.25343506	<0.00698	11.5822062	43.193569	0.19579586	2648.97632	2.96809191	89.7387537	28.0451983	0.36665763	0.12178123	196677.737
PM18AJ311	C19AU08C218.csv	<0.0403	<0.0416	92187.8674	1.18987534	0.01232371	12.2597527	47.1708399	0.25666199	5594.40281	16.5207133	85.2952702	10.4947864	1.94441114	0.37105045	194152.66
PM18AJ311	C19AU08C219.csv	<0.0334	<0.0347	86899.2615	1.21503085	<0.00702	16.1584599	44.9169678	0.37657911	2763.1457	6.31539694	82.0955216	103.967404	0.49580357	0.24208593	195775.272
PM18AJ311	C19AU08C220.csv	<0.0333	<0.0347	88913.4826	1.35939916	<0.00701	15.3309779	40.0486582	0.23518012	2751.27424	3.93701639	86.3804987	27.1712867	0.39095015	0.13658452	195001.47
PM18AJ311	C19AU08C222.csv	<0.033	<0.0347	87039.2252	1.30080503	<0.00706	11.7925433	40.3754388	0.26116301	2050.34384	3.98431675	83.7321035	24.9449904	0.26169675	0.21562126	193214.113
PM18AJ311	C19AU08C223.csv	<0.054	<0.0569	87187.8161	2.27888557	<0.0116	15.6370208	40.6636336	0.29423001	2735.96765	3.53323039	81.0244349	50.6964934	0.51265141	0.10945069	191593.648
PM18AJ311	C19AU08C224.csv	<0.0362	<0.0383	92042.2458	0.62784892	<0.00772	15.2585597	35.6504803	0.22084818	3687.56744	6.02084719	81.8504895	41.6883591	0.5502552	0.1341292	197322.459
PM18AJ311	C19AU08C225.csv	<0.0615	<0.0652	87565.3483	0.6561169	<0.0134	16.7047225	43.0257319	0.21082896	2756.92019	3.66246023	78.8549911	44.2951332	0.52333403	0.14154041	193264.915
PM18AJ311	C19AU08C226.csv	<0.0839	<0.0856	86765.789	1.66024399	<0.0173	8.79770854	38.9291879	0.17591171	3051.96567	4.08562783	83.4002752	17.1769531	9.90206178	0.09619619	194012.348

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ209	E19JN26a319.csv	0.32898258	<0.00623	46.3446263	0.59288106	104.41189	0.01790402	123099.992	4990.67105	1105.3657	0.0065411	48.4469704	0.24597308	0.15939454	0.16241726	0.18166891
PM18AJ209	E19JN26a321.csv	0.16620424	<0.00521	24.0113247	0.41339781	70.5728616	0.0054123	127960.821	4868.07512	359.357622	0.00216139	47.6432429	0.60316821	0.48984224	0.54686084	0.0591095
PM18AJ209	E19JN26a322.csv	0.10800482	0.01300736	294.278947	0.2336072	46.395689	<0.00203	69930.4171	3237.27934	30362.5746	0.0044535	29.957358	0.26679482	0.28195461	0.2568692	<0.0594
PM18AJ209	E19JN26a323.csv	0.1226032	<0.00552	36.7241264	0.33764179	57.201174	0.00232252	130824.002	4855.8911	175.258245	<0.00216	56.7307023	0.08001646	0.13431104	0.1134754	0.04569235
PM18AJ209	E19JN26a325.csv	0.28568078	<0.00519	38.582094	0.44670554	58.2854923	0.00862521	129291.271	4748.75239	231.569975	<0.00203	65.1014013	0.27639368	0.31443075	0.29755203	0.05238045
PM18AJ209	E19JN26a326.csv	0.2580346	0.00532453	33.1347853	0.68835711	67.9796694	0.01326237	121291.44	5376.44572	70.949083	<0.00199	58.4310939	0.31166913	0.36058277	0.34510594	0.08439138
PM18AJ209	E19JN26a327.csv	0.17384751	<0.00624	23.78613	0.30638983	67.8584342	0.01099077	130736.071	4388.68567	137.302908	0.00701503	52.8238312	0.55044493	0.67113875	0.55087509	<0.051
PM18AJ209	E19JN26a329.csv	0.35118062	0.04537416	43.1695514	0.56885513	101.596847	0.02147893	106867.326	6140.24696	189.080469	0.00967586	49.8916834	0.47524195	0.44466949	0.40353157	0.07978548
PM18AJ209	E19JN26a330.csv	0.12910669	<0.0117	29.4814479	0.27994131	83.3372227	0.01322653	111990.264	5396.94784	99.5663667	<0.00459	52.3554147	0.38715138	0.42235912	0.3932213	0.18709393
PM18AJ209	E19JN26a331.csv	0.28071453	0.01382924	32.6698839	0.4631142	88.82273	0.01747613	114539.6	5943.9711	120.634724	0.04189394	50.8995784	0.31731281	0.30135661	0.30036496	0.0937901
PM18AJ209	E19JN26a332.csv	0.32046274	0.02061972	61.4664234	0.50149295	107.049407	0.02863848	111526.372	5733.31297	186.982619	0.01572702	48.5698884	0.31199084	0.28101268	0.33335883	0.17645366
PM18AJ209	E19JN26a341.csv	0.150796	<0.0055	46.9890318	0.17748096	69.5062228	0.00602504	133707.485	4333.45664	377.273798	0.03983237	60.4412515	0.43628972	0.52048248	0.46241669	<0.0465
PM18AJ209	E19JN26a345.csv	0.25889748	<0.00969	30.9006615	0.25377188	73.8054905	<0.00269	123752.584	4942.5247	247.040227	<0.00371	54.473115	1.83227496	1.83390274	1.67353457	0.18595748
PM18AJ209	E19JN26a346.csv	0.21887676	0.00768823	58.9664603	0.31603868	71.8015532	0.00792532	128217.802	4639.83785	148.380718	0.00974155	50.4333507	0.78632344	0.84699006	0.87482656	0.061815
PM18AJ209	E19JN26a348.csv	0.23917111	<0.00742	13.7545734	0.31372134	66.6159735	0.00712658	129091.826	4820.53291	201.859442	0.01137068	46.4080741	0.34702154	0.44567139	0.43806355	0.06784945
PM18AJ212	C19AU08C227.csv	0.04031023	<0.0049	30.3225099	<0.00268	40.8063849	0.00565838	137622.581	5928.94241	21.6173815	0.02468192	59.2884823	<0.056	<0.0168	0.00844359	<0.168
PM18AJ212	C19AU08C229.csv	0.04088428	<0.00366	45.5990578	0.01111018	40.1235114	0.00346164	143272.651	5146.41813	27.3205281	0.0899027	57.003243	0.08467272	<0.0126	<0.00211	<0.127
PM18AJ212	C19AU08C230.csv	0.05736787	<0.00399	43.7697231	0.01489932	42.1194316	0.00505874	137812.617	5965.28756	26.0808626	0.09347552	58.4323944	<0.0456	<0.0138	<0.00231	<0.138
PM18AJ212	C19AU08C231.csv	<0.0102	<0.00376	29.6184667	0.01691076	44.6402788	<0.00162	132944.189	6638.39865	25.5854844	0.01607634	52.9590397	<0.0429	<0.0129	<0.00218	<0.129
PM18AJ212	C19AU08C232.csv	0.0346796	0.0101439	41.960196	0.0092999	42.3400221	0.00484207	131006.487	7164.4781	26.5586627	0.00581408	60.0943963	0.06217852	<0.0114	<0.00193	<0.113
PM18AJ212	C19AU08C233.csv	<0.0166	<0.00611	50.228802	0.01829191	40.1332193	0.01398733	121947.271	7535.22441	32.3252319	<0.00407	58.9575276	<0.068	<0.0205	<0.00349	<0.204
PM18AJ212	C19AU08C234.csv	0.07367802	<0.0042	40.7348074	0.04282223	48.2707551	0.02248462	131582.967	5523.44856	37.2535653	<0.00277	53.3094269	<0.0476	<0.0143	0.00450071	<0.14
PM18AJ212	C19AU08C235.csv	0.40180871	<0.00438	41.6384422	0.0871288	51.2431754	0.04207724	136167.812	5365.50094	167.913618	<0.0029	50.1902925	<0.0496	<0.0149	<0.00257	<0.145
PM18AJ212	C19AU08C236.csv	0.03869626	0.08854413	17.1123171	0.1006413	80.8926145	0.04157903	102423.289	7724.76327	41.8009109	<0.00513	29.7125735	0.16668105	<0.0259	<0.00452	<0.265
PM18AJ212	C19AU08C243.csv	0.03875899	<0.00403	41.4022473	0.09251536	49.1701684	0.01198294	143758.399	5059.11722	71.9319423	<0.00259	52.1466797	<0.0452	<0.013	<0.00244	<0.13
PM18AJ212	C19AU08C244.csv	0.02083744	<0.00437	52.262155	0.00897389	42.2125561	0.0028728	137849.675	5889.73501	28.4458048	<0.00273	48.5472392	0.11260421	<0.0139	<0.00261	<0.14
PM18AJ212	C19AU08C245.csv	<0.0104	0.02062858	44.5251122	0.01701888	43.5243115	0.00231912	126159.852	9217.49679	35.6700274	0.01228156	70.5818689	<0.0426	<0.0119	<0.00228	<0.121
PM18AJ212	C19AU08C246.csv	<0.00995	0.01972599	92.6795842	0.02149808	45.6187064	0.00399569	145622.735	4901.21187	57.5024445	0.0116398	55.0881615	<0.0406	<0.0113	0.0086147	<0.116
PM18AJ212	C19AU08C249.csv	0.15327638	<0.00489	39.2132783	0.25752667	43.0625629	0.00759748	138028.66	4923.16151	39.8228534	0.01555838	48.514209	<0.0544	<0.0146	0.05987523	<0.156
PM18AJ212	C19AU08C250.csv	0.0160209	<0.00375	51.7434416	0.01261119	39.5833292	0.00392246	130623.367	5783.60511	36.0934771	<0.00237	52.2404186	0.05696079	<0.011	0.01196209	<0.12
PM18AJ212	C19AU08C251.csv	<0.0115	0.04566929	52.8761014	0.02647274	39.3436935	0.01771839	141097.602	5742.01215	59.4710046	0.02561343	54.0569061	<0.0476	<0.0125	<0.0026	<0.132
PM18AJ212	C19AU08C253.csv	<0.0132	<0.00479	30.7932284	0.02301884	39.2600125	0.01121251	142012.479	4917.73979	34.0271261	0.02124607	50.878803	<0.0532	<0.0136	0.00413125	<0.148
PM18AJ212	C19AU08C255.csv	0.02451568	0.01693273	76.2887065	0.02338362	42.147733	0.00491521	133883.739	6540.18357	49.8934235	<0.00207	41.0429572	0.06720484	<0.00929	0.01649076	<0.107
PM18AJ212	C19AU08C256.csv	0.01105923	<0.00367	44.3477699	<0.00212	37.8722665	<0.00161	125080.464	7997.47434	27.8559847	<0.00224	46.6203758	0.08916707	<0.01	0.00857272	<0.118
PM18AJ212	C19AU08C257.csv	0.23570539	0.0139938	39.4598092	0.20707124	47.4297491	0.01200069	139746.383	5120.66787	41.6185677	0.01915079	52.9614539	<0.0379	<0.00915	0.06924564	<0.108
PM18AJ215	E19JN26a403.csv	0.0797748	<0.00527	129.663076	0.38191001	67.4522316	0.00290748	95695.9605	6536.40678	293.681873	0.00971542	29.9886897	0.04455832	0.03797497	0.05711242	<0.0467
PM18AJ215	E19JN26a404.csv	0.05854671	0.01058384	96.4100774	0.21387584	63.7059282	<0.00159	95783.6137	6558.05572	95.7726855	0.00339108	32.4439626	0.07598471	0.10865165	0.06795664	<0.0495
PM18AJ215	E19JN26a405.csv	0.0679012	<0.00511	131.005083	0.20450135	66.404574	0.00542184	95451.2525	6676.38962	143.289915	0.04491148	31.8390558	0.0583201	0.05684277	0.07862468	<0.0448
PM18AJ215	E19JN26a406.csv	0.08516275	<0.0055	60.7508742	0.14651423	51.0650682	0.00527781	88446.8678	5612.90312	61.423382	<0.00206	57.0358414	0.97535787	1.06531914	1.03991326	<0.0478
PM18AJ215	E19JN26a407.csv	0.07164812	<0.00529	55.741567	0.1345105	64.9137448	0.006763	95830.5532	6683.67598	40.3234694	<0.00199	36.5251285	0.0830621	0.06526926	0.07076496	<0.0458
PM18AJ215	E19JN26a408.csv	<0.00972	0.00772012	41.1697464	0.02785616	73.9519276	0.00232673	94436.8019	6357.65548	78.4957673	0.00695877	31.5623333	<0.027	<0.0306	0.03532441	<0.0462
PM18AJ215	E19JN26a409.csv	0.07152211	<0.00534	53.6257786	0.17524352	74.2599981	<0.00152	94116.7885	6209.67977	54.3190891	<0.002	32.4250507	<0.0267	<0.0303	0.03752186	<0.0455
PM18AJ215	E19JN26a410.csv	0.01452713	<0.0054	30.5847436	0.14802421	74.2344231	<0.00153	94999.0264	6352.00722	38.1174353	0.00697019	32.9875388	0.07703063	<0.0304	0.03542212	<0.0457
PM18AJ215	E19JN26a411.csv	0.01930261	0.00812545	36.1317398	0.17230732	74.2922147	<0.00156	95423.4583	6310.70908	39.3620115	0.00685876	32.717954	0.03493618	0.03630735	<0.0235	<0.0462
PM18AJ215	E19JN26a412.csv	0.02296215	<0.00602	56.9083778	0.14336423	76.3554278	<0.00171	95378.1091	6357.37833	67.4532976	<0.00226	32.2316796	0.25665154	0.21593394	0.28518092	<0.0504
PM18AJ215	E19JN26a413.csv	<0.00958	<0.0053	38.4464663	0.0095394	70.8361266	0.00290903	95550.9799	6658.31259	83.7532877	0.01556737	32.6594031	<0.0264	0.05274398	0.06172262	<0.044
PM18AJ215	E19JN26a414.csv	<0.0103	<0.00572	30.241501	0.00987154	69.1669271	<0.00163	96571.9114	6763.00842	70.5335848	0.00983982	33.7101971	0.05338084	0.08267315	0.14506087	<0.0472
PM18AJ215	E19JN26a415.csv	0.01982424	<0.00634	42.937658	0.02418861	69.9728269	<0.00181	95269.7825	6490.95819	137.641927	<0.00237	31.9373423	0.11443635	0.10153439	0.09135353	<0.052
PM18AJ215	E19JN26a416.csv	0.01057654	<0.00527	44.8691382	0.01562566	67.1156339	<0.0015	94861.0717	6571.59112	180.203313	<0.00197	35.972656	0.03963179	0.03159299	0.04320406	<0.0429
PM18AJ215	E19JN26a417.csv	<0.00952	<0.00527	37.2119348	0.01832582	69.3296356	0.00164429	95900.4657	6688.03962	109.95018	0.01544499	32.7666642	0.06979865	0.04246345	0.03619407	<0.0427
PM18AJ215	E19JN26a418.csv	0.03457359	0.01478454	31.7352083	0.01503459	65.4656733	<0.00219	96749.0234	6745.19757	95.6682317	<0.00277	34.7357732	0.06201643	<0.0424	<0.0326	<0.0597
PM18AJ215	E19JN26a419.csv	<0.00958	<0.0053	36.081293	0.01130787	69.4642665	<0.00151	94803.3749	6536.78148	89.5571447	0.00683198	34.2073508	0.03142138	0.03603936	0.04451401	<0.0424

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ215	E19JN26a420.csv	0.88909568	0.03166132	49.0399161	2.28131608	61.0761784	0.03856033	92963.5007	6155.27207	284.963052	<0.003	42.1847765	<0.0391	<0.0435	<0.0335	<0.0615
PM18AJ215	E19JN26a421.csv	0.05489704	0.00737667	100.521596	0.22293924	67.2388411	0.00160964	95207.7624	6687.45242	241.089695	0.00666087	33.6709873	0.04953779	0.06515699	0.07208981	<0.041
PM18AJ215	E19JN26a422.csv	0.01062959	<0.00533	64.3226705	0.02138099	73.0741471	0.00183782	94184.6912	6411.25563	56.5711434	0.02871231	27.3426749	0.05853952	0.03312168	0.03496102	<0.042
PM18AJ215	E19JN26a423.csv	0.03574264	<0.00531	47.6718614	0.14085694	73.8406863	<0.00151	94304.1344	6366.90644	74.6389078	0.01050653	31.4072262	0.3614231	0.2849602	0.33564792	<0.0418
PM18AJ215	E19JN26a425.csv	0.01404095	0.00749844	67.9814445	0.01122468	69.2103714	0.00348588	93131.9096	6501.66216	160.436069	0.00695392	29.6028932	0.06421888	0.04273749	0.03497461	<0.0417
PM18AJ215	E19JN26a426.csv	<0.00943	0.00742146	30.8688636	0.01636231	66.0904942	0.00222752	95242.5688	6728.9501	64.420029	<0.00194	37.4861802	0.06354564	0.0691562	0.04535244	<0.0409
PM18AJ215	E19JN26a427.csv	0.07726449	<0.0053	67.5233835	0.36515317	62.2377125	0.00290578	93617.286	6714.92379	137.137375	0.00489955	33.6672436	0.74412102	0.83446471	0.8890229	0.04497642
PM18AJ220	E19JN25a314.csv	<0.00977	<0.00561	45.3494768	0.00540894	40.7625257	0.00185128	167846.351	1068.89587	59.66035	<0.00264	338.04576	0.63209796	0.6770379	0.78246029	0.12135625
PM18AJ225	E19JN26a077.csv	0.01972974	<0.00464	48.8912062	0.0033238	57.0396239	0.00685241	135217.17	2383.9742	103.797362	<0.00207	236.74718	<0.0323	0.03806841	0.03467547	<0.0591
PM18AJ225	E19JN26a078.csv	<0.00807	<0.00465	42.1871614	0.00508466	58.473953	0.00685787	136873.373	2348.4553	94.4279645	<0.00208	236.747349	0.04578935	<0.0357	0.03468865	<0.0589
PM18AJ225	E19JN26a079.csv	<0.00808	<0.00466	44.5599492	<0.00204	58.6325677	0.00563616	136412.881	2367.79754	105.078474	<0.00208	237.087433	0.04043015	0.0885223	0.06512727	<0.0588
PM18AJ225	E19JN26a080.csv	<0.00808	<0.00466	41.3183795	0.00509103	59.2268676	0.00316665	136891.279	2331.1922	94.2441032	<0.00208	239.176988	0.03776623	0.0546831	0.05317272	<0.0586
PM18AJ225	E19JN26a081.csv	0.01060522	0.00804222	57.8999869	0.0051121	57.3821042	0.00873403	135042.177	2398.76118	99.1895224	0.00378615	240.23699	0.05726512	0.05138126	0.03752655	<0.0587
PM18AJ225	E19JN26a082.csv	<0.00813	0.00976844	42.5178664	0.0021035	60.2483846	0.00236916	137061.198	2345.40755	103.059129	<0.00209	237.707056	0.03345556	<0.0363	0.0796729	<0.0586
PM18AJ225	E19JN26a083.csv	<0.00811	0.00803909	41.9498522	0.00335374	59.1039284	0.00255671	136072.745	2360.35602	99.5139501	<0.00208	239.719084	0.0353908	0.04103083	0.03220269	<0.0582
PM18AJ225	E19JN26a084.csv	<0.00805	<0.00464	46.1422355	0.00681914	62.4047269	0.00681541	136312.17	2341.20076	93.5074869	<0.00206	228.546258	0.04338467	0.05403715	0.03858739	<0.0575
PM18AJ225	E19JN26a085.csv	<0.00814	0.00805737	47.6679095	<0.00204	61.277532	0.00813283	136586.628	2343.11289	99.368522	<0.00209	232.0165	0.03837604	<0.0365	0.03230895	<0.058
PM18AJ225	E19JN26a086.csv	<0.00808	<0.00465	45.4177771	<0.00202	59.4268887	0.0080625	133872.648	2403.69783	80.781709	<0.00207	232.565548	0.05459311	<0.0363	0.04136562	<0.0573
PM18AJ225	E19JN26a087.csv	<0.00809	0.00948452	50.2848902	<0.00202	60.6897466	0.00705726	135152.67	2415.58156	97.5694285	0.00445016	229.231138	0.07936496	0.04573163	0.05982724	<0.0571
PM18AJ225	E19JN26a088.csv	0.01498986	0.00793478	54.3202231	<0.002	60.6876574	0.00435048	133127.48	2376.55166	91.7577079	<0.00206	230.481615	0.04625444	<0.0361	0.03331684	<0.0565
PM18AJ225	E19JN26a089.csv	0.0099264	<0.00566	50.1377165	0.01165529	59.3509406	0.00716913	135267.503	2437.81264	78.9424307	<0.00249	220.306518	0.04291174	<0.0443	0.05263293	<0.0687
PM18AJ225	E19JN26a090.csv	<0.00814	0.02469066	43.7005929	0.003369	57.7300213	0.00687155	138125.222	2337.66886	96.2676513	0.0066604	313.695981	<0.0315	<0.0367	0.02981739	<0.0567
PM18AJ225	E19JN26a091.csv	0.12386953	0.01200557	44.3262547	0.29525986	57.8464811	0.00692125	136815.518	2389.26688	101.178149	<0.00214	289.070336	<0.0323	<0.0378	<0.0275	<0.0581
PM18AJ225	E19JN26a092.csv	<0.00817	<0.00471	51.2138978	0.00338281	57.3090868	0.00317345	137386.997	2345.62019	113.302778	<0.00208	323.940396	<0.0315	0.0677722	<0.0268	<0.0564
PM18AJ225	E19JN26a093.csv	<0.0081	0.00797789	41.7399922	0.01736645	56.8504957	0.00375863	137720.879	2320.52121	91.2976744	<0.00207	315.98695	0.03325771	<0.0366	<0.0265	<0.0557
PM18AJ225	E19JN26a094.csv	<0.00924	<0.00532	52.5660431	0.0341367	53.8456526	<0.00136	135502.802	2417.79138	100.891676	<0.00235	300.587545	0.03815983	<0.0416	0.03816563	<0.0632
PM18AJ225	E19JN26a095.csv	0.01051817	0.01215881	50.2999599	0.00337124	58.2249751	0.0019227	135975.689	2377.96684	100.072419	<0.00207	275.153454	0.03347006	0.07056485	0.04468494	<0.0554
PM18AJ225	E19JN26a097.csv	0.01068803	0.00813768	49.3705451	<0.00203	57.3304689	0.00257939	136783.334	2370.47829	112.867007	<0.0021	298.224154	0.04250251	<0.0374	<0.0267	<0.0558
PM18AJ225	E19JN26a098.csv	<0.00814	0.01215003	50.7724708	0.00864523	56.9439951	<0.0012	137419.448	2361.3802	92.9291405	<0.00207	303.465063	<0.0309	<0.0368	<0.0262	<0.0547
PM18AJ225	E19JN26a099.csv	<0.00819	0.00804001	57.0313502	0.00339815	58.5177237	0.006259	136443.677	2375.72896	101.399032	<0.00208	277.748388	0.08356284	0.0538808	0.06934309	<0.0547
PM18AJ225	E19JN26a100.csv	<0.00993	0.03261798	49.5526591	0.00359651	54.8828475	0.00621993	135695.345	2546.1187	99.0565983	<0.00252	228.810374	0.11374865	0.11228237	0.10298922	<0.0661
PM18AJ225	E19JN26a101.csv	0.01966867	<0.0047	50.3960937	<0.00199	58.6976889	0.00437983	136382.212	2342.96538	111.810995	0.00377717	249.542095	<0.0307	<0.0368	<0.0259	<0.0539
PM18AJ228	E19JL11a343.csv	0.18242196	0.01395564	17.4934679	1.44202187	54.5794332	0.00627706	68456.4251	9049.56163	11.6582701	<0.00249	16.46874	4.50721276	4.50930373	4.45649503	<0.0572
PM18AJ228	E19JL11a344.csv	0.23003876	<0.00607	18.9825094	1.95549823	55.4262549	0.00430636	69444.9975	8875.64206	11.6367965	<0.00243	15.956449	4.52035256	4.33120196	4.32386126	<0.0562
PM18AJ228	E19JL11a345.csv	0.22403861	0.01680698	25.3962699	1.38318574	52.731872	<0.00176	70821.1597	8835.99934	19.048098	<0.00247	14.9174264	4.51349731	4.28377518	4.24299835	<0.0574
PM18AJ228	E19JL11a346.csv	0.25812665	<0.00701	26.3907688	1.19866932	52.6343042	0.00280475	71790.673	8811.82961	16.5261256	<0.0028	11.7053042	3.42288469	3.36054083	3.42008428	<0.0653
PM18AJ228	E19JL11a347.csv	0.26837753	0.00770542	41.0887743	1.57217822	53.7331638	0.00562203	70695.0748	8793.18349	22.0450047	0.00330608	12.7643018	3.83661328	3.7061288	3.69369658	<0.0581
PM18AJ228	E19JL11a348.csv	0.24824979	<0.00693	31.2094382	1.23408689	53.6657275	0.00454243	69909.0858	8912.89714	18.4406673	0.01020254	15.7554275	3.8894835	3.57242335	3.86293807	<0.0644
PM18AJ228	E19JL11a349.csv	0.24897941	<0.00621	16.9025635	1.31202492	54.9039569	0.00464228	68638.4819	8910.35136	13.3607637	<0.00248	15.1849257	2.88502829	2.82375831	2.93312662	<0.0585
PM18AJ228	E19JL11a350.csv	0.18027703	<0.00787	68.6763102	1.93453742	55.07076	0.01398706	54253.88	7941.11946	45.2602293	0.00741151	20.6225456	2.70324434	2.38973853	2.59133122	<0.0746
PM18AJ228	E19JL11a351.csv	0.40306699	<0.00631	69.7546222	2.18868742	66.6410461	<0.00184	58141.9261	9100.03872	41.5065419	<0.00256	17.6425818	3.19934977	3.12928236	3.17734581	<0.0609
PM18AJ228	E19JL11a352.csv	0.17107426	<0.00612	16.5227434	1.31773185	52.4194603	<0.00176	69711.6554	8831.47649	13.0168989	0.00316979	16.0022771	1.91309111	1.78558844	1.93196294	<0.0587
PM18AJ228	E19JL11a353.csv	0.22521047	0.00768908	22.7989235	1.23513042	53.9637384	0.00360249	66202.9004	9038.41722	14.2417492	<0.00248	15.8297037	4.11230006	3.97469409	3.99403905	<0.0595
PM18AJ228	E19JL11a354.csv	0.0912079	<0.00688	10.4233978	0.55665291	51.7383865	<0.00198	71913.2209	9969.61659	10.7038562	<0.00275	17.2139825	1.92983385	2.30368945	2.16673567	<0.0669
PM18AJ228	E19JL11a355.csv	0.30237729	<0.00774	398.446438	0.97629674	55.5632762	0.00754513	56523.5592	8255.66815	81.2733658	0.00558946	12.3124381	1.58021601	1.28951529	1.21251952	<0.0758
PM18AJ228	E19JL11a356.csv	0.1791298	<0.00646	41.71349	1.38617306	58.891256	0.00481079	69483.4136	8917.70285	12.0794163	<0.00259	11.7195306	6.30768921	5.97361856	6.34733472	<0.0639
PM18AJ228	E19JL11a357.csv	0.28562414	<0.0119	157.623348	1.91476818	59.7893469	<0.00341	63617.0813	8649.68	41.8708501	<0.00478	11.3711537	4.63017133	4.67566336	4.56018528	0.19845651
PM18AJ228	E19JL11a358.csv	0.21266764	<0.0061	59.6846517	1.68696129	57.2652509	0.00421391	71338.3715	8620.77846	19.3211733	0.00325101	11.7780498	5.90785585	5.57383414	5.61622186	<0.0617
PM18AJ228	E19JL11a359.csv	0.17458816	<0.00626	32.7256148	1.12934825	55.0056868	<0.0018	73763.7877	9291.71665	16.8268924	<0.00253	15.8217967	3.20699013	3.04388574	3.20044846	<0.0641
PM18AJ228	E19JL11a360.csv	0.18722779	<0.00658	349.223264	0.95476527	53.7556961	<0.00189	57588.2181	8059.01044	72.5417567	<0.00265	9.83952078	2.79986286	2.49506073	2.58592113	<0.0682
PM18AJ228	E19JL11a361.csv	0.26425372	0.00895849	68.5274513	1.84097703	56.1992814	<0.00244	65885.6912	8491.78443	27.7312029	0.00683175	13.6906503	4.50082713	4.54541638	4.61168983	<0.0902
PM18AJ228	E19JL11a362.csv	0.3604462	0.00787311	277.679261	1.84163578	50.4627991	0.00923494	61078.1134	7659.0149	71.5473915	0.00327309	13.9015556	6.74980474	6.4270399	6.56045923	<0.0679

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ228	E19JL11a363.csv	0.21995432	<0.0063	21.6304313	1.18657364	53.6176226	0.00240328	74072.1605	10248.7358	17.9377083	<0.00255	21.4628788	3.75788484	3.75418923	3.7817002	<0.0683
PM18AJ228	E19JL11a365.csv	2.55391515	<0.0131	117.109928	10.4197346	52.3248969	0.06356394	63074.8604	7414.28754	97.4781516	0.11119667	14.2278982	71.7274135	70.2660999	71.9285991	1.0971591
PM18AJ229	E19JN25a007.csv	0.02967911	0.00479128	484.934488	0.00544636	78.2376186	0.01458604	151510.218	1721.28186	36.1618566	0.00338289	352.661725	2.15985548	2.2318926	2.19377265	<0.087
PM18AJ229	E19JN25a008.csv	0.02817884	0.00442369	269.107499	0.00515716	79.4974691	0.00669565	153845.705	1687.32767	32.5437817	0.00314399	312.995975	0.29802204	0.27827455	0.29542783	<0.0844
PM18AJ229	E19JN25a009.csv	0.0204463	0.01768823	489.271152	<0.00181	79.1432093	0.01154832	153835.527	1712.65353	44.3905885	0.02069547	333.856341	1.12522421	1.15074511	1.13299948	<0.0845
PM18AJ229	E19JN25a010.csv	<0.00844	0.0524454	217.372947	0.00885756	62.6232116	<0.00128	153122.59	1702.07325	37.9266344	<0.00257	270.199403	1.45348339	1.37817132	1.56654949	<0.0853
PM18AJ229	E19JN25a011.csv	<0.00821	0.01408519	315.799179	<0.00182	67.7506398	0.00324797	150643.4	1680.05048	51.0422843	<0.0025	295.697873	0.76833773	0.67926652	0.78939693	<0.0811
PM18AJ229	E19JN25a019.csv	0.01051978	0.00451755	360.922858	0.00356121	63.8313598	0.00440775	150225.725	1689.41338	44.4783912	0.00325728	312.311167	<0.0567	0.07298544	0.0687971	<0.071
PM18AJ229	E19JN25a021.csv	0.00994214	0.0162477	189.629541	0.01173546	100.824723	0.01957645	125674.434	2332.76899	350.06353	0.00576215	549.277782	0.25266915	0.29077287	0.21412079	1.44761762
PM18AJ229	E19JN25a022.csv	0.01912053	0.02469098	415.761833	0.00855479	86.8955525	0.01209816	150860.386	1720.2728	105.459784	<0.00243	323.445799	0.77161695	0.72281977	0.81697742	0.0666413
PM18AJ229	E19JN25a023.csv	0.03557818	<0.00482	766.309817	0.03492553	62.4724137	0.01326524	149549.97	1759.13057	67.9483893	<0.00297	356.315023	0.64881299	0.67601458	0.78170857	<0.0809
PM18AJ229	E19JN25a024.csv	<0.0132	0.0312747	305.247259	0.01300582	113.317588	<0.00199	130798.112	2006.82304	61.6997674	0.01325642	674.307065	4.61290416	4.68714581	5.05958521	<0.108
PM18AJ229	E19JN25a025.csv	<0.00851	<0.00418	299.34997	0.00194167	66.8789459	<0.00129	150806.906	1691.23932	42.1410543	<0.00258	300.874218	0.43761433	0.3194285	0.37148747	<0.0691
PM18AJ229	E19JN25a040.csv	0.01941412	0.01262299	429.161995	0.00524594	71.5886008	0.01721727	150040.949	1725.31597	64.5866875	0.01191429	348.105412	0.95558284	1.05737739	0.9720748	<0.0634
PM18AJ229	E19JN25a054.csv	0.02802118	0.02864859	196.679931	0.02908066	78.5991213	0.01811798	139927.305	1947.93364	404.628391	0.00315625	216.393225	0.22820759	0.15990496	0.32514424	1.27579377
PM18AJ229	E19JN25a056.csv	0.05939489	<0.0045	400.518092	0.00763445	69.0352648	0.01936703	151378.935	1707.80693	41.5582977	0.00527672	343.470217	0.1302356	0.10989814	0.15167488	<0.0674
PM18AJ229	E19JN25a057.csv	0.01733271	0.07388836	546.395277	<0.00205	66.5464777	0.02238092	141113.761	1781.33771	2889.56724	0.00974172	330.491709	0.12113238	<0.0689	0.08091641	<0.0728
PM18AJ231	E19JL15a125.csv	0.31953219	0.08706399	14.956477	1.03189703	47.5427824	0.0137751	107425.562	2473.99454	13.917606	0.00676408	73.1741563	0.78861328	0.67831097	0.79151591	<0.0582
PM18AJ231	E19JL15a126.csv	0.31716921	0.10772904	20.5234355	1.04332837	58.7092133	0.01614523	113273.398	1472.36083	16.1960331	0.00668291	33.009316	1.10807276	0.96249355	1.09069237	<0.0533
PM18AJ231	E19JL15a127.csv	0.23424544	0.0306886	26.3370856	1.03548203	52.2709025	0.00820429	115174.148	1649.64819	19.4157028	0.01538974	35.8828543	0.38650018	0.27324996	0.39282384	<0.053
PM18AJ231	E19JL15a128.csv	0.25069983	0.04909761	20.0025522	0.94887699	45.9869323	0.0095965	107849.208	2666.50916	9.99011867	0.00670017	82.2572529	0.58524718	0.4247703	0.73336489	<0.0534
PM18AJ231	E19JL15a129.csv	0.11749729	0.02128517	20.5684775	0.89254091	51.407185	0.00548368	108975.619	3453.37722	28.2903455	<0.00211	108.211604	0.39300347	0.27146287	0.35571853	<0.052
PM18AJ231	E19JL15a130.csv	0.48338146	0.10032458	26.9550986	2.10299931	56.0923182	0.0184223	105008.254	1895.02369	19.3461899	0.00680076	44.3121028	0.69042338	0.60929492	0.69774366	<0.0542
PM18AJ231	E19JL15a131.csv	0.18272804	0.05345646	24.602138	1.13219821	55.6959906	0.00693678	110425.491	1733.51257	20.1764085	<0.00216	33.1558941	0.85979224	0.55114508	0.8371952	<0.0533
PM18AJ231	E19JL15a132.csv	0.22619216	0.03524391	14.3428904	0.74725815	46.3582228	0.01019188	106010.562	2131.39726	13.4001406	0.00780026	60.5358164	1.05922216	0.67594204	1.00031838	<0.0525
PM18AJ231	E19JL15a133.csv	0.32351357	0.06081181	28.4312585	1.95981788	51.8894178	0.01283172	113543.217	1646.64562	15.2790567	0.23839813	53.4614966	0.20767217	0.24433306	0.2504515	<0.0625
PM18AJ231	E19JL15a134.csv	0.703669	0.0450632	37.6337204	2.5390946	58.6630569	0.01013226	116435.185	1716.20398	22.9889461	0.08452127	53.0390458	0.24530974	0.21338847	0.25053871	<0.0531
PM18AJ231	E19JL15a135.csv	0.2171931	<0.00563	16.9880739	1.12894433	71.2217095	0.00287238	115921.648	1537.97144	10.0936897	0.02683726	35.80002	0.10211366	0.1049174	0.08135758	<0.0563
PM18AJ231	E19JL15a136.csv	0.40257279	0.02574192	11.7870494	1.64492001	59.0951002	0.01017415	119098.356	902.512757	8.69577275	0.01867894	58.7122377	0.11758045	0.08151466	0.10633419	<0.0633
PM18AJ231	E19JL15a137.csv	1.56056008	0.04978146	48.2594316	2.96293452	73.2030251	0.08976906	124776.59	1432.25275	25.7752882	0.01233998	49.9108266	1.0216577	0.8706533	0.89358498	<0.0604
PM18AJ231	E19JL15a138.csv	0.65277986	0.00866158	29.1313051	1.75009788	59.0138503	0.0275346	123074.971	1550.76968	19.5619696	0.01599258	57.473822	1.66434227	1.4417673	1.65412555	<0.054
PM18AJ231	E19JL15a139.csv	0.70442659	0.0579314	71.7203862	2.01395204	85.4277352	0.05104299	100923.08	2061.77004	24.1359833	0.19333446	33.7691852	0.49390923	0.41075961	0.57350173	<0.0797
PM18AJ231	E19JL15a140.csv	0.24517529	0.01782967	19.4764483	1.27391213	55.4781005	0.01814739	112263.634	1467.86674	13.428093	0.00291304	35.373663	2.85680627	2.34994355	2.63175267	<0.0558
PM18AJ231	E19JL15a141.csv	0.39005574	0.03932642	31.8968425	1.46211397	59.740548	0.01701475	95034.6134	1718.53944	21.1052098	0.09470318	14.1876845	9.9026626	8.95290034	9.73324707	<0.0534
PM18AJ231	E19JL15a142.csv	0.19785753	0.02624485	9.32334602	0.81446791	48.8237745	0.00759019	106952.271	1979.37579	13.0386961	<0.00249	46.017108	0.76743846	0.57323769	0.70584195	<0.0606
PM18AJ231	E19JL15a149.csv	0.43715785	0.00868901	27.2051725	1.82759756	48.908309	0.01349805	106992.781	1759.86738	13.8895921	0.04380051	50.9285827	0.13403897	0.07082068	0.14823605	<0.0562
PM18AJ231	E19JL15a150.csv	0.31003762	0.02655543	14.4046003	1.65104806	61.0307869	0.01232555	114761.487	1569.54375	13.6985205	0.04808675	66.236086	0.21682414	0.16152229	0.21889125	<0.0549
PM18AJ233	E19JN25a125.csv	0.04532488	0.00800032	24.0804561	0.03244291	96.8030747	0.00715632	57396.281	3359.8735	56.5818226	<0.0024	502.211919	1.51387597	1.53139483	1.6774776	0.05512771
PM18AJ233	E19JN25a126.csv	0.05307727	0.00778156	21.1913979	0.02848012	98.952097	0.00700344	59300.2903	3439.86759	45.9600397	<0.00238	453.809588	1.30384026	1.33830792	1.34143226	<0.0541
PM18AJ233	E19JN25a127.csv	0.04539049	0.01394106	173.048169	0.05017102	92.0160346	0.0132602	46333.9368	2801.84411	1335.30118	0.02246158	434.472589	3.35536757	3.80160693	3.66988892	0.09118266
PM18AJ233	E19JN25a128.csv	0.06004708	<0.00543	20.6271301	0.00614662	92.3144363	0.00418658	56636.2538	3787.86953	213.098717	<0.00301	965.380525	0.35701613	0.44826802	0.41530769	<0.0688
PM18AJ233	E19JN25a129.csv	0.03908185	<0.00419	19.9157787	0.02621152	64.8983262	0.00282672	48595.588	3868.57701	109.057475	<0.00233	732.22585	1.95508402	1.84580064	2.0755437	<0.0532
PM18AJ233	E19JN25a130.csv	<0.00854	<0.00449	20.2079834	0.02673124	62.0342596	0.00587041	56799.7302	4128.38425	57.7711567	<0.00249	825.276199	0.77258444	0.76522276	0.7213034	<0.0571
PM18AJ233	E19JN25a131.csv	<0.00843	<0.00443	14.2492966	0.02529456	64.1099802	<0.00128	47582.1345	3944.13667	110.440336	0.00287182	773.722702	0.54456342	0.57753278	0.56147304	<0.0564
PM18AJ233	E19JN25a132.csv	0.18637352	<0.00816	23.5682818	0.56873055	92.342462	0.04536436	56282.1388	3141.6798	1403.84116	<0.00455	570.184908	1.96306778	2.02346459	1.97708322	1.52136568
PM18AJ233	E19JN25a133.csv	0.01424302	<0.00444	14.8746759	0.00528706	108.335528	0.00419567	71116.417	4507.93631	57.560629	0.00593335	604.860925	2.21477808	2.37502606	2.28608123	<0.0567
PM18AJ233	E19JN25a134.csv	<0.00828	<0.00436	59.8837123	0.0068732	92.9895919	0.00589545	68113.3129	4565.47649	107.275844	<0.00241	683.318526	1.88448235	1.85226595	1.89121739	<0.0557
PM18AJ233	E19JN25a136.csv	0.06257157	<0.00437	46.9757757	0.1404327	101.005495	0.01660461	75186.8454	3678.78879	136.349873	<0.00241	1482.70343	7.9331321	8.07247823	7.83246974	0.11543132
PM18AJ233	E19JN25a137.csv	0.12564451	<0.0057	22.5428769	0.54935194	102.173794	0.01677735	65879.1424	4028.06735	223.648689	<0.00314	436.187357	2.13358598	1.98701032	1.98018198	0.13809491
PM18AJ233	E19JN25a138.csv	0.19632424	0.0232451	892.750154	1.37433388	83.921878	0.04556729	45777.655	2386.12705	2524.78115	0.0346924	358.00638	11.8646931	12.1250256	11.591716	0.22571654
PM18AJ233	E19JN25a139.csv	<0.0131	<0.00692	18.7596929	0.01441065	73.1581873	<0.00199	57556.6814	4218.0646	126.793825	<0.00381	485.672371	1.32757874	1.3799258	1.38922066	<0.0889
PM18AJ233	E19JN25a140.csv	0.18811447	0.03038343	52.471275	0.21783933	68.2898552	0.03243254	66512.8362	3964.76746	55.1638484	<0.00236	2054.64744	10.5473225	11.0273281	10.714841	<0.0553

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ233	E19JN25a142.csv	0.46952312	<0.00831	112.940171	1.01189049	100.816096	0.10316795	61297.0923	14342.9774	1163.65699	0.05777682	438.671778	92.8525433	99.619252	96.666902	0.48973507
PM18AJ233	E19JN25a143.csv	0.08088431	0.01345569	62.7285078	0.1358969	76.6810116	0.02148338	67244.435	3628.87766	140.731255	0.00968349	2882.59842	5.65362155	5.79728005	5.31221654	<0.0782
PM18AJ233	E19JN25a168.csv	0.05142513	0.02482122	228.945765	0.08263386	95.8134145	0.00985072	65635.4848	3357.2795	6056.98772	0.01486051	1447.34021	5.16374366	5.74507455	5.39508156	0.06832449
PM18AJ233	E19JN25a169.csv	0.83053064	<0.00615	12.3317192	12.3872646	70.2822126	0.03741048	57581.7317	4221.91516	31.3814207	0.01233985	282.209084	3.02951145	3.3717789	3.28993376	2.25813174
PM18AJ233	E19JN25a170.csv	0.03506017	<0.0044	40.2464052	0.026463	99.9175605	0.00225124	56401.3211	3455.33464	188.080893	<0.00234	433.104897	0.90452628	1.03244567	0.95758878	<0.0556
PM18AJ242	E19JL15a058.csv	0.12399871	0.00952787	68.1148368	<0.00216	95.952993	0.01858706	96979.5294	5818.39709	142.726586	<0.00276	103.3519	0.08373324	<0.0652	0.10663031	0.13765994
PM18AJ242	E19JL15a059.csv	0.05844436	<0.00714	73.6504175	0.02349779	93.2857505	0.01944384	95330.808	5733.24798	269.808491	<0.003	108.222807	<0.0607	<0.0709	0.05436493	0.1617209
PM18AJ242	E19JL15a060.csv	<0.0172	<0.0102	116.662153	0.00945362	96.3222229	0.00627867	94464.0133	5660.71393	137.326481	0.03383381	109.728102	0.1477065	<0.102	0.10221201	0.15634734
PM18AJ242	E19JL15a073.csv	<0.0139	<0.00829	53.5494701	0.02028994	74.6414728	0.060302	95114.8864	5218.66649	2463.5213	<0.00347	118.613389	0.12442149	0.17580884	0.17163833	<0.0941
PM18AJ242	E19JL15a076.csv	0.08155822	0.01592951	270.61694	0.00641173	88.1247732	0.00760672	93494.304	5378.20524	2356.65312	0.02388263	101.033504	0.19603973	0.16371852	0.16171792	0.3094278
PM18AJ244	C19AU08C169.csv	0.20599372	0.02562695	7.63340289	0.32894792	36.0158142	0.02720051	70647.9584	6907.70281	60.1322144	0.0144274	11.3940805	0.35148988	<0.0168	0.04862645	<0.171
PM18AJ244	C19AU08C170.csv	0.13067563	0.11128273	8.34229333	0.36306286	37.2373041	0.01753669	69787.5328	6999.9123	63.0833009	0.030985	11.0890949	0.42457436	<0.0154	0.02922071	<0.161
PM18AJ244	C19AU08C171.csv	0.11188836	0.14619587	5.76791274	0.28509726	37.9332891	0.01594612	68411.1244	6982.78133	55.882986	0.00565339	11.6224786	12.4582198	<0.0152	0.0215254	<0.163
PM18AJ244	C19AU08C173.csv	0.15262697	0.036291	6.30956352	0.38132436	38.4617056	0.00937952	68841.2978	7028.46377	60.8118064	<0.00325	10.3686674	0.35102879	<0.0138	0.02046729	<0.156
PM18AJ244	C19AU08C174.csv	0.11061758	0.18085436	6.28216615	0.28696052	40.2013781	0.02439236	68692.936	7174.00686	63.3326261	0.01926394	11.0819313	0.38608021	<0.0129	0.01881676	<0.149
PM18AJ244	C19AU08C175.csv	0.07891436	0.06208052	5.42745507	0.30290282	38.8895774	0.00732545	69679.3117	7040.91798	58.6259127	0.01629735	10.8933757	13.4284693	<0.013	0.02627787	<0.153
PM18AJ244	C19AU08C176.csv	0.14700139	0.01760894	6.15319232	0.26858457	37.3817456	0.0099932	70393.8782	6856.85422	62.1392869	0.00966782	11.3204155	16.5608103	0.01908849	0.03101918	<0.141
PM18AJ244	C19AU08C177.csv	0.17936335	0.08358709	5.36973254	0.27787471	38.6904265	0.01313831	69401.4648	6891.01882	60.3363379	0.00553637	10.9317246	36.0805351	<0.0112	0.02410007	<0.137
PM18AJ244	C19AU08C178.csv	0.19189396	0.09338601	5.76515602	0.31949172	37.4302081	0.02741466	72626.2922	7119.35452	58.5992484	<0.00298	10.6524537	0.41726893	<0.0106	0.04035353	<0.132
PM18AJ244	C19AU08C181.csv	0.17808966	0.16991822	6.68670207	0.42658767	37.179811	0.02878306	70151.6034	6836.72273	63.7621865	0.01404312	10.6438769	0.42436787	<0.01	0.02825177	<0.129
PM18AJ244	C19AU08C185.csv	0.11900011	0.12489333	8.52689521	0.44352233	40.0755051	0.02835182	68884.2179	7327.58227	73.0054428	<0.00319	10.3198308	0.3742079	0.01245182	0.01035781	<0.136
PM18AJ244	C19AU08C186.csv	0.10847292	0.11327735	7.9487588	0.29683402	38.1391814	0.01996909	69294.8426	6836.07545	76.5433397	<0.00298	11.7366972	1.04600667	<0.00954	0.02422994	<0.127
PM18AJ244	C19AU08C187.csv	0.4347213	0.09565798	4.84174482	1.6932317	36.0627037	0.0193597	70147.4779	6828.82882	60.9016918	0.00550548	12.3390682	1.75297416	<0.00921	0.02878521	<0.123
PM18AJ244	C19AU08C189.csv	0.16722092	0.13097065	7.48177838	0.28868865	37.0035384	0.02240077	70964.659	6744.72723	62.8077073	<0.00288	11.3289262	0.65415156	<0.00928	0.03902508	0.12549603
PM18AJ244	C19AU08C190.csv	0.10536698	0.07825688	5.08308259	0.29799365	38.1942471	0.02513355	68658.7614	6749.71059	62.7671197	<0.00284	11.9977991	0.46576833	<0.00922	0.03968995	<0.123
PM18AJ244	C19AU08C191.csv	0.28758406	0.10907322	4.86463798	0.97405856	38.9099344	0.01894871	74665.4207	7516.63114	57.0564573	0.00488788	8.701464	0.251786	<0.00813	0.01507439	<0.108
PM18AJ244	C19AU08C194.csv	0.1035561	0.10834402	10.6695396	0.38929659	37.4404493	0.0169113	68674.7028	6752.69869	58.3402867	<0.00275	12.6630769	0.51684971	<0.00928	0.04519574	<0.121
PM18AJ244	C19AU08C195.csv	0.08754639	0.05186076	9.26324176	0.22583604	38.588964	0.0178088	69634.2176	6594.13786	52.5110809	0.0054689	12.4042899	0.50759708	<0.00925	0.04680887	<0.12
PM18AJ244	C19AU08C196.csv	0.10466759	0.10288812	8.87025525	0.33062655	37.0412027	0.01627497	68075.5728	6629.6531	48.782311	0.00745105	10.8722961	21.5929033	<0.0107	0.04188991	<0.137
PM18AJ249	E19JN25a256.csv	0.02400879	0.0121084	64.5602002	0.01284725	58.0246127	0.00559415	132751.684	4730.79437	51.5517355	0.02347493	28.5807264	0.14437478	0.09180384	0.11910141	<0.0502
PM18AJ249	E19JN25a258.csv	0.01847499	0.07219452	80.3517514	0.01888786	59.4600291	0.01958082	129066.672	4677.21665	100.961677	0.01511615	26.8537605	0.17789848	0.13578542	0.15857694	0.07567679
PM18AJ249	E19JN25a261.csv	<0.011	0.02753869	48.9418021	0.00315617	60.3754744	0.0035453	133154.012	4351.76359	59.9565271	0.05512872	29.5910392	0.0884612	0.06840293	0.07020177	<0.0597
PM18AJ249	E19JN25a262.csv	0.01119715	<0.00563	50.7875538	0.04849847	59.9792638	0.00512439	132649.077	4529.28557	57.5332926	0.00367333	30.4868721	0.0472072	0.05354132	0.06525244	<0.0548
PM18AJ249	E19JN25a263.csv	0.02124916	0.05043134	53.7130722	0.04512471	71.2971515	<0.00284	131188.935	4678.38129	45.2683874	0.01455283	30.829095	0.08232981	<0.0824	<0.0543	<0.102
PM18AJ249	E19JN25a264.csv	0.02308791	<0.00506	47.6246241	0.02107047	61.5996518	0.00538299	131754.612	4577.00384	46.7723574	0.00316867	30.2967446	0.128466	0.10586504	0.08029317	<0.0494
PM18AJ249	E19JN25a265.csv	<0.015	<0.00837	44.9213128	0.00361854	74.2945899	0.00573337	124716.157	4463.37774	45.6446168	<0.00417	32.2629801	<0.0551	0.07436286	<0.0435	<0.0836
PM18AJ249	E19JN25a267.csv	<0.012	<0.00671	68.0059114	0.00436416	43.8581458	<0.00182	132171.561	5107.63854	48.3043513	<0.00328	192.433213	13.8063044	13.9858573	13.2678148	<0.0658
PM18AJ249	E19JN25a268.csv	<0.00941	<0.00527	53.0096748	0.00564348	45.0528568	<0.00143	133241.036	5130.71913	49.8983793	0.00616902	187.356667	56.0520062	57.8275034	56.6486622	<0.0518
PM18AJ249	E19JN25a270.csv	0.10473416	0.06703056	153.75957	0.1312021	58.6782313	0.01841913	139173.938	4521.23904	241.709893	0.00452074	126.232931	21.754556	22.6906669	22.3488093	0.0916461
PM18AJ249	E19JN25a277.csv	0.06261264	0.04644509	50.4809386	0.09232844	56.3328817	0.00290687	131165.522	4739.27399	59.5569865	0.00794178	29.5900946	0.13148961	0.09392177	0.12446886	<0.0599
PM18AJ249	E19JN25a278.csv	0.11432772	0.00851205	138.592751	1.42244241	33.2634416	0.01411517	119856.545	7080.76521	115.729362	0.02274219	61.9047755	6.72205853	6.8172578	6.68231127	0.19756582
PM18AJ249	E19JN26a007.csv	<0.0478	<0.028	390.510347	0.10433069	214.951256	<0.00687	121787.286	6678.75161	630.104671	0.05234841	43.8957266	5.74954962	6.01721543	5.96807543	0.60126342
PM18AJ249	E19JN26a026.csv	0.14373452	0.06407085	303.784198	0.23510036	108.445025	0.00870069	103964.912	8919.42747	252.314814	<0.00588	88.4944964	4.17406992	4.37537003	4.31212392	0.35676627
PM18AJ249	E19JN26a028.csv	<0.0193	0.02647214	802.241614	0.10211839	193.547084	0.0082482	134741.944	7340.78992	972.270827	<0.00493	34.5876226	1.83744468	1.58415881	1.97177038	0.34322906
PM18AJ249	E19JN26a033.csv	0.13151495	0.12452076	557.353783	0.02402743	205.988884	0.0175356	149194.221	7871.47642	198.129541	0.04019658	21.1836574	7.88978434	7.68850487	7.58590594	<0.169
PM18AJ252	E19JL15a234.csv	1.85648019	0.12279152	385.264447	1.12355001	11.749051	0.13207263	126649.14	3956.25148	472.904047	<0.00259	20.4600946	0.35105385	0.40223673	0.22106725	<0.0614
PM18AJ252	E19JL15a236.csv	1.15902101	0.01013762	691.279894	0.95638075	27.2973248	0.08183223	158810.923	2975.16808	868.759221	0.22782561	31.6142529	0.06819192	<0.0482	0.09190579	<0.066
PM18AJ252	E19JL15a237.csv	1.0938043	<0.00637	161.72017	0.78033184	36.0969021	0.10102595	154675.456	3057.06297	1215.58838	0.03252808	32.5984061	0.09121262	0.121627	0.1461708	<0.0571
PM18AJ252	E19JL15a238.csv	1.65687317	<0.00671	447.975606	1.27611419	30.1909205	0.16410691	156728.114	3288.62511	239.570538	0.01209045	25.5507045	0.06979658	<0.044	<0.027	<0.0602
PM18AJ252	E19JL15a240.csv	1.41346464	0.01470889	167.539301	0.97012973	29.4271158	0.15046598	157361.591	3039.84387	323.198583	0.01591367	33.9992861	0.05501159	<0.0461	0.03643809	<0.0631
PM18AJ252	E19JL15a244.csv	1.66445828	0.01319162	74.2050406	0.90459907	19.0802493	0.13999317	155845.327	2806.72898	138.092163	<0.00367	39.7869111	<0.0556	<0.0625	<0.039	<0.0886
PM18AJ252	E19JL15a330.csv	3.4645403	0.27358396	304.659448	3.28462429	10.3293519	0.2275875	113712.016	5690.76391	210.551943	<0.00361	10.5080245	0.09731282	0.09866147	0.08392595	0.32362836

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ264	E19JL15a078.csv	0.15847104	<0.00661	51.3241428	0.67785267	68.3963476	0.01255191	103170.382	5788.67863	139.68274	0.01382862	23.8315402	0.86535413	1.02776157	1.01464242	<0.074
PM18AJ264	E19JL15a079.csv	0.2066073	<0.00513	47.7660326	0.75476022	75.3632255	0.01120212	101230.295	5412.63474	294.52252	0.00366022	25.3969485	0.87348779	0.9844826	0.96094659	<0.0572
PM18AJ264	E19JL15a080.csv	0.30683834	0.01315812	65.4172842	0.72297769	74.5888161	0.01533623	99805.9801	5520.45432	399.838667	<0.00281	23.1022397	0.94672578	1.10868729	0.93884182	<0.0736
PM18AJ264	E19JL15a081.csv	0.2802243	<0.00503	56.7962965	1.08216098	82.3452197	0.01410955	106990.33	5036.40906	578.622365	0.00638884	29.0217674	1.15448848	0.94569315	1.13660944	<0.0557
PM18AJ264	E19JL15a082.csv	0.20542822	<0.00517	44.9748892	0.6745473	78.3686345	0.01448735	103348.166	5370.83429	323.915075	0.02145989	26.2214596	1.22853313	1.36630285	1.33706321	0.0952986
PM18AJ264	E19JL15a083.csv	0.25756101	0.03128292	64.7264066	0.81025968	82.82025	0.02422766	101746.163	5240.20514	582.713842	0.00681735	26.5159068	1.34331505	1.28988239	1.38381588	0.13150565
PM18AJ264	E19JL15a084.csv	0.13169658	<0.00508	66.1056403	0.98012248	77.7851689	0.01249759	103777.604	4824.08904	568.516495	0.01226771	28.1940344	0.297546	0.31570328	0.26776091	<0.0557
PM18AJ264	E19JL15a087.csv	0.14362073	0.00799921	52.141639	0.66412782	79.3893396	0.01609217	104363.692	5197.09554	289.628654	0.0064295	30.0092774	0.5674368	0.54547572	0.53011949	<0.0551
PM18AJ264	E19JL15a088.csv	0.27707393	<0.005	42.2152667	0.9227877	81.2471274	0.02697905	106958.076	5057.97356	203.415519	<0.00206	29.824084	3.36102097	3.49629941	3.33312499	0.12183098
PM18AJ264	E19JL15a089.csv	0.32622854	0.00795547	47.7126395	1.29792339	82.2059028	0.0241697	108598.731	5003.89254	404.288454	0.00919718	30.4701165	6.28990137	6.62018972	6.77461452	0.18207673
PM18AJ264	E19JL15a092.csv	0.30722985	0.02688441	81.0593953	1.1174986	75.2890144	0.02586117	97568.7146	5180.97459	201.407081	0.03284697	26.2815397	0.68991095	0.88063852	0.79067992	0.17442624
PM18AJ264	E19JL15a093.csv	0.15421283	0.00831521	113.242435	0.6542118	67.0764506	0.0029662	92792.0858	5195.69898	232.224707	0.0066874	22.6053496	0.81649253	0.7729527	0.84338355	<0.0563
PM18AJ264	E19JL15a095.csv	0.61588034	<0.00644	52.0715728	2.61067469	65.5880872	0.04202923	102359.687	5873.98548	320.291186	<0.00264	23.2772459	0.62527448	0.71548571	0.67004471	<0.0679
PM18AJ264	E19JL15a096.csv	0.2581998	0.01661011	61.6192672	1.18224167	70.6858631	0.00851146	99491.3644	5312.95601	386.494711	0.00359696	24.453561	0.64009835	0.66571956	0.73593517	0.14306078
PM18AJ264	E19JL15a097.csv	0.25871317	0.01209784	43.2466887	0.95974166	80.167501	0.01953759	106847.593	4890.78086	274.658401	0.0063115	31.5602225	2.02520976	2.1014877	2.15457338	0.11500181
PM18AJ267	E19JL15a169.csv	0.21073293	0.10144522	132.01765	0.76415323	64.7919924	0.00794399	90728.7643	1791.47815	130.050341	0.00565084	20.1603167	3.4722838	3.42415909	3.41699467	<0.0578
PM18AJ267	E19JL15a171.csv	0.53425161	0.03214095	55.0923872	1.65937898	55.1739847	0.01747562	88287.8733	1981.97516	27.5133596	0.02254213	23.6660813	14.0397913	13.7796138	13.9573695	0.27205863
PM18AJ267	E19JL15a172.csv	0.43511149	0.04747062	53.3860721	1.71469824	53.2574491	0.01759171	89411.724	2043.9625	26.0152643	0.00486503	23.8985091	13.9630723	14.1101135	14.1430707	0.17801373
PM18AJ267	E19JL15a173.csv	0.15456509	0.04963225	112.656492	0.63478767	63.4730091	0.00394959	90520.3108	1813.88275	19.9218737	0.00995142	13.3409662	3.6912422	3.80996289	3.82488286	<0.0592
PM18AJ267	E19JL15a174.csv	0.41575791	0.02829431	60.8180692	1.58986692	56.278249	0.01695601	88886.8317	1975.73546	36.7080188	0.00233754	21.2744726	11.0735855	10.3868994	11.0931543	0.1805148
PM18AJ267	E19JL15a175.csv	0.21349983	0.02701708	54.2404796	0.81823602	69.178684	0.01270752	90702.7613	1772.50935	19.866714	0.00498059	17.8132269	3.14908692	3.18258807	2.94723369	<0.0821
PM18AJ267	E19JL15a177.csv	0.21510036	0.01487963	128.713734	0.87530174	68.0990331	0.01237587	91405.2537	1919.91182	62.0753896	0.00773057	14.9537312	1.09961043	0.95970884	0.97130113	<0.0556
PM18AJ267	E19JL15a181.csv	0.17258614	0.14122361	121.757501	1.1045589	68.0049955	0.01641274	93231.6852	1905.62207	32.8134456	<0.00332	17.9699493	3.86481293	3.61828899	4.35106817	0.09009625
PM18AJ267	E19JL15a182.csv	1.67211915	0.06459301	47.3863609	5.63078862	58.2230792	0.10988949	89088.2991	1906.11315	34.992531	0.01906351	15.6058475	8.47862752	9.13011259	8.99710398	0.06891778
PM18AJ267	E19JL15a184.csv	0.22025902	<0.0084	68.7494685	1.15448486	63.2273218	0.01268002	93236.7043	1927.26806	44.8808978	<0.00327	16.2455621	5.37487194	4.93652342	5.0519051	0.08887607
PM18AJ267	E19JL15a187.csv	0.33176222	0.26259227	47.1697301	2.27204436	61.7758838	0.02821942	87880.3145	1633.66953	117.243206	0.01825253	12.36455	4.14629108	4.1895681	4.20048278	0.19877016
PM18AJ268	E19JL11a294.csv	<0.0156	<0.00885	250.905635	0.00715903	76.7035475	0.0084086	125465.076	1159.61338	41.9074938	0.02589214	463.49996	2.66334378	2.41163622	2.80716076	<0.08
PM18AJ268	E19JL11a296.csv	<0.0118	<0.00671	83.3881869	0.01409564	47.0546726	<0.00195	129674.4	1228.33797	33.6902945	0.01282486	902.169801	3.2043173	3.37015442	2.95895886	<0.0607
PM18AJ268	E19JL11a302.csv	0.11154728	0.08963326	708.377697	0.03024682	66.5472851	0.02628936	122691.432	1085.35956	367.672833	0.08801082	431.007397	10.6964596	11.0285257	10.5976952	0.24972171
PM18AJ268	E19JL11a313.csv	<0.0136	0.02492159	172.019881	0.01024948	74.7027703	<0.00225	130639.091	985.8947	37.2485347	0.02307523	342.134293	0.99207163	1.12379222	1.00119037	<0.0713
PM18AJ270	E19JN26a160.csv	<0.00826	<0.00473	17.3988505	0.02397271	24.0691355	<0.00123	82978.6397	6403.13532	9.78063744	<0.00201	30.4506222	<0.0283	0.04425157	0.033748	<0.0469
PM18AJ270	E19JN26a162.csv	0.0394662	<0.00607	20.5302843	0.21699324	68.4224176	<0.00158	81208.8726	5467.9754	13.5265279	0.00792528	21.3593742	7.9908727	7.48537346	7.92499257	0.06107013
PM18AJ270	E19JN26a165.csv	3.73084603	0.1848638	511.120235	0.42506265	52.9869525	0.26531909	74879.4611	4991.72898	995.622749	0.82315251	23.4535597	7.23058428	6.74762342	6.91105634	<0.112
PM18AJ270	E19JN26a166.csv	0.02805506	0.00685361	11.8277873	0.0379219	27.1836404	<0.0014	86768.8672	6364.02346	10.1479538	<0.00228	32.3544179	<0.0319	<0.0388	0.04093984	<0.0536
PM18AJ270	E19JN26a167.csv	<0.00798	0.00497925	22.6708526	0.06179036	27.7563427	0.00226375	89475.0325	4730.29482	37.8081428	<0.00194	33.5735938	0.04495469	0.04868332	0.05950172	<0.0456
PM18AJ270	E19JN26a168.csv	<0.00787	<0.0045	15.3995332	0.05771507	24.425678	<0.00118	84043.6468	6122.07926	7.07099682	<0.00191	32.0691129	<0.0267	0.04505003	0.01984711	<0.045
PM18AJ270	E19JN26a170.csv	0.01854797	0.06413674	48.3560838	0.07501082	30.82545	0.00570514	89104.0506	5482.01049	47.2325206	0.02974088	27.1541315	0.67943439	0.52628725	0.57462697	<0.0764
PM18AJ270	E19JN26a171.csv	<0.00907	0.00521756	43.5428536	0.12906218	41.0859919	<0.00136	94388.691	6252.4728	32.5603108	<0.0022	35.3169052	0.1011408	0.13857702	0.10158132	<0.0521
PM18AJ270	E19JN26a172.csv	0.01916622	<0.00476	27.8764617	0.10043156	31.7575182	<0.00125	96884.6912	4982.32865	15.642511	<0.00201	53.6262629	24.1484961	23.7396063	24.282884	<0.0479
PM18AJ270	E19JN26a173.csv	0.07594663	0.01666319	12.831632	0.09155517	26.0733234	<0.00194	87154.3664	4864.51992	25.4484774	0.04544131	98.2021303	61.6933548	63.5877441	61.8710414	<0.0746
PM18AJ270	E19JN26a174.csv	0.01842841	<0.00458	32.0662806	0.0816369	33.2804407	<0.0012	86548.7107	6057.06445	9.2625815	<0.00194	37.9550976	0.11034599	0.08163636	0.09311275	<0.0463
PM18AJ270	E19JN26a175.csv	0.01016542	<0.00488	7.09655152	0.0239514	21.1223942	<0.00128	81233.5427	6862.52055	7.6982265	<0.00206	23.7842326	0.24838029	0.14249481	0.17764734	<0.0494
PM18AJ270	E19JN26a176.csv	<0.00817	<0.00467	12.6924132	0.06013449	24.4870524	<0.00122	83729.2844	6160.87165	7.40991607	<0.00197	31.2862455	0.22104987	0.18788058	0.20922104	<0.0473
PM18AJ270	E19JN26a177.csv	0.01945014	0.00799393	21.1985239	0.02399747	26.4924973	<0.00166	86096.0566	4587.72942	14.8763856	0.00661659	38.5791308	7.10939662	7.37292152	7.50480213	<0.0642
PM18AJ270	E19JN26a179.csv	<0.00924	0.01756025	32.6568527	0.20601527	42.0089088	<0.00138	96641.6035	6399.29231	26.4043798	0.01276506	36.3499109	1.59263372	1.70595505	1.4579688	<0.0532
PM18AJ270	E19JN26a181.csv	<0.0104	<0.00593	23.8472874	0.07354164	24.1649599	<0.00156	80217.958	6023.26526	15.3982093	<0.0025	33.0085167	0.1006225	0.06936968	0.1005613	<0.0607
PM18AJ270	E19JN26a182.csv	<0.0079	<0.00451	14.2137444	0.02292732	19.9305425	<0.00118	79667.2469	6638.21665	<5.53	0.00354009	25.8115106	0.04440993	0.03634214	0.0212475	<0.0462
PM18AJ270	E19JN26a183.csv	<0.00814	0.00753951	128.179967	0.04379871	25.8819024	<0.00122	80365.6597	6379.87719	40.919289	0.00364563	30.4167865	0.02995499	<0.033	<0.0201	<0.0477
PM18AJ270	E19JN26a184.csv	0.02052652	<0.00462	28.7909579	0.11480365	28.5712938	0.00268716	85015.4817	6227.06498	7.09563803	0.00521572	33.8387489	51.2071972	51.5368453	52.4712301	<0.0476
PM18AJ272	E19JL15a262.csv	0.21628056	0.00803821	41.2022458	0.78503183	60.2210229	0.04022774	92494.7238	6837.33957	34.0700155	0.09571467	12.1300357	7.74969885	7.92924483	8.04172105	0.06452688
PM18AJ272	E19JL15a263.csv	0.44515282	0.04189876	59.3764059	0.89644814	75.6508996	0.16275023	95938.4992	5443.10542	107.585374	0.06958961	13.7345222	8.90808209	9.17237079	9.4512519	<0.0485
PM18AJ272	E19JL15a264.csv	0.13263565	<0.00544	44.3814184	0.73986224	71.1190064	0.03736471	86777.1593	7342.69651	29.1928714	0.07410727	14.879551	2.68666688	2.46482301	2.59894766	<0.0483

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ272	E19JL15a265.csv	0.09964552	0.01763761	45.0064653	0.5809261	63.3766061	0.02003324	87028.9989	8173.40413	22.4967356	0.17948178	6.73424563	3.76166193	3.71783247	3.8051076	0.07383729
PM18AJ272	E19JL15a266.csv	0.09885873	<0.00561	31.0935222	0.28581231	54.4653572	0.01884857	85061.941	7932.40707	19.4371286	0.11937863	8.07838219	6.08774334	5.66875718	6.07738413	<0.0495
PM18AJ272	E19JL15a269.csv	0.03546173	<0.00616	72.0855858	0.57888708	56.0246207	<0.00166	103989.176	4241.39432	21.8402074	0.07852151	23.8747643	4.31508897	4.50395145	4.50824057	<0.0542
PM18AJ272	E19JL15a270.csv	0.08003449	0.01065074	27.7061829	0.45756024	61.0221415	0.0074752	108467.17	4193.05934	12.4116291	0.00314679	20.9367349	5.67287866	5.66928939	5.65366966	<0.053
PM18AJ272	E19JL15a271.csv	0.05566539	<0.00579	18.6203435	0.61521329	63.2573172	0.00466275	109571.782	4071.82002	12.0415616	<0.00217	22.3435481	2.8606122	2.98266744	3.07988646	<0.0507
PM18AJ272	E19JL15a272.csv	0.06681805	<0.00616	45.5668686	0.35354492	59.3295036	0.00257814	102441.347	5199.31791	193.411544	0.0328806	19.2420059	2.97168318	3.24358908	3.14890644	<0.0539
PM18AJ272	E19JL15a274.csv	0.15808664	<0.00555	22.595593	0.60825446	41.2910947	0.00933727	106975.565	4395.12546	12.05019	0.00944421	12.3873039	10.3049357	9.85432471	10.1131259	<0.0482
PM18AJ272	E19JL15a281.csv	0.16224329	0.03711674	25.2061846	0.83535396	91.9647271	0.00886648	86664.9678	6151.47389	25.2577614	0.02596911	10.2582103	23.2393024	22.4118699	22.6982846	<0.0485
PM18AJ272	E19JL15a282.csv	0.09710911	0.00829792	70.8247596	0.47378595	70.9496569	0.00830228	106593.498	3971.68218	19.5775562	0.06209241	26.06283	7.18384974	7.25413942	7.49802255	<0.0488
PM18AJ272	E19JL15a283.csv	0.12223299	<0.0057	17.2747927	0.75050036	80.2977926	0.00582315	100400.528	4910.02816	12.757548	<0.00213	21.4951997	12.1968166	11.9124328	12.5054317	<0.0474
PM18AJ272	E19JL15a284.csv	0.3508653	0.01252069	32.2786974	0.86364443	65.0203534	0.04510209	97773.0513	5533.19033	54.3800595	0.02532431	8.73283846	9.65432691	9.67510738	9.71607503	<0.0478
PM18AJ272	E19JL15a286.csv	0.11468905	<0.00704	23.445802	0.51907308	47.8185856	0.00303577	103549.868	4835.66513	15.4240719	0.01725051	25.9615286	3.64925679	3.6932341	3.90798084	<0.0576
PM18AJ272	E19JL15a287.csv	0.04819993	<0.0076	33.0076244	0.47657733	50.667689	0.0061077	100499.305	4745.65165	7.33855286	0.01224102	17.4525906	6.37918728	6.44875916	6.42804035	<0.0626
PM18AJ274	E19JN25a171.csv	0.01450276	<0.00473	35.0997355	0.01959418	103.742422	0.00366336	26340.4429	15413.2475	<5.65	<0.00251	29.5872816	0.07923853	0.05456285	0.06289257	<0.0597
PM18AJ274	E19JN25a172.csv	0.01131519	<0.00512	10.7101757	0.04788991	100.65831	0.01005937	55209.5603	14000.7913	7.54936292	0.02052794	120.346505	<0.0433	0.09881652	0.06819654	<0.0645
PM18AJ274	E19JN25a173.csv	0.06966885	<0.00514	57.941333	0.18176524	92.1343461	0.01859812	48696.8646	14793.5614	31.7277795	<0.00272	132.995248	0.11198619	0.11764067	0.16157978	<0.0645
PM18AJ274	E19JN25a174.csv	0.03805507	<0.00559	57.5547981	0.04601843	100.79968	0.0060084	36736.741	15402.9293	10.2377247	0.00685667	99.8325074	0.08450149	0.06250626	0.03848997	<0.0699
PM18AJ274	E19JN25a181.csv	0.08748268	<0.00697	48.8388883	0.533655	89.130927	0.01161536	53747.5112	14387.2786	72.5344304	0.02110552	124.001234	0.53930515	0.4306079	0.56128292	0.14109225
PM18AJ274	E19JN25a186.csv	0.30421423	<0.00541	64.3469649	3.54400304	79.5938195	0.02730928	51175.4028	12351.7596	44.6755048	0.05471352	122.66309	8.0489297	8.36543303	8.32079353	1.63603081
PM18AJ274	E19JN25a187.csv	0.01411606	<0.00511	258.827585	0.01252051	101.277969	0.00471078	26743.5728	13242.3044	127.98726	0.01566953	29.9180085	0.11376951	<0.0495	0.06963034	<0.0608
PM18AJ274	E19JN25a188.csv	<0.0183	<0.00957	51.0111873	<0.00339	102.493595	<0.00269	24442.2328	14763.1993	17.87174	<0.00515	27.1295061	0.16565958	0.22124358	0.13313819	<0.117
PM18AJ274	E19JN25a189.csv	<0.0134	0.03406676	33.8847282	0.03988186	105.959444	0.00868158	25736.6534	15857.356	11.8026869	0.0237796	44.5191918	0.09721302	0.16082057	0.11469338	<0.0853
PM18AJ274	E19JN25a191.csv	0.03307985	0.03304854	984.536931	0.07713498	82.5024973	0.00706781	68989.7522	10321.7169	327.125682	<0.0027	435.896627	0.1225174	0.06978559	0.06531291	<0.0604
PM18AJ274	E19JN25a192.csv	0.01533853	0.00638052	27.8919264	0.03703709	73.4268411	<0.00155	105247.08	11362.5157	30.5035101	0.00486033	195.500515	0.1751749	0.13458136	0.11780357	<0.0643
PM18AJ274	E19JN25a193.csv	0.4256026	0.02574476	76.5777492	1.26458036	81.4548007	0.011126	98098.4912	11004.1787	68.5463411	0.06475598	203.800099	0.12285117	0.15309943	0.09417497	<0.0716
PM18AJ274	E19JN25a194.csv	<0.00891	0.07913449	51.9987983	0.12863269	91.7521572	0.00301784	100015.056	10961.6203	26.3720745	<0.0025	174.987946	0.57184664	0.50661542	0.52087685	<0.0553
PM18AJ274	E19JN25a195.csv	0.01460387	0.01607551	18.9490679	0.06222946	60.9948455	<0.0013	88328.0441	16479.5088	13.772646	<0.00241	112.587531	0.68719263	0.65230775	0.70118711	<0.0529
PM18AJ274	E19JN25a196.csv	0.43843999	<0.00986	133.267456	5.38470733	76.9810278	0.02011833	53065.8907	11771.8487	108.657122	0.06224986	154.911562	5.80896794	5.50351723	5.22179527	3.46551645
PM18AJ274	E19JN25a222.csv	0.04625571	0.02834999	82.4391427	0.22357592	114.85236	0.00606363	78064.6266	12598.2092	19.428225	0.17213136	426.389749	0.2284615	0.1378404	0.12665074	<0.0709
PM18AJ274	E19JN25a223.csv	0.02035755	<0.00514	345.645776	0.08425682	92.2468685	0.0018474	52432.2683	13349.3079	16.2575614	0.00467915	304.624384	0.07150674	0.08129477	0.08075326	<0.0509
PM18AJ274	E19JN25a224.csv	0.05067099	0.01549347	326.416078	0.24478989	107.591881	0.00861466	24808.4675	15250.8711	114.3909	0.05463881	41.7675049	0.19446334	0.2249659	0.23027595	0.08540725
PM18AJ275	E19JN26a041.csv	<0.0182	<0.0106	48.6599135	<0.00486	70.9642072	0.0057397	125127.721	7313.01226	68.1239584	<0.00461	368.019131	0.08675965	0.13933321	0.06831803	<0.13
PM18AJ275	E19JN26a042.csv	0.15554635	0.01466455	49.009897	<0.00492	90.4802926	0.02429033	98379.0702	5497.7643	10268.7934	<0.00467	323.02488	<0.0797	0.12589943	<0.0538	<0.132
PM18AJ275	E19JN26a043.csv	0.05751834	<0.0109	23.8672486	<0.00498	91.0426993	0.02058595	116624.775	5875.46865	1392.83498	<0.00473	369.270534	0.0819014	0.11199246	0.09621296	<0.134
PM18AJ275	E19JN26a044.csv	0.10040657	<0.0123	45.6403457	0.01047777	95.131397	0.02120448	113863.888	5690.89914	2878.3837	<0.00537	326.557656	1.42233297	1.28887025	1.42325537	<0.152
PM18AJ275	E19JN26a045.csv	<0.0329	<0.0191	148.560339	0.01260446	84.4690534	<0.00477	109685.387	5232.1699	2713.78834	<0.00835	328.126291	<0.141	<0.124	<0.0983	<0.236
PM18AJ275	E19JN26a046.csv	<0.0262	0.02329246	216.24514	<0.00697	80.7264531	<0.0038	121938.983	6043.16311	705.288228	<0.00665	362.147985	0.12108957	0.20375385	<0.0786	<0.188
PM18AJ275	E19JN26a047.csv	0.03219111	<0.013	170.362146	<0.00595	72.9278171	0.01718788	116199.43	5653.48766	2164.38503	<0.00569	325.482826	<0.0955	<0.0853	0.07848745	<0.161
PM18AJ275	E19JN26a051.csv	0.12526843	0.01982687	46.7392043	<0.00473	115.19224	0.04804962	103516.386	6120.73909	2201.99777	<0.00454	233.424299	<0.0756	<0.0695	<0.054	<0.129
PM18AJ275	E19JN26a052.csv	0.14437167	<0.0109	19.3582435	<0.00495	102.114073	0.01660129	104735.741	5996.42726	384.594631	<0.00475	294.692336	0.12834629	<0.0732	0.12138519	<0.135
PM18AJ275	E19JN26a053.csv	0.0398818	<0.0126	28.8270711	0.0119308	94.9847617	0.02353269	110907.192	6302.70777	1733.22228	<0.0055	465.612371	<0.0908	<0.0848	<0.0669	<0.156
PM18AJ275	E19JN26a054.csv	0.0469732	<0.0166	113.111663	0.03164516	70.808351	0.01058288	73354.7393	4086.95199	23494.819	<0.00715	316.911999	<0.119	<0.112	<0.0882	<0.203
PM18AJ275	E19JN26a056.csv	0.07717353	<0.0166	21.5818335	<0.00747	106.167198	0.02760432	91359.6213	5487.60772	380.574621	<0.00721	323.857775	0.12241617	0.15689253	0.15463152	<0.205
PM18AJ275	E19JN26a057.csv	0.13867226	<0.0115	13.3928042	0.01170115	104.987018	0.04011429	97809.2825	5605.99093	215.327933	<0.00502	292.401914	0.12731242	0.12077006	0.07481208	<0.143
PM18AJ275	E19JN26a058.csv	0.10846627	0.01307335	48.3815353	0.00505807	105.407846	0.03861177	98502.401	5546.33105	89.1821233	<0.00486	321.794281	0.18251701	0.15050625	0.17032505	<0.138
PM18AJ275	E19JN26a059.csv	<0.032	<0.0185	333.520889	<0.00831	73.1828236	0.02289564	80281.0653	4055.67334	12446.004	<0.00822	332.759938	0.97826644	1.03963808	0.8756266	<0.229
PM18AJ275	E19JN26a061.csv	0.09787964	<0.0154	89.2188808	0.02741014	107.840417	0.01295419	90247.1404	5148.73917	1763.94553	0.01229921	311.91696	0.62335218	0.34085938	0.48549589	<0.188
PM18AJ275	E19JN26a062.csv	0.05780546	<0.0131	21.6549981	0.0170802	107.997377	0.03325582	109375.299	6069.5085	791.164785	0.01848006	306.748268	<0.09	<0.09	<0.0703	<0.162
PM18AJ275	E19JN26a066.csv	0.15245896	<0.0158	19.0480626	<0.007	93.4358851	0.00686131	108605.113	6581.93998	1267.53488	<0.00685	385.77388	<0.109	<0.112	0.19335414	<0.194
PM18AJ279	E19JN26a266.csv	0.01893115	<0.00495	23.8697402	0.02096812	73.3807044	0.01388276	134233.841	6062.53646	33.5260513	0.00375005	107.690855	0.14110822	0.16486097	0.11188318	<0.045
PM18AJ279	E19JN26a267.csv	3.24066848	<0.00527	18.788831	7.1438288	71.8756818	0.13688898	136633.754	5967.51101	43.8999526	<0.00209	102.275151	0.13883291	0.10565929	0.1384754	<0.0477
PM18AJ279	E19JN26a268.csv	<0.00911	<0.00516	24.1625545	0.02632667	74.1582702	0.00474482	130805.5	5908.95853	27.4683248	0.00858945	97.4744271	0.07236741	0.06178786	0.06454761	<0.0465

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ279	E19JN26a275.csv	<0.0117	<0.00663	20.5407283	<0.00205	68.9365259	0.00376625	135646.541	5993.0842	20.5583953	<0.00263	91.2749946	0.08005337	0.04417641	0.06147783	<0.0579
PM18AJ279	E19JN26a276.csv	0.06253915	0.01002848	19.1342295	0.16037279	67.5054012	0.02160586	129378.553	5734.48842	38.3786739	<0.00205	90.5503475	1.53915846	1.50731996	1.55437686	<0.045
PM18AJ279	E19JN26a277.csv	0.04679966	0.03997758	42.7894001	0.1091735	69.8647641	0.00522317	122585.84	5635.60218	50.3188562	0.01713008	105.613759	0.3840364	0.38225361	0.27073411	0.0970337
PM18AJ279	E19JN26a278.csv	<0.0102	0.00694845	18.3509774	0.00332884	67.4109204	0.00211439	134286.921	6162.09003	30.1862905	0.04474278	97.9520712	0.18035364	0.11605424	0.12673071	<0.0509
PM18AJ279	E19JN26a279.csv	7.01004266	0.00674877	25.1417378	19.2971447	68.6088141	0.17017286	126761.913	5408.99172	55.3807395	0.01885716	83.2067167	2.68655672	2.7356395	2.71273764	<0.0475
PM18AJ279	E19JN26a280.csv	0.01855369	<0.00489	30.3746846	0.01897614	86.2639253	0.00528611	128121.583	6064.00486	87.3230884	0.02027151	109.493866	0.09302011	0.13996135	0.11055933	<0.0416
PM18AJ279	E19JN26a281.csv	0.03682126	0.02812125	58.3302073	0.0054339	82.7891049	0.02221838	132935.514	6190.1695	105.165114	0.00373635	79.878802	0.3068778	0.24372088	0.25359432	<0.0418
PM18AJ279	E19JN26a282.csv	0.05946698	0.05149457	55.262762	0.03160724	88.7950338	0.0193869	128754.106	6175.87831	126.430795	<0.00227	81.3386236	0.44901133	0.43451186	0.41135599	0.06369796
PM18AJ279	E19JN26a283.csv	0.02657193	<0.00575	70.3203251	0.01660097	74.7200487	0.00414601	116694.942	6016.2356	91.0654101	0.00534766	72.3148326	0.13118971	0.1513485	0.14834579	0.06526679
PM18AJ279	E19JN26a286.csv	0.13240291	0.0153247	44.2160262	0.05275486	63.2630615	0.0718153	111150.028	4883.51768	49.1970464	0.07156966	72.00739	4.47427657	4.10092192	4.45738475	<0.0881
PM18AJ279	E19JN26a287.csv	<0.00893	0.02073936	30.5126437	0.00218998	67.6911921	0.00973779	132942.847	6055.86044	37.3642746	0.00392504	69.6296782	0.17168997	0.2066571	0.20759242	<0.0418
PM18AJ279	E19JN26a288.csv	0.0363003	0.02065531	29.5648137	0.05526716	76.8884819	0.0134981	135529.286	6127.56195	40.6739788	0.00511163	117.319725	0.20577777	0.09656561	0.10516972	<0.0406
PM18AJ279	E19JN26a289.csv	<0.0114	<0.00648	16.7443674	0.01615855	65.1807316	<0.00176	122900.098	5771.63932	26.7219065	<0.00255	88.8708296	0.10059527	0.1483098	0.07305909	<0.0531
PM18AJ279	E19JN26a290.csv	0.03817632	<0.00741	53.6160636	0.0222072	83.2525316	0.0111353	134172.5	6326.66461	98.2499821	<0.00291	102.611474	0.07049975	0.13528405	0.10608888	<0.0604
PM18AJ279	E19JN26a291.csv	0.12008448	0.04994757	24.3679005	0.07467345	69.3475735	0.03516597	118637.201	5621.20361	84.9425506	0.13333064	64.447167	4.46760609	4.63630466	4.55041681	<0.0553
PM18AJ279	E19JN26a292.csv	0.04070279	0.0319974	33.8530643	0.01333758	87.3722957	0.02305744	133377.677	6214.24357	98.7160817	<0.00214	80.6020027	0.24838145	0.24356345	0.21603154	<0.0441
PM18AJ279	E19JN26a293.csv	0.02194478	<0.00498	43.7604299	0.04963629	88.0522561	0.01434917	129685.188	6306.11874	102.865862	0.00297553	79.1867885	0.17486064	0.12910618	0.14535073	<0.0399
PM18AJ279	E19JN26a294.csv	<0.0127	<0.00721	49.7372363	0.04645325	71.9365424	<0.00196	131568.244	6158.81307	53.3580918	0.03098724	83.7132882	0.05637452	0.06465129	0.05306436	<0.058
PM18AJ279	E19JN26a295.csv	0.02766301	<0.00496	32.7114131	0.04670644	77.6943413	0.0065241	132728.829	5901.89116	42.81911	<0.00195	82.163036	0.08793816	0.0759259	0.11473868	0.04515019
PM18AJ281	E19JL11a317.csv	0.04397814	0.01492447	50.4335626	0.1722354	71.6110541	<0.00221	77545.013	6635.95482	1307.14755	0.01010776	31.9508453	0.23325823	0.18602635	0.21894172	<0.0701
PM18AJ281	E19JL11a318.csv	0.02422533	<0.00831	680.04881	0.11236534	44.1463996	<0.0024	58488.4023	4687.24301	21543.338	0.00477035	24.0443706	0.34783785	0.39963459	0.37344287	<0.0763
PM18AJ281	E19JL11a320.csv	0.05176819	<0.0132	37.8673022	0.20735554	66.3850142	<0.00381	74293.339	6638.62381	933.71	<0.00535	34.7185375	0.23904556	0.26274307	0.26866109	<0.121
PM18AJ281	E19JL11a327.csv	0.04940438	<0.00719	34.2021503	0.20578503	64.6112064	<0.00208	78967.4973	6670.80455	328.309111	<0.00284	29.2612783	<0.0441	<0.0519	0.0495381	<0.0659
PM18AJ281	E19JL11a328.csv	0.06534497	0.01961589	31.9258687	0.28589234	65.1819011	0.00343295	77943.9196	6664.19283	496.461863	0.01019468	31.1417555	0.10825678	0.06430919	0.09211324	0.06769946
PM18AJ281	E19JL11a329.csv	0.19487904	0.00969919	151.343593	0.59700812	64.0606514	0.00723314	78965.8536	6653.87688	2565.42752	0.00716363	30.3260991	0.32539091	0.08437032	0.13386197	<0.077
PM18AJ281	E19JL11a330.csv	0.17805509	<0.0099	35.6179889	1.10227171	63.009899	0.01724304	81156.37	6676.50516	318.743022	0.02939838	31.9246521	0.43834377	0.38178454	0.51941722	<0.0906
PM18AJ281	E19JL11a331.csv	0.30415389	<0.00809	50.4548493	0.90420356	65.0982463	0.01942415	81114.2168	6750.82478	1104.4682	0.01251874	36.1387477	0.12790382	0.19388553	0.14340222	<0.0741
PM18AJ281	E19JL11a332.csv	0.11772576	0.00990788	22.3194243	0.55228552	69.1487716	0.00738092	78167.5739	6719.10112	144.239974	0.00790991	34.8216938	0.0973428	<0.0553	0.06546718	<0.0709
PM18AJ281	E19JL11a333.csv	0.12974027	0.01037558	21.8330139	0.55877855	68.6987083	0.00477168	77798.3916	6619.31404	520.949271	<0.00302	34.941943	0.05469727	<0.0542	0.04226379	<0.0697
PM18AJ281	E19JL11a334.csv	0.1263872	0.04309065	34.0873442	1.0005394	65.623498	0.00427401	79266.1745	6757.7357	662.631989	<0.0028	30.7395165	0.12370451	0.12886834	0.14328075	0.15847567
PM18AJ281	E19JL11a336.csv	0.31168806	<0.00715	22.6975083	1.20161633	64.109584	0.01225385	77388.3933	6651.52209	55.2370904	0.00738198	39.7157183	2.24850662	2.13076979	2.09294165	<0.0655
PM18AJ281	E19JL11a337.csv	0.05460935	0.04110675	22.5174333	0.59420415	57.1804505	<0.0025	79803.8853	6838.57288	14.26218	0.00682466	52.9821662	0.13928829	0.07022586	0.10180944	<0.08
PM18AJ281	E19JL11a338.csv	<0.0156	0.03425157	29.0376406	0.28971205	66.0875626	<0.00259	81325.444	6912.6399	376.622522	<0.00358	30.3030536	0.53056953	0.29505609	0.3208907	<0.0826
PM18AJ281	E19JL11a339.csv	<0.0128	0.03242255	49.7145137	0.40977864	66.658091	<0.00213	75867.9538	6783.54494	387.045151	<0.00294	30.23867	0.20847019	0.20220849	0.21441646	<0.0678
PM18AJ281	E19JL11a341.csv	0.2731907	0.01365225	30.7403667	0.85124908	62.9129243	0.02380396	79357.5491	6656.08457	402.12876	<0.00294	34.2236031	0.06963678	0.08111486	0.08590154	<0.0681
PM18AJ281	E19JL11a342.csv	0.02537335	<0.0078	80.9595532	0.18684654	62.2214498	<0.00225	73593.2371	6276.12054	6281.11915	0.01160769	28.9705597	0.25592119	0.17163847	0.325467	<0.0719
PM18AJ283	C19AU08C259.csv	0.06425342	0.01014972	13.6594746	<0.00184	34.5791269	0.00275261	132732.798	2568.58506	34.0315293	0.00614392	116.291587	0.05356452	<0.00837	<0.00198	<0.102
PM18AJ283	C19AU08C261.csv	<0.00881	<0.0032	16.9250744	0.00372275	29.1169485	<0.0014	133692.924	2703.67656	49.7940041	<0.0019	113.519169	0.05750371	<0.00809	0.00412182	<0.101
PM18AJ283	C19AU08C262.csv	0.01312361	<0.00322	10.051476	<0.00185	32.9784752	0.00172074	131573.885	2738.25295	27.1838084	<0.00191	129.034904	0.06831191	<0.00805	0.00519296	<0.102
PM18AJ283	C19AU08C264.csv	<0.00891	0.0242881	15.1971214	0.00661641	33.7274729	0.00717214	133181.804	2936.1451	51.8963764	<0.00189	131.794463	0.07171099	<0.00786	0.00220784	<0.101
PM18AJ283	C19AU08C266.csv	0.01338086	0.01033553	19.6503217	0.00371261	25.1692688	0.00280888	135890.36	3050.91807	28.3504359	<0.00184	125.993554	0.07392323	<0.00762	<0.00199	<0.101
PM18AJ283	C19AU08C267.csv	0.22345177	0.07367219	46.8020429	<0.00218	36.1741917	0.01677709	132755.605	2671.66827	165.285548	0.07145597	94.7652819	<0.0409	<0.00879	<0.00232	<0.121
PM18AJ283	C19AU08C268.csv	0.07205248	0.01151953	15.9207741	0.00720042	35.1399049	0.00316505	135343.363	3047.24266	31.5272953	<0.00192	145.516088	0.08883242	<0.00782	0.00701232	<0.106
PM18AJ283	C19AU08C269.csv	0.15071432	0.12858497	29.7736172	0.04226745	43.2949155	0.02433806	128293.379	2925.71769	95.3276692	0.02216025	130.719972	0.17371527	<0.00731	0.00814127	<0.101
PM18AJ283	C19AU08C270.csv	0.02160948	<0.00333	26.0604368	<0.00194	40.2892749	0.00295144	132238.788	2967.32817	84.7908597	<0.00192	120.906823	0.14947338	<0.00771	<0.00211	<0.108
PM18AJ283	C19AU08C272.csv	<0.0125	0.0275316	19.7991344	<0.00258	29.2221193	<0.00199	132591	2985.16975	162.639805	0.01626885	138.049064	0.07489974	<0.0102	0.00697748	<0.144
PM18AJ283	C19AU08C273.csv	0.03129998	<0.00431	24.3826317	0.00609365	37.819721	0.02354625	132891.443	3040.82077	353.38663	0.01955939	146.60869	0.23079143	<0.00979	<0.00271	<0.143
PM18AJ283	C19AU08C280.csv	0.40068464	0.06333978	46.5984482	0.09003564	38.7873437	0.04317643	129270.99	2947.79797	174.944184	0.08714154	129.096287	0.09738065	<0.00736	0.0194574	<0.104
PM18AJ283	C19AU08C281.csv	0.01285487	<0.00314	14.8392962	<0.00184	37.105494	0.00606017	134999.215	3040.21956	30.0462725	0.01006762	131.013566	0.10937165	<0.00743	0.00252329	<0.104
PM18AJ283	C19AU08C284.csv	0.01742398	<0.00392	71.2632825	0.00824972	46.3259675	0.01261597	133378.736	3035.25875	169.832556	<0.00211	133.256692	0.07528073	<0.00963	0.00856321	<0.133
PM18AJ283	C19AU08C285.csv	0.05055192	0.04296426	39.5581768	0.01431006	30.8104823	0.0070232	134079.166	2876.86469	92.4038762	0.02659967	121.505666	0.12704172	<0.00779	<0.00202	<0.104
PM18AJ283	C19AU08C286.csv	0.01328614	<0.00315	36.3516331	0.0065808	28.2287006	0.00591115	138498.642	2994.95507	65.2931761	0.00649206	124.219088	0.06840046	<0.00797	<0.00203	<0.105

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ285	E19JL15a105.csv	<0.0134	<0.00798	363.769381	0.00372368	113.611267	<0.00243	123894.088	1641.80923	2900.83925	0.03285417	303.300033	0.21108932	0.2777278	0.20753754	<0.0814
PM18AJ285	E19JL15a106.csv	0.0250477	<0.0067	450.446078	0.00697737	82.8980968	<0.00204	125728.648	1747.04646	49.2161316	0.00503814	503.709244	1.22861374	1.20844427	1.20747279	<0.0682
PM18AJ285	E19JL15a107.csv	<0.011	<0.00656	198.84734	0.00265887	89.5125905	<0.002	129047.574	1445.72261	1478.61557	<0.00267	307.316706	<0.0514	<0.0562	<0.0371	<0.0666
PM18AJ285	E19JL15a108.csv	0.01923045	<0.00669	251.098795	0.00657423	85.1404501	0.00217357	126655.132	1547.68925	82.8573295	0.01148667	251.683896	<0.0523	<0.0565	<0.0373	<0.0686
PM18AJ285	E19JL15a109.csv	0.02828727	<0.00847	327.320583	0.01300591	141.367263	<0.00257	125678.223	2023.43286	194.477384	<0.00344	572.297052	<0.0661	<0.0712	<0.0471	0.116453
PM18AJ285	E19JL15a110.csv	0.04465862	0.00782314	217.810742	<0.00208	75.9163056	0.00398904	133643.528	1462.04183	46.0536425	<0.00272	163.336197	<0.052	<0.056	0.05068073	<0.0673
PM18AJ285	E19JL15a112.csv	<0.0169	<0.01	55.2741003	<0.00313	251.405739	<0.00304	121934.491	2038.77753	156.667081	<0.00408	3472.2392	<0.078	<0.0837	<0.0555	<0.101
PM18AJ285	E19JL15a113.csv	0.01166893	0.00767296	281.299845	<0.00181	98.1624772	0.00307874	114075.312	1680.35235	8578.35723	<0.00235	285.703417	<0.0451	<0.0484	<0.0321	<0.0582
PM18AJ285	E19JL15a114.csv	0.20826018	0.05040827	277.972415	0.03228809	93.6184364	0.0159399	123776.871	1858.17539	983.207095	0.13394434	286.566196	<0.0428	<0.0458	0.03776422	<0.0552
PM18AJ285	E19JL15a116.csv	0.0751346	0.02148683	367.788545	0.01536221	177.609724	<0.00207	132862.256	1812.4634	328.136494	0.06082605	575.538138	<0.053	<0.0566	<0.0376	<0.0701
PM18AJ285	E19JL15a117.csv	0.01059117	<0.00557	331.015678	<0.00172	82.7983413	0.00241245	126034.503	1481.59184	44.1371522	0.01606734	172.751016	<0.043	<0.0458	<0.0305	<0.0554
PM18AJ285	E19JL15a118.csv	0.23430236	0.00761015	467.629987	0.01807684	105.175343	0.0126098	125934.541	2061.49001	443.029321	0.03714775	304.459345	0.1293249	0.09284895	0.15983191	0.07655846
PM18AJ285	E19JL15a119.csv	0.31442554	0.0205365	250.810961	0.09428604	92.6321796	0.02186664	129861.579	1649.93213	874.599883	0.10491389	198.766951	<0.0467	<0.0497	<0.0331	<0.0602
PM18AJ285	E19JL15a120.csv	0.01538735	<0.00618	260.975461	<0.00191	185.468351	<0.00186	133161.09	1828.09675	67.6151087	0.0121655	429.586596	<0.0476	<0.0506	<0.0337	<0.0613
PM18AJ285	E19JL15a121.csv	0.05856252	<0.00602	133.393085	0.0058327	155.957924	0.0024995	135139.436	2150.62134	88.9003737	0.01556114	390.662494	<0.0462	<0.0491	<0.0327	<0.0596
PM18AJ285	E19JL15a122.csv	<0.00942	<0.00559	202.133204	0.00466368	116.777533	<0.00168	124970.614	2260.67248	108.171428	0.01113957	387.61848	<0.0429	<0.0456	<0.0304	<0.0553
PM18AJ285	E19JL15a123.csv	0.02030584	<0.00666	229.223778	0.0092209	133.062369	0.00247474	129687.794	2158.24812	145.12755	<0.00264	403.664969	<0.0511	<0.0542	0.03837645	<0.0659
PM18AJ286	E19JL15a245.csv	0.48833161	0.04930059	84.1162684	0.85024871	137.146161	0.00640466	75825.7694	3770.92391	84.1913876	<0.00443	51.8948506	0.32060721	0.18505913	0.2070536	<0.105
PM18AJ286	E19JL15a246.csv	0.05560697	0.02519999	70.1919446	0.02632197	121.437482	0.00409608	77442.93	3658.16434	42.916579	0.00302413	48.5932428	0.19562606	0.20256756	0.19907938	<0.0557
PM18AJ286	E19JL15a247.csv	0.03007121	0.05080726	61.4283347	0.02528338	117.032189	0.00456756	84301.1265	4015.11646	48.8926653	<0.00224	58.2536829	0.23267095	0.21681402	0.21943872	<0.0531
PM18AJ286	E19JL15a248.csv	0.04220189	0.0285643	111.395541	0.0521429	112.517577	<0.0016	90180.4754	4643.35494	75.4507603	0.0042624	68.4999486	0.26527128	0.31757302	0.26425016	<0.0524
PM18AJ286	E19JL15a249.csv	0.03957617	0.01287574	128.734527	0.03063995	114.269177	0.00722211	88674.8214	4801.8828	83.5227852	<0.00222	67.855354	0.22361217	0.18896533	0.26351407	<0.0524
PM18AJ286	E19JL15a250.csv	0.05637451	0.02302554	127.150441	0.04721931	111.863888	0.00539219	88881.9777	4720.65722	92.8559487	<0.00223	70.6580969	0.26152985	0.23632809	0.26201295	<0.0527
PM18AJ286	E19JL15a251.csv	0.02997677	0.02707369	233.199053	0.0403626	108.799181	0.00387689	88563.1108	4657.84525	142.04384	0.00997711	68.46835	0.27236174	0.3269432	0.31272879	<0.0521
PM18AJ286	E19JL15a253.csv	0.05913587	0.04525779	104.054856	0.05884566	121.971961	0.00178941	81090.1547	3885.84734	58.5241268	0.01301704	55.1645927	0.38237482	0.39745697	0.40122882	<0.0522
PM18AJ286	E19JL15a254.csv	0.02137462	0.04418218	62.872052	0.07835023	103.575463	0.0070897	82822.8886	4238.78364	49.39583	0.17236888	68.2849011	0.19422178	0.25087371	0.23384592	0.0800844
PM18AJ286	E19JL15a256.csv	0.0451473	0.06497184	180.111722	0.06188455	107.778101	0.01145697	86347.0298	4528.2053	123.232345	0.00708326	67.3797813	0.35958383	0.35046363	0.31424386	<0.0532
PM18AJ286	E19JL15a257.csv	0.06035866	0.06987078	228.408589	0.09091186	99.7321905	0.00941698	86293.7631	4458.73196	117.718309	0.01946867	65.7333715	0.76236249	0.81611791	0.83717473	0.12394204
PM18AJ286	E19JL15a258.csv	0.01499397	<0.00597	172.513736	0.04849223	60.0017681	<0.00162	74104.4074	4389.72087	267.033163	0.04115379	61.2173018	0.2172725	0.15881573	0.2171802	<0.0533
PM18AJ286	E19JL15a261.csv	0.07183969	0.03261657	163.117417	0.0849399	101.211636	0.0089021	89512.2238	4917.96546	119.557795	0.06733343	77.7239213	1.04660074	1.06065272	1.02007892	0.09685571
PM18AJ290	E19JL15a188.csv	0.10168027	<0.0122	476.583691	0.01967184	45.6893217	0.0057572	101855.523	4358.29998	57.0472736	<0.00472	59.7331083	<0.0807	<0.0955	<0.0576	<0.12
PM18AJ290	E19JL15a189.csv	0.04479584	<0.00559	22.3343041	0.04911702	42.1860136	0.00693147	103433.229	4485.46201	105.454728	0.00273348	85.0794745	0.3255127	0.38933548	0.40279277	0.14324279
PM18AJ290	E19JL15a191.csv	<0.00958	<0.00565	44.2923415	0.00818741	50.6626633	<0.00161	107364.644	4882.54747	66.4884517	0.00715954	54.7193026	0.09365409	0.06916951	0.09627675	<0.0551
PM18AJ290	E19JL15a192.csv	0.01456715	<0.00556	31.7490951	<0.00159	52.3462335	0.00651177	108290.783	4930.74239	29.5118396	<0.00215	58.8070961	<0.0362	<0.043	0.02773234	<0.0541
PM18AJ290	E19JL15a194.csv	0.01690262	<0.00862	36.6015906	<0.00258	50.0342221	<0.00245	111047.356	5076.38509	17.4980433	<0.00348	47.0141347	1.06737737	1.20086668	1.24635462	0.11292486
PM18AJ290	E19JL15a195.csv	0.01016403	<0.00562	33.6232761	0.00590589	48.8501835	0.00378878	105752.336	4888.94122	17.1265609	0.00388189	45.1946297	<0.0361	0.0679177	<0.0256	<0.0544
PM18AJ290	E19JL15a196.csv	<0.0137	<0.00807	24.0965214	<0.00225	45.389331	<0.00229	109805.914	5395.822	10.8122405	<0.00303	50.7235707	<0.0516	<0.0615	<0.0367	<0.0759
PM18AJ290	E19JL15a197.csv	<0.00925	0.00793628	21.6554045	0.01816639	40.8901699	0.01391447	101891.617	4152.59234	24.481909	0.00655491	58.1478467	<0.0347	<0.0414	<0.0247	<0.0526
PM18AJ290	E19JL15a198.csv	0.10211546	0.01863454	15.1407708	0.07772367	45.9226515	0.00376061	105078.16	4752.38277	18.0313187	<0.0025	52.8689766	<0.0411	<0.049	<0.0292	<0.0624
PM18AJ290	E19JL15a199.csv	<0.0103	<0.00613	15.5122614	0.02090506	46.9395133	<0.00174	103760.638	4590.29845	13.0184503	<0.00234	47.3525179	0.04124377	<0.0462	<0.0275	0.08153212
PM18AJ290	E19JL15a200.csv	0.01472731	<0.00552	47.4872533	0.02773867	45.1701568	0.00173962	103604.798	4431.27698	24.5314603	<0.00214	61.9432306	0.03929755	<0.0413	<0.0246	<0.0528
PM18AJ290	E19JL15a201.csv	0.0094556	<0.0054	24.8685603	0.00734322	41.0910527	<0.00152	102710.647	3869.77609	19.3091025	<0.00207	66.6789451	0.04298105	<0.0403	0.02523977	<0.0515
PM18AJ290	E19JL15a202.csv	0.02863026	<0.00543	35.0614979	0.02729309	42.9581955	0.00235958	103670.207	4152.7684	21.1979333	<0.00211	68.1240806	<0.0337	<0.0403	0.03419271	<0.0517
PM18AJ290	E19JL15a203.csv	<0.00921	<0.00542	25.1189078	0.03223527	59.9538037	0.0029434	99712.9375	3476.1425	91.6443674	<0.00208	95.5795304	0.04072009	<0.0401	0.04710917	<0.0516
PM18AJ290	E19JL15a204.csv	0.05768785	0.04043319	51.1709385	0.14461161	39.111224	0.01095815	102340.864	3714.97808	66.9904674	0.00551463	77.6471493	0.16096174	0.23294951	0.20657765	<0.0505
PM18AJ290	E19JL15a205.csv	0.01478544	<0.00639	19.2792634	0.00302079	44.2820505	0.0083088	105705.772	4376.59086	22.1656406	<0.00243	55.7514979	<0.0393	<0.0469	0.03654681	<0.0599
PM18AJ299	E19JL11a271.csv	<0.0192	<0.0105	11.54042	0.00722577	61.2287742	<0.00318	95619.8569	8772.86736	<8.28	0.15654606	19.1407904	0.30131234	0.39000465	0.70705482	<0.097
PM18AJ299	E19JL11a276.csv	<0.0159	<0.00902	19.8185576	<0.00287	55.2644807	<0.00264	93905.4069	9609.22789	<7.08	<0.0034	24.019886	0.19409797	0.11405685	0.1646099	<0.0806
PM18AJ299	E19JL11a277.csv	<0.011	<0.00625	18.9398386	<0.00199	65.0535919	0.00242413	104884.532	6551.9893	8.44291025	0.01239018	24.6010577	0.52200246	0.50572221	0.51518424	<0.0558
PM18AJ299	E19JL11a278.csv	<0.0132	0.01186765	16.3433805	<0.00238	58.7140825	0.00215234	93837.6016	9535.34171	<5.80	0.01482881	23.4662859	0.20566371	0.15661356	0.23093739	<0.0668
PM18AJ299	E19JL11a279.csv	0.0170929	<0.00677	12.7347732	0.00608623	59.2948545	<0.00198	90232.3705	9146.60344	5.4644018	0.02288237	17.0112796	0.49813657	0.42192949	0.36728518	<0.0609
PM18AJ299	E19JL11a281.csv	0.10381534	0.00926239	15.1810125	0.02654316	56.8567276	0.00480606	90320.1945	10528.3442	6.99857239	0.29520604	16.5691098	0.57090605	0.42797986	0.56217258	<0.0551

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ299	E19JL11a282.csv	<0.0107	0.02532224	18.7697162	0.00312428	57.775615	<0.00177	86937.7307	8865.10986	7.77689123	<0.00237	25.0470578	0.5397318	0.53291066	0.55800712	<0.0542
PM18AJ299	E19JL11a283.csv	<0.0113	<0.00642	132.202443	0.01212176	53.701475	0.00341652	97012.7778	8236.9073	21.2344501	0.00719877	13.4678752	1.53908828	1.60354949	1.69188626	0.09946836
PM18AJ299	E19JL11a284.csv	0.01405954	0.00817384	15.8237234	0.01298544	61.9563925	<0.0018	91838.9462	10065.196	5.73266084	<0.00244	19.4110488	0.42930813	0.45805624	0.42276404	<0.0552
PM18AJ299	E19JL11a285.csv	0.0587915	0.01075312	16.6330437	0.08199068	60.577254	0.00313574	93288.5388	11026.0621	8.07865548	<0.00362	23.0634128	0.44950666	0.50407883	0.50100153	<0.0806
PM18AJ299	E19JL11a287.csv	0.1259577	0.01225428	79.155718	0.38006718	52.8442312	0.00357397	95048.2481	6604.4291	23.6112837	0.00906719	15.6646498	2.41215695	2.7548319	2.5567577	0.58028457
PM18AJ299	E19JL11a289.csv	<0.0115	<0.00655	22.7385676	0.03819866	50.6940186	0.0026069	78714.3723	9756.48788	<5.02	<0.00255	42.2515949	1.83393591	2.01999535	1.86601984	<0.0585
PM18AJ299	E19JL11a290.csv	0.01374146	<0.00632	22.9838905	0.02134208	57.2628538	<0.00184	92079.3808	9378.97691	8.67402892	<0.00248	17.376139	1.0186049	0.92891889	0.96017127	<0.0569
PM18AJ299	E19JL11a291.csv	<0.0164	0.03879693	45.6255297	0.01559193	60.1218121	0.00816573	90600.3877	9409.82029	11.6654549	<0.00365	17.1847862	1.65936253	2.46715355	1.87512859	<0.0839
PM18AJ299	E19JL11a292.csv	0.04633759	0.03262473	43.9350436	0.05463688	54.3006744	0.00402799	79883.576	9206.00631	9.21785457	0.00269186	11.410312	2.42709501	2.48910253	2.480663	<0.0566
PM18AJ302	E19JL15a207.csv	2.96829176	0.03534447	68.1214834	9.45261946	141.4173	0.12733354	94556.8619	4307.92566	155.756432	0.08757344	24.2570621	9.78088941	9.63823432	9.46493739	0.12106005
PM18AJ302	E19JL15a208.csv	4.68992265	<0.0118	81.3082736	12.7604159	158.673908	0.32269345	96873.4623	3949.76878	172.928613	0.20627123	34.0648408	28.0539658	29.3554601	28.6066984	<0.111
PM18AJ302	E19JL15a215.csv	5.11601143	0.0633195	87.6644732	13.9692367	149.878433	0.37653578	101227.451	3501.02916	159.515474	0.33732825	30.2072778	15.1436209	15.5903864	14.3918532	0.21712817
PM18AJ302	E19JL15a216.csv	5.29027612	0.046649	106.049348	14.0956851	148.355253	0.26368248	94308.3686	3645.7933	148.580552	0.12406127	24.1378538	12.2149326	11.8094051	11.8686959	0.07909157
PM18AJ302	E19JL15a217.csv	4.59221573	0.05515467	92.2857898	14.1620622	100.558326	0.13355262	100788.23	2597.84169	72.9726753	0.13421913	21.7208661	12.8314113	12.8755542	12.9636235	<0.047
PM18AJ302	E19JL15a219.csv	1.80112021	0.11972214	90.0563261	5.71463621	109.501032	0.10518998	97485.4823	2974.00852	45.025393	0.10869475	16.4703659	66.4142606	67.3454279	66.3693217	0.09004776
PM18AJ302	E19JL15a220.csv	0.8640155	0.02936137	79.287341	3.01467593	127.81796	0.05836758	92222.8175	3421.15981	19.928295	0.05990435	23.8451688	13.6221354	13.0562196	13.395082	<0.0493
PM18AJ302	E19JL15a221.csv	1.33815584	0.05558437	62.8451215	4.18143731	128.42991	0.1058415	92599.0634	3459.83728	28.2329206	0.06177503	24.3681016	61.1158131	60.630689	61.0479835	<0.0488
PM18AJ302	E19JL15a222.csv	1.50249688	0.04953529	72.7627905	4.86284685	130.186366	0.03026282	93260.8101	3520.53625	25.8908184	0.06894344	24.7254082	5.0160454	4.99626684	4.95675388	<0.0617
PM18AJ302	E19JL15a223.csv	0.37583814	0.02114518	83.8018414	1.21815693	131.609757	0.02616246	94392.3736	3587.0279	18.6777539	0.02384931	18.53436	5.5576187	5.87002304	5.62408031	<0.0502
PM18AJ302	E19JL15a224.csv	0.10157585	<0.00584	16.5294073	0.60291164	97.0243736	0.01486978	97805.6485	3108.29534	12.3229381	0.00859167	19.1312687	5.53055349	5.32244051	5.24354431	<0.0532
PM18AJ302	E19JL15a225.csv	0.02488629	<0.0062	22.4503849	0.33924391	105.647943	0.00187398	82472.9255	3430.00764	47.7888887	<0.00233	13.9383005	2.20197793	2.24658568	2.28405314	<0.0557
PM18AJ302	E19JL15a226.csv	5.90901613	0.01521061	56.5154577	16.0096214	146.882881	0.34253438	95974.8167	3367.57956	107.318183	0.07586415	27.1748033	21.3739545	21.1311063	21.0993362	0.16779105
PM18AJ302	E19JL15a228.csv	0.22080262	0.01262142	60.4897239	0.91258051	125.119022	0.01489905	90194.027	4164.54317	7.51027528	0.03616146	23.7870574	4.42693314	4.42098524	4.32718941	<0.0504
PM18AJ302	E19JL15a229.csv	0.27425901	0.01725762	14.8420775	1.15303392	141.613882	0.03603428	98223.5112	2500.96242	15.3043721	0.0274207	17.8873145	36.3253087	35.8304498	36.1880436	<0.0499
PM18AJ302	E19JL15a230.csv	0.26711799	<0.00551	44.8076081	0.99824852	113.609775	0.01018671	93443.0423	2482.73103	26.9402596	0.04034925	22.3469572	6.44558274	6.26363585	6.60143689	<0.0498
PM18AJ302	E19JL15a231.csv	4.81193768	0.01974804	70.9339039	13.4628045	144.111284	0.22741527	94680.3782	3961.78316	154.011658	0.20919004	28.8656756	18.1479999	17.8770238	17.9567911	0.04693217
PM18AJ304	E19JN25a065.csv	0.02988735	0.01750671	425.075595	0.01827762	47.674663	<0.0013	114287.359	6843.1164	253.451193	0.0210262	28.1294642	0.06019927	<0.0589	0.07520536	<0.0629
PM18AJ304	E19JN25a066.csv	0.04504822	<0.0056	54.4556455	0.01171812	50.4652282	0.01283375	125493.197	6218.06031	109.010536	0.05069886	26.7562148	0.09603096	<0.076	0.05415403	<0.0811
PM18AJ304	E19JN25a067.csv	0.15227655	0.08995054	60.0484639	0.2656182	55.638546	0.01152953	114298.195	6435.68128	92.1033003	0.07270367	26.2538534	2.39306298	2.30324668	2.38576498	<0.0674
PM18AJ304	E19JN25a069.csv	0.02524784	0.01111033	116.30309	0.07298201	67.8608102	<0.00181	112166.922	8278.52209	57.1985226	0.01786917	26.8255802	0.16888922	<0.081	0.12205427	<0.0866
PM18AJ304	E19JN25a071.csv	0.01956095	0.05093474	83.0288812	0.00455432	64.4356879	0.00544562	107903.546	8732.30415	26.5593457	0.02433426	29.8248435	0.74272107	0.62839237	0.7672159	<0.0617
PM18AJ304	E19JN25a072.csv	0.02833353	0.05592871	88.3673631	0.01255555	59.9255041	<0.00181	108597.743	8227.31256	27.058684	0.02141262	39.117071	0.13652782	<0.0806	0.15301524	<0.0858
PM18AJ304	E19JN25a086.csv	0.0632837	0.01310977	41.9117394	0.0238275	42.8225835	0.0083591	116330.508	6931.249	35.4936485	0.0151895	39.9894015	0.07646986	0.06658774	0.14259655	<0.0591
PM18AJ304	E19JN25a087.csv	0.06957399	<0.0043	33.1263995	0.05246246	51.5500504	0.00920905	127952.022	5142.54755	85.2890417	0.01167973	45.4030039	0.10509809	0.05942936	0.17622832	<0.057
PM18AJ304	E19JN25a088.csv	0.0459142	0.0122654	33.5197824	0.0567609	53.2530987	0.01268723	125666.445	5340.24656	47.5523073	0.028126	46.8105305	0.11415359	0.0687273	0.17094223	<0.056
PM18AJ304	E19JN25a089.csv	<0.0143	0.15313868	42.6561071	0.02060631	59.5838743	0.00671787	112038.492	7321.59582	37.8394744	0.015819	28.3431815	0.46545594	0.34633154	0.48677902	<0.0969
PM18AJ304	E19JN25a090.csv	0.03785953	0.02937472	53.6381416	0.04590636	60.2717323	0.01053295	113965.583	6888.62624	147.790578	0.03738294	34.5458973	0.15871114	0.08108843	0.14131852	<0.0571
PM18AJ304	E19JN25a091.csv	<0.0154	0.1776392	557.197395	0.06208054	74.9513579	0.0123754	103360.217	7314.31124	57.4163951	0.18267501	23.1079482	<0.0886	<0.0956	0.09562414	<0.104
PM18AJ304	E19JN25a092.csv	0.05145128	0.05013002	45.8884812	0.02639469	44.9259766	0.01109971	116108.818	6359.13893	39.6837459	0.04001925	36.2458429	0.10845864	<0.0524	0.12603071	<0.0566
PM18AJ304	E19JN25a093.csv	0.05088938	0.0300073	39.460682	0.02287148	47.1658529	0.01674965	119100.306	6036.2624	31.4381958	0.06015963	34.7603249	0.13011767	0.07142514	0.14344679	<0.0563
PM18AJ304	E19JN25a095.csv	0.33079053	0.02378349	59.9952037	0.6695126	52.9014326	0.03397438	120165.793	5337.31957	96.6755748	0.0260334	36.4418977	0.12067228	<0.0761	0.22385601	<0.0846
PM18AJ304	E19JN25a096.csv	0.05561541	0.01655588	24.6392812	0.01924817	50.2089028	0.01162989	124112.536	5515.95413	36.9666008	<0.00249	39.1402132	0.07775545	<0.0515	0.13551867	<0.0558
PM18AJ304	E19JN25a097.csv	0.06789422	0.0584792	29.4834115	0.00992784	46.7875008	0.01623602	117110.861	5856.03604	58.5651011	0.04009477	38.2253841	0.13410699	0.17046542	0.25726328	<0.0706
PM18AJ304	E19JN25a101.csv	<0.0099	0.02937244	58.0866809	0.04689405	39.395598	0.01028547	115078.04	7617.40896	90.4588045	0.0475408	29.0503621	<0.0565	<0.0598	0.07899254	<0.0644
PM18AJ304	E19JN25a102.csv	0.06452094	0.04547485	223.00705	0.11999573	85.654251	0.00975999	100549.154	9697.05824	65.3383466	0.03680319	19.3887573	0.38393763	0.32521078	0.35579105	<0.0553
PM18AJ304	E19JN25a103.csv	<0.0118	0.01244747	94.7336325	0.01191975	42.7586436	<0.00173	112278.282	8334.52642	27.0429867	0.01945032	58.0956552	0.06617739	<0.0685	0.1054552	<0.075
PM18AJ304	E19JN25a104.csv	0.04890083	0.03642243	189.747831	0.02527465	72.9159933	0.00555349	104278.228	7037.18736	30.5736397	0.02909207	58.9511855	0.14942555	0.0991045	0.12908665	<0.0652
PM18AJ305	E19JL15a151.csv	0.35910996	0.04274081	28.2473314	0.65371167	64.5178631	0.09375479	100678.178	3873.19673	140.028762	0.02048424	63.7188056	<0.0381	0.05235666	0.055822	<0.051
PM18AJ305	E19JL15a152.csv	0.31049473	0.06023321	30.591984	0.52407578	65.1402222	0.09669254	102478.956	3739.21667	141.290138	0.00337214	65.2510089	0.0765063	<0.04	0.06346127	0.05828845
PM18AJ305	E19JL15a153.csv	0.49650331	0.08361085	27.6671234	0.56252505	65.9078669	0.12979872	102719.751	3834.04291	131.86039	0.03350395	63.5650999	0.07948095	0.06214413	0.07492912	<0.0509
PM18AJ305	E19JL15a154.csv	0.38247999	0.04297962	37.2042231	0.59542417	66.4270841	0.13059805	104080.868	3720.01076	143.99941	0.01097936	69.4809149	<0.0418	0.0680327	0.0426019	<0.0562
PM18AJ305	E19JL15a155.csv	0.42453523	0.02395005	31.0694162	0.56033285	62.2241201	0.09686967	99158.7554	3898.85745	145.459103	0.00744362	60.764688	0.07953146	<0.0428	0.03785306	<0.0523

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Gd157	Hf178	K39	La139	Li7	Lu175	Mg24	Mn55	Na23	Nb93	Ni60	Pb206	Pb207	Pb208	Sb121
PM18AJ305	E19JL15a156.csv	0.4967111	0.0951748	32.2439982	0.5426773	62.7031169	0.05065479	102351.513	4095.98634	173.384189	0.0498908	62.6124299	0.11367137	0.09853809	0.13775485	<0.0732
PM18AJ305	E19JL15a157.csv	0.42527511	0.02311291	51.1219268	0.68347614	66.0957153	0.10227557	102071.635	4052.68587	183.359049	0.03454239	67.9736859	0.07870104	<0.0418	0.07676979	<0.0512
PM18AJ305	E19JL15a158.csv	0.638413	0.05188582	53.4470671	0.60841471	69.4149827	0.14445071	104494.619	3877.89384	162.043172	0.01051267	71.0604129	0.08723123	0.08384487	0.11182928	0.05818507
PM18AJ305	E19JL15a159.csv	0.39638831	0.07605374	33.2630984	0.59520612	66.3130281	0.12906123	102373.639	3817.1125	165.152878	0.00951852	66.160956	0.09061458	0.0577111	0.0611781	<0.0563
PM18AJ305	E19JL15a160.csv	0.3136935	0.09338824	51.3348957	0.69804698	62.7870506	0.09582264	99363.808	3998.26884	213.728374	0.01904079	64.1713988	0.05138378	<0.042	0.02934415	<0.0517
PM18AJ305	E19JL15a161.csv	0.41802143	0.08741204	33.3444673	0.64696693	64.453999	0.08070237	101560.809	3969.64694	159.060954	0.02110981	61.7365377	<0.0384	<0.0431	0.04466538	<0.0527
PM18AJ305	E19JL15a162.csv	0.43655401	0.10978311	37.1522365	0.62077688	64.2494464	0.10545434	102002.058	3926.00735	149.421416	0.04128237	63.9742049	<0.0371	<0.0417	0.0680077	<0.0512
PM18AJ305	E19JL15a163.csv	0.63449287	0.07611232	34.1373322	1.23135906	57.6247552	0.1207131	90674.2737	3300.65568	125.216976	0.0111471	56.7734539	0.08590386	0.05453237	0.10008004	<0.0663
PM18AJ305	E19JL15a164.csv	0.42595494	0.06075059	28.1408101	0.99020631	61.2975919	0.10709114	97920.5857	3812.68714	171.835902	0.01929483	62.9138155	0.04749064	<0.0407	0.06098975	<0.0499
PM18AJ305	E19JL15a165.csv	2.45836204	0.03247334	37.5366028	5.67116023	65.0798581	0.19627903	102067.268	3873.765	179.506234	0.0427575	66.01949	0.10188618	0.06483053	0.12106361	<0.0748
PM18AJ305	E19JL15a166.csv	0.36576028	0.06891126	42.8671889	0.72295667	62.5261375	0.07799355	100172.209	3911.7455	229.1876	0.01124177	63.9594109	<0.0373	0.04370813	0.03230387	<0.0519
PM18AJ305	E19JL15a168.csv	0.44469073	0.08870349	37.624592	0.63131165	64.6430767	0.14703789	106180.854	4003.5155	162.408635	0.0100047	65.004039	0.09128951	0.08718453	0.12571115	<0.0564
PM18AJ309	E19JL15a308.csv	<0.0122	<0.00709	99.4108597	0.00448382	22.2525942	0.00285063	122823.076	6419.98287	328.105328	0.00740322	667.449101	0.03760482	<0.041	<0.0275	0.20361759
PM18AJ309	E19JL15a309.csv	<0.0104	<0.00601	85.2952978	0.01033529	17.952813	<0.00157	105242.657	5353.15599	247.94133	<0.00221	693.359371	0.2779967	0.25482803	0.25712293	0.39954631
PM18AJ309	E19JL15a310.csv	<0.0105	<0.00609	65.4479716	0.0041495	17.3985105	<0.00159	120966.938	6408.51946	274.21606	0.01111882	326.52197	0.09161013	0.14855978	0.11904567	0.22790103
PM18AJ309	E19JL15a311.csv	<0.0114	0.01797042	95.6964665	<0.00171	19.1124296	0.00209233	116842.21	5892.77108	518.835249	<0.00243	313.555059	0.16400186	0.25382621	0.24846913	0.29654379
PM18AJ309	E19JL15a312.csv	<0.0119	0.01510299	78.8012303	0.00262457	26.0872338	<0.0018	114547.09	5899.90384	255.777951	0.00446821	255.97022	0.12128068	0.16449149	0.08804595	0.22414049
PM18AJ309	E19JL15a314.csv	<0.0134	0.00858048	50.7545753	0.01719583	22.9710291	<0.00202	106873.342	6088.64989	167.095101	<0.00285	336.525388	0.23340071	0.15434851	0.15434173	0.27029227
PM18AJ309	E19JL15a315.csv	<0.0131	0.01142154	90.1012489	<0.00194	40.1789642	<0.00197	131266.434	6229.90711	593.189816	0.00877075	234.448221	<0.0341	0.05474146	0.07607667	0.14346223
PM18AJ309	E19JL15a316.csv	<0.0207	0.01576441	71.5250094	0.01701448	40.4296293	0.00817487	118899.862	5814.50304	368.369633	0.02972049	293.73563	0.08919569	0.07365978	0.04879316	0.21687396
PM18AJ309	E19JL15a317.csv	<0.0112	0.01688785	68.5173428	<0.00166	38.3055103	<0.00169	132059.142	6251.84245	193.436551	0.01186328	241.943117	<0.0291	<0.0358	<0.0241	0.11299412
PM18AJ309	E19JL15a318.csv	0.02114945	<0.00594	98.7601651	<0.00152	24.3617884	0.00409916	118268.14	6881.50067	1555.60513	0.01020004	284.29017	0.30803457	0.32005956	0.29914719	0.18068432
PM18AJ309	E19JL15a319.csv	0.05029681	0.04159111	90.468279	0.16959904	24.7515152	0.00674602	120880.909	6500.92833	461.11402	0.01654208	441.294099	7.23001338	6.20619995	6.91137403	0.2098319
PM18AJ309	E19JL15a323.csv	0.04214437	<0.0101	62.0228166	0.23497541	20.4653506	0.00917633	117502.797	7064.34944	177.332925	0.10876223	323.789457	0.349064	0.51643212	0.25657044	0.19400647
PM18AJ309	E19JL15a324.csv	0.0401534	0.08704021	63.2530377	0.08310934	23.9672047	0.00539249	115961.445	6147.8419	172.487311	0.02823639	329.235418	0.28952727	0.35184617	0.43574902	0.08911302
PM18AJ309	E19JL15a325.csv	<0.0104	0.01377944	63.3630894	<0.00153	24.9770897	<0.00155	122634.394	6152.33806	394.713752	<0.00219	312.494043	0.08852358	0.05200327	0.1172031	0.20147478
PM18AJ309	E19JL15a326.csv	<0.0108	<0.00623	86.1612521	0.0076706	18.8928136	<0.00161	114339.508	6323.98539	409.967731	0.0170354	252.737165	0.19559856	0.18700845	0.22620075	0.1703123
PM18AJ311	C19AU08C197.csv	0.72485899	0.01744553	35.9428381	1.45216972	64.9382247	0.10887614	98496.1153	3082.16996	74.3623723	0.02145695	169.893795	0.21547513	<0.00982	0.09380074	<0.126
PM18AJ311	C19AU08C198.csv	1.52627406	0.12555323	41.5426699	2.75022676	68.2906497	0.14393016	98795.6163	3320.50477	84.3205768	0.08851988	167.694998	0.37931744	<0.00921	0.17223113	<0.116
PM18AJ311	C19AU08C199.csv	1.14510618	0.10449836	40.1718406	2.4122223	62.7358814	0.18115827	100974.988	3302.44596	72.4904918	0.06144425	174.06238	0.40804533	<0.0119	0.16307556	<0.156
PM18AJ311	C19AU08C206.csv	1.16239897	<0.00576	66.7146136	1.93051054	69.2569137	0.13689024	98245.2549	3343.37022	84.2275453	<0.00421	162.976535	0.39966152	<0.0171	0.19957195	<0.201
PM18AJ311	C19AU08C207.csv	0.52887479	0.09785299	50.159098	1.28066679	65.3268649	0.08972513	98029.0963	2967.1791	74.4711108	0.02761055	177.820702	0.25802376	<0.00959	0.15327239	<0.113
PM18AJ311	C19AU08C208.csv	0.59770405	<0.00487	45.3468173	1.26872208	62.4712215	0.10111807	92775.4945	3161.34834	72.6415068	0.05220878	160.876631	0.36973619	<0.0143	0.16064674	<0.17
PM18AJ311	C19AU08C209.csv	0.16076382	0.02301871	35.1325407	0.38426826	54.2189304	0.03318316	97017.6935	2551.63131	37.9537154	0.013206	151.65404	0.10098799	<0.00993	0.07129644	<0.115
PM18AJ311	C19AU08C211.csv	0.73495711	0.02257791	40.5426284	1.44138109	64.7820274	0.11973286	99052.3858	3129.03749	61.4951811	0.03601179	170.00476	0.31471292	<0.0102	0.06634548	<0.116
PM18AJ311	C19AU08C212.csv	0.73905351	0.08669079	114.578767	1.5139199	64.4065898	0.11426776	98424.6689	3088.10288	81.1395832	0.02054184	171.303532	0.26402869	<0.0102	0.23286733	<0.115
PM18AJ311	C19AU08C213.csv	1.33099929	0.10197366	129.62484	3.90543341	64.1242694	0.09456789	97661.9624	3122.7696	94.9347718	0.02824997	168.761524	0.25261895	<0.0103	0.18885953	<0.114
PM18AJ311	C19AU08C215.csv	2.13217047	0.01781741	37.9154297	4.66730766	65.3734773	0.16966348	98333.3911	3092.39525	91.7472996	0.03503706	200.233671	0.36047198	<0.0108	0.24889916	<0.119
PM18AJ311	C19AU08C216.csv	0.8581254	0.10968055	28.1247995	1.44079345	64.9746078	0.12454761	97451.2542	3165.65379	59.6432992	0.03180788	201.481009	0.17574839	<0.0103	0.18697462	<0.112
PM18AJ311	C19AU08C218.csv	1.82395333	0.02721321	61.3139911	6.75854299	62.5632002	0.15978301	97388.648	3093.88356	68.9330093	0.04967879	167.119374	0.24329001	<0.0128	0.24973044	<0.138
PM18AJ311	C19AU08C219.csv	1.39302055	0.14806306	43.4959973	2.74055154	67.3864886	0.16810855	99635.59	3282.88502	72.0757479	0.04282708	169.499402	0.37951424	<0.0105	0.21308678	<0.111
PM18AJ311	C19AU08C220.csv	0.72582368	0.00947576	59.0237667	1.81150461	68.9792052	0.10828598	99323.8634	3190.73623	70.8522568	0.01280594	205.892189	0.3213044	<0.0106	0.24646873	<0.111
PM18AJ311	C19AU08C222.csv	1.16145827	0.10058965	38.4510969	1.70822966	67.69624	0.12369794	101176.312	3121.27192	69.1537347	0.0281238	171.829541	0.43578396	<0.0107	0.07399039	<0.11
PM18AJ311	C19AU08C223.csv	0.89891245	<0.0052	53.6788079	1.4446831	68.8851075	0.11062882	94677.889	3156.34644	67.3134999	0.02587781	161.779504	0.25122691	<0.0178	0.19176765	<0.18
PM18AJ311	C19AU08C224.csv	0.79562065	0.21560951	39.8694846	2.41364604	63.9008825	0.07585981	98207.9325	3099.43088	49.8348714	0.05722098	164.685143	0.20875674	<0.0118	0.1496033	<0.121
PM18AJ311	C19AU08C225.csv	0.6433156	0.05339454	43.0011251	2.11207271	62.2165656	0.10086373	96064.3877	3084.72315	66.339549	0.02973974	171.295358	0.16189881	<0.0201	0.13775008	<0.205
PM18AJ311	C19AU08C226.csv	0.72569412	<0.00776	35.5419277	1.67411864	65.7528981	0.11929821	94099.7144	2938.85359	57.5486815	<0.00554	180.728891	0.25012588	<0.0267	0.08616733	<0.267

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ209	E19JN26a319.csv	123506.739	2.21579668	1.94934915	0.00629385	0.00653977	90.2667587	83.2755237	0.01780954	0.00941673	257.108211	1.67729911	0.0643365	595.194437	0.06657905
PM18AJ209	E19JN26a321.csv	130733.078	1.72751857	1.37847525	0.00226967	0.00707291	99.5505089	97.7128372	<0.0128	0.00630556	313.358763	1.10004276	0.03179593	597.668344	0.07701861
PM18AJ209	E19JN26a322.csv	192340.357	1.88693151	116.055149	<0.0022	0.00445701	45.2495192	45.0374339	<0.0183	<0.00247	222.706601	0.49092139	0.05478647	365.314198	0.05330938
PM18AJ209	E19JN26a323.csv	128550.834	1.53650418	1.75352373	<0.00165	0.00234886	69.2667954	72.2805159	<0.0138	<0.00181	285.616098	0.6849166	<0.0061	553.112973	0.0153062
PM18AJ209	E19JN26a325.csv	131969.215	1.59098547	1.15849205	<0.00155	0.00611081	57.8195815	56.5342357	<0.0132	0.0060914	320.822632	1.23342017	0.03318341	587.820944	0.0767698
PM18AJ209	E19JN26a326.csv	128216.241	1.6583154	1.36106248	<0.00152	0.008232	62.0416565	60.3468231	<0.013	0.02580764	350.127658	2.00061195	0.0656045	640.322223	0.13734293
PM18AJ209	E19JN26a327.csv	125649.64	1.68267981	1.0408279	<0.00186	0.00860376	219.92402	206.071572	<0.0162	0.00766353	271.603552	0.94014547	0.04907387	550.639824	0.15921123
PM18AJ209	E19JN26a329.csv	127984.36	1.6358986	1.97632452	<0.00153	0.05548735	69.1846444	68.9919674	<0.0136	0.03729568	368.917776	2.49435806	0.16381043	681.954485	1.68961876
PM18AJ209	E19JN26a330.csv	137143.795	2.24263869	1.31873106	<0.0035	0.01071572	66.3000792	58.4123665	<0.0314	0.01743224	359.269597	1.50104507	0.12613742	786.216102	0.14721058
PM18AJ209	E19JN26a331.csv	124368.131	1.74004672	1.67784598	<0.00176	0.02336719	77.0908615	79.8407505	<0.016	0.01718175	378.964989	2.07913927	0.10726916	653.399311	0.10384231
PM18AJ209	E19JN26a332.csv	128314.545	2.18754603	2.46117526	<0.00169	0.09190971	101.9802	99.5725604	<0.0155	0.03347271	328.28724	2.48620981	0.16864354	670.01249	0.31475934
PM18AJ209	E19JN26a341.csv	130668.444	2.42895786	0.49565839	<0.00164	0.00922573	230.411637	228.444208	<0.0164	0.01723709	303.260218	1.17345022	0.04902484	581.281519	0.06793341
PM18AJ209	E19JN26a345.csv	135048.411	1.79283848	1.37990832	<0.00288	<0.00359	119.748432	118.006244	<0.0301	0.006749	316.538599	0.95785319	0.02603646	607.945981	0.85160954
PM18AJ209	E19JN26a346.csv	134623.343	1.85622789	1.16867537	<0.00154	0.00896258	152.485194	151.025552	<0.0162	0.01439767	254.454906	1.60945004	0.06316256	645.151799	0.08636772
PM18AJ209	E19JN26a348.csv	124893.057	1.59361034	1.41941698	0.00477511	0.01135254	139.485135	141.21184	<0.0236	<0.00255	298.663321	1.18752709	0.01992187	554.93529	0.10788504
PM18AJ212	C19AU08C227.csv	133912.049	0.14355868	6.84780886	0.0133426		143.139576	140.092048	0.05545189		282.170119	0.12230606	0.01009269	577.357064	0.27768306
PM18AJ212	C19AU08C229.csv	133283.737	0.24693343	5.81605036	<0.00226		271.102995	278.658116	<0.0215		257.528813	0.23660549	0.02511501	497.540236	0.47792374
PM18AJ212	C19AU08C230.csv	130276.595	0.21903959	6.33431904	0.01181205		182.698392	162.407959	<0.0233		261.013071	0.17129702	0.02209118	542.1381	0.16286428
PM18AJ212	C19AU08C231.csv	131681.489	0.15060619	4.77379315	<0.00234		88.8364522	79.1171328	<0.0218		316.145278	0.10100902	0.05141949	578.993382	0.15313459
PM18AJ212	C19AU08C232.csv	134597.83	0.13406906	4.71369196	0.00249806		91.173452	93.9158952	<0.0192		276.193364	0.10592964	0.00824942	726.938046	0.05131044
PM18AJ212	C19AU08C233.csv	139186.573	<0.146	3.01285706	<0.00381		180.629748	185.375837	<0.0343		312.144305	0.62309183	0.1100003	828.402474	<0.00937
PM18AJ212	C19AU08C234.csv	138620.534	0.16337973	4.60763116	<0.00262		102.001225	103.171419	<0.0239		279.597355	1.54608326	0.12435743	544.05908	0.03943522
PM18AJ212	C19AU08C235.csv	133985.374	0.20622344	5.24427025	<0.00274		78.5207806	81.8263866	<0.0248		277.268144	3.46487029	0.22920133	463.342894	0.36749053
PM18AJ212	C19AU08C236.csv	134165.135	0.29853586	14.5140059	<0.00481		70.9012463	75.9471394	<0.0432		574.594336	3.48895378	0.11489311	486.141899	0.67909997
PM18AJ212	C19AU08C243.csv	133992.189	0.11700806	6.2707271	<0.00255		50.0998682	55.402903	<0.022		244.451092	3.14767342	0.07832416	426.62709	0.08396001
PM18AJ212	C19AU08C244.csv	129574.049	0.1171249	4.89267259	0.0156735		128.709465	126.980814	0.08423731		332.778724	0.50002977	<0.00679	541.215833	0.19646204
PM18AJ212	C19AU08C245.csv	131202.294	0.1393179	5.2444735	0.00605539		66.8870204	67.0829802	<0.0206		275.689903	0.13971223	0.0183562	902.282935	0.14624316
PM18AJ212	C19AU08C246.csv	138905.296	0.12849515	4.35158391	<0.00232		97.0068756	95.3611302	<0.0197		223.774599	0.15913989	0.03243036	552.130113	0.21001296
PM18AJ212	C19AU08C249.csv	139674.488	0.16906051	6.30162978	0.00759015		43.1653842	37.7230734	0.03588344		283.243042	0.75603692	0.02297711	509.31397	0.28111593
PM18AJ212	C19AU08C250.csv	150477.183	<0.0924	5.55927255	<0.0024		89.3060836	92.3721533	0.02241027		234.187077	0.12460772	0.03206823	581.899773	0.14354506
PM18AJ212	C19AU08C251.csv	130378.066	<0.102	6.95348664	<0.00274		89.4173513	88.9340679	<0.0229		244.73305	0.20756749	0.04325581	527.464262	0.23525577
PM18AJ212	C19AU08C253.csv	136910.439	0.15218188	4.661445	<0.00308		55.2139849	54.0797317	0.04498372		283.814603	0.15168883	0.02109132	490.322849	0.28227471
PM18AJ212	C19AU08C255.csv	134820.97	0.11263413	4.40927195	<0.00217		82.9023419	82.8645877	<0.0181		264.079548	0.30643176	0.04717554	648.890559	0.31753039
PM18AJ212	C19AU08C256.csv	123533.81	0.18626823	4.98387108	<0.00237		97.2438113	107.560182	<0.0197		359.885085	0.14723682	0.02828209	785.798281	0.06643427
PM18AJ212	C19AU08C257.csv	135128.337	0.12525327	8.00150175	<0.00221		41.8652217	41.0517242	0.04363916		275.73774	2.28259535	0.06775733	469.493123	0.38440147
PM18AJ215	E19JN26a403.csv	124511.536	1.6504792	5.81319633	<0.00154	<0.0019	145.307554	144.555885	<0.0135	0.00284125	618.349482	0.51444865	0.04120159	720.220946	0.06095116
PM18AJ215	E19JN26a404.csv	120972.214	1.40140767	6.4983221	<0.00165	<0.00202	139.09169	143.782368	<0.0141	<0.00183	628.583466	0.34112845	0.02450552	684.245163	0.0483549
PM18AJ215	E19JN26a405.csv	124555.418	1.64600487	7.29412443	0.00156151	0.00603227	150.47226	159.698278	<0.0125	0.00536172	612.847958	0.3058511	0.03076443	715.900944	0.2765692
PM18AJ215	E19JN26a406.csv	123220.528	1.55075578	3.99404404	<0.00161	<0.002	137.632495	133.344063	<0.0131	<0.00181	635.023845	0.32508514	0.02783408	628.049881	0.02221715
PM18AJ215	E19JN26a407.csv	124566.69	1.42227705	6.52955732	<0.00155	0.00255419	120.923173	119.590642	<0.0121	<0.00172	610.645095	0.33636939	0.02518922	735.448888	0.05682208
PM18AJ215	E19JN26a408.csv	123145.504	1.57648635	4.75604359	<0.00157	0.00401738	162.733843	163.917266	<0.0121	<0.00176	688.090946	0.08034658	<0.00584	715.339575	0.05188863
PM18AJ215	E19JN26a409.csv	124106.998	1.50987613	4.42302888	<0.00156	<0.00192	153.874093	149.889427	<0.0117	<0.00174	621.244828	0.34315542	0.00636596	700.619802	0.06594705
PM18AJ215	E19JN26a410.csv	123150.192	1.48066692	3.93384663	<0.00158	0.00402002	152.611855	155.436363	<0.0115	0.00488003	619.4639	0.28940378	0.01120317	715.902933	0.04681442
PM18AJ215	E19JN26a411.csv	120438.994	1.36777851	4.07554985	<0.00161	<0.00198	166.313955	167.945921	<0.0114	0.00420048	607.163612	0.20674506	0.00744913	693.6312	0.02564054
PM18AJ215	E19JN26a412.csv	118226.711	1.48900757	4.5952166	<0.00176	0.00301778	155.359767	157.69967	<0.0121	0.00267133	617.696405	0.19183177	0.01337711	658.305078	0.00723723
PM18AJ215	E19JN26a413.csv	124902.468	1.5802198	5.12129606	0.00398943	<0.00191	144.904837	145.977641	<0.0103	<0.00173	615.378378	0.07265125	0.01927164	728.486815	0.0409041
PM18AJ215	E19JN26a414.csv	119947.304	1.48003921	5.576866	<0.00167	0.01265784	145.596698	149.150661	<0.0109	<0.00185	608.895618	0.05034486	0.01220201	676.503964	0.04565609
PM18AJ215	E19JN26a415.csv	127758.785	1.61428716	5.95645562	<0.00185	0.00604652	146.301993	148.577468	<0.0116	<0.00206	606.690383	0.07593898	<0.00687	746.703209	0.07497379
PM18AJ215	E19JN26a416.csv	125419.199	1.5468869	6.58765119	<0.00154	<0.00189	132.83755	137.759106	<0.00939	<0.00172	604.60608	0.05478076	0.00896944	710.080083	0.0639796
PM18AJ215	E19JN26a417.csv	124877.794	1.49472381	4.43321327	<0.00153	0.00320103	150.936725	149.890405	<0.0091	0.00282966	605.628015	0.06702987	0.01090647	725.799562	0.07054506
PM18AJ215	E19JN26a418.csv	116878.065	1.26074015	6.29976653	0.0048424	0.00502406	144.590312	143.117078	<0.0129	0.00445923	626.149226	0.0502104	<0.00833	627.128124	0.16149471
PM18AJ215	E19JN26a419.csv	123022.866	1.45987897	4.04386026	<0.00154	0.00466748	168.026518	171.215946	<0.00864	0.00219911	631.823752	0.03709396	<0.00573	721.777842	0.04076465

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ215	E19JN26a420.csv	121035.608	1.44934039	6.93555418	<0.00225	0.41478824	115.156845	112.930438	<0.0126	0.01360061	630.052462	3.39109808	0.14771367	663.95076	0.16015816
PM18AJ215	E19JN26a421.csv	125538.971	1.41864217	5.8059223	<0.0015	0.00243078	134.876325	138.807308	<0.00797	<0.00168	604.0559	0.40170204	0.02142654	737.883707	0.06422154
PM18AJ215	E19JN26a422.csv	121770.441	1.58460196	3.64223018	<0.00155	<0.0019	175.793424	173.460412	<0.00802	0.00582856	675.015737	0.09372095	0.0090356	710.424737	0.09086095
PM18AJ215	E19JN26a423.csv	122250.483	1.72155229	4.35175914	<0.00154	<0.0019	167.781593	162.794273	<0.00783	0.00454103	611.188526	0.16035288	0.01213243	724.272826	0.04368096
PM18AJ215	E19JN26a425.csv	124743.191	1.53112475	4.47583761	<0.00153	0.00255867	140.311478	143.898626	<0.00754	<0.00173	643.540068	0.03247851	<0.00569	716.562116	0.03114374
PM18AJ215	E19JN26a426.csv	124370.812	1.54353133	4.70721354	<0.00152	<0.00187	131.239116	133.221105	<0.00739	0.00470538	607.537859	0.0711483	0.01346835	739.469479	0.05480641
PM18AJ215	E19JN26a427.csv	124613.977	1.5274577	7.56092466	0.00170149	0.00234221	131.246178	133.398141	<0.00744	0.00498647	612.907381	0.60109093	0.01689283	726.595232	0.11691597
PM18AJ220	E19JN25a314.csv	136154.712	1.485186	7.1271874	<0.00191	<0.00212	30.8691745	29.8139066	<0.0109	<0.00192	150.834846	0.04094843	<0.00589	254.105387	0.02231025
PM18AJ225	E19JN26a077.csv	133889.895	2.70443007	7.71344359	<0.00151	<0.00192	30.5526231	28.3384554	<0.0181	<0.00165	231.161858	0.09999122	0.01094797	348.340975	0.27029033
PM18AJ225	E19JN26a078.csv	134543.862	2.48658101	4.88129065	<0.00152	<0.00193	30.9033061	29.8190557	<0.0181	<0.00165	230.038485	0.12496905	0.01911564	351.549521	0.19093843
PM18AJ225	E19JN26a079.csv	133997.422	2.20001246	5.03372505	<0.00152	0.00241575	30.6452324	30.8531631	<0.018	<0.00165	231.902416	0.10765073	0.01097625	351.219747	0.1911331
PM18AJ225	E19JN26a080.csv	135079.466	2.08822029	4.65684924	<0.00152	0.00241424	37.8754897	35.6297382	<0.0179	<0.00165	234.038596	0.09509422	<0.00555	353.395751	0.25061958
PM18AJ225	E19JN26a081.csv	133147.209	2.20053518	4.52671239	<0.00152	0.00314723	30.115255	30.144306	<0.0179	<0.00166	236.88302	0.14424534	0.02465052	346.759395	0.18673992
PM18AJ225	E19JN26a082.csv	133713.072	2.08837468	5.32851298	<0.00153	0.00303861	28.9002504	30.0485181	<0.0178	<0.00167	229.654987	0.16393008	0.02552861	346.672433	0.10938047
PM18AJ225	E19JN26a083.csv	134329.159	2.05992957	5.29226238	<0.00152	<0.00193	25.7263924	28.0773723	<0.0177	0.00288474	231.027689	0.10794546	0.03556824	354.911715	0.11674805
PM18AJ225	E19JN26a084.csv	135774.341	1.9402995	5.41933279	<0.00151	0.00597193	45.3739936	43.8775271	<0.0174	<0.00165	228.216539	0.07482274	0.01360504	347.62798	0.33850472
PM18AJ225	E19JN26a085.csv	134884.252	1.93171234	5.10990962	<0.00153	0.00458803	47.5781163	44.8595279	<0.0175	0.00417598	228.157639	0.11818378	0.02471187	353.014724	0.27709594
PM18AJ225	E19JN26a086.csv	133032.591	1.83629797	5.35750591	<0.00151	0.01026725	38.5759739	39.4337505	<0.0173	0.00222785	219.862758	0.17808065	0.02450231	355.934572	0.26493272
PM18AJ225	E19JN26a087.csv	132693.98	1.83783511	5.96431589	<0.00152	0.00676566	38.1636833	38.4631005	<0.0172	<0.00165	222.566891	0.12191123	0.03994882	342.968304	0.2444737
PM18AJ225	E19JN26a088.csv	133755.365	1.87196391	5.77688433	<0.00151	0.00807327	35.8730932	38.4952174	<0.0169	0.00221269	227.38422	0.13621803	0.02165167	352.049448	0.2139126
PM18AJ225	E19JN26a089.csv	131753.542	1.85396846	5.76050744	<0.00184	0.00499732	41.2769815	45.8314168	<0.0206	<0.00199	220.53808	0.15995804	0.04192681	343.51775	0.25390167
PM18AJ225	E19JN26a090.csv	134484.297	1.91804316	5.10635468	<0.00152	0.00314219	26.8799455	28.8206363	<0.0169	0.00223645	231.881842	0.07415413	0.02737706	351.999069	0.15654992
PM18AJ225	E19JN26a091.csv	132501.862	1.81678816	5.57189658	0.00210428	0.1290597	25.2874359	24.3309797	<0.0173	0.00338396	233.855556	0.68125798	0.02680533	342.715766	0.22353939
PM18AJ225	E19JN26a092.csv	134911.629	1.74296453	5.34840141	<0.00153	<0.00194	23.112538	24.1972953	<0.0167	<0.00167	229.005984	0.07437756	0.01649953	348.921505	0.13199056
PM18AJ225	E19JN26a093.csv	135149.402	1.7756864	5.22927972	<0.00152	<0.00192	27.9668616	25.9249443	<0.0165	0.00222624	232.970367	0.09112899	0.02449764	350.151374	0.19041427
PM18AJ225	E19JN26a094.csv	131243.358	1.67192252	6.20736546	<0.00173	<0.00217	25.1874789	24.7509151	<0.0186	0.00364576	240.502515	0.08134855	0.01340948	340.695362	0.09683482
PM18AJ225	E19JN26a095.csv	134513.786	1.71546594	4.82540087	<0.00152	0.00528224	29.9834956	30.3511233	<0.0162	<0.00166	228.343692	0.06398458	0.03547023	354.542161	0.21579176
PM18AJ225	E19JN26a097.csv	134362.561	1.6834706	5.35980935	<0.00154	<0.00196	23.6676629	23.0725474	<0.0162	<0.00168	228.734489	0.04353095	<0.00566	354.698195	0.25980857
PM18AJ225	E19JN26a098.csv	135213.028	1.63979929	4.8085444	<0.00152	<0.00193	27.6165723	25.1586059	<0.0158	<0.00166	227.565017	0.09882815	0.0109603	355.461508	0.14611684
PM18AJ225	E19JN26a099.csv	133329.31	1.64226585	4.88385539	<0.00153	0.00243674	33.4504467	32.8831914	<0.0158	<0.00167	235.404136	0.05932691	0.00828478	351.990418	0.31199764
PM18AJ225	E19JN26a100.csv	125523.355	1.69421912	5.80972717	0.00658718	0.00244997	20.2702707	20.9044101	<0.019	0.0040067	240.777133	0.16473926	0.07472198	317.304045	0.2431859
PM18AJ225	E19JN26a101.csv	134647.357	1.65442148	4.68347873	<0.00152	<0.00192	26.7664419	23.6667218	<0.0154	<0.00165	234.023023	0.10622882	0.00824345	353.971319	0.20072353
PM18AJ228	E19JL11a343.csv	119432.591	1.36206573	1.31254271	0.00404613	<0.00243	50.3441249	48.3719817	<0.0118	0.01077101	261.087341	0.96498438	0.01227822	961.771798	0.04736073
PM18AJ228	E19JL11a344.csv	120583.299	1.3923092	2.23117675	<0.00224	<0.00236	57.1002282	59.8882938	<0.0114	0.01147715	262.472386	1.25251912	0.03151621	969.418973	0.03168084
PM18AJ228	E19JL11a345.csv	120279.143	1.22437099	1.31354078	<0.00226	<0.0024	58.7872929	55.3728643	<0.0116	0.0123253	288.189479	0.88192812	0.02831323	956.406879	0.15100587
PM18AJ228	E19JL11a346.csv	116897.715	1.14909902	1.47302637	0.00424444	0.00285363	56.0349455	57.1487835	<0.0133	0.01843987	269.458718	0.93319614	<0.00811	748.960081	0.01859765
PM18AJ228	E19JL11a347.csv	121952.006	1.23584942	1.58115921	0.00350859	<0.00242	54.5753726	54.335538	<0.0117	0.01900442	281.524923	1.21531148	0.03141662	909.454803	0.02198238
PM18AJ228	E19JL11a348.csv	115728.639	1.26718132	1.31245561	0.0077683	<0.00267	53.032018	54.8739275	<0.0133	0.00806909	288.299302	0.83803591	0.02060007	951.758106	0.00780991
PM18AJ228	E19JL11a349.csv	118839.974	1.30126944	1.38742255	<0.0023	0.00326628	60.4308896	59.420992	<0.0121	0.00483296	274.870807	0.81078112	0.01176097	902.312643	0.13719753
PM18AJ228	E19JL11a350.csv	118486.755	1.24312073	4.95718655	0.0076273	<0.00309	53.2822013	49.3717707	<0.016	0.05652866	180.978478	1.68592745	0.07192939	579.339053	0.55142178
PM18AJ228	E19JL11a351.csv	125208.552	1.20242173	4.58776633	<0.00234	0.00546747	54.9882797	56.6084762	<0.0128	0.05960703	172.140498	1.71933152	0.04939931	771.521891	0.43809586
PM18AJ228	E19JL11a352.csv	119049.961	1.14885415	1.43753647	0.00346848	<0.00241	54.5965467	53.8251527	<0.0127	0.01032244	289.093462	0.77759806	0.04007939	981.283585	0.23821846
PM18AJ228	E19JL11a353.csv	119373.367	1.13795824	1.76690962	0.00348931	<0.0024	56.1432825	58.898474	<0.0132	0.01920558	262.717021	0.92450893	0.04333243	945.313616	0.06209813
PM18AJ228	E19JL11a354.csv	116263.64	1.31200585	0.71902267	<0.00256	<0.00265	78.4367243	80.8718443	<0.0152	0.0057935	281.925543	0.40006477	0.0090401	969.626881	0.00515846
PM18AJ228	E19JL11a355.csv	132451.92	1.1230079	31.226287	0.00580431	<0.00297	50.7281012	54.6156233	<0.0177	0.0354368	176.183587	1.1034183	0.06593858	623.578247	0.41207891
PM18AJ228	E19JL11a356.csv	119952.037	1.24766287	1.81240605	<0.0024	<0.00254	56.1208486	54.224199	<0.0156	0.0147931	241.960191	0.91967921	0.04804247	829.798518	0.07933608
PM18AJ228	E19JL11a357.csv	131668.908	1.13176803	28.5239421	<0.00442	0.00861393	52.4612267	57.966369	<0.0302	0.02019537	234.287001	0.79655758	<0.0137	791.079379	0.11491228
PM18AJ228	E19JL11a358.csv	121429.35	1.22801777	2.16225584	<0.00227	0.00288377	57.3118741	58.2363441	<0.0162	0.01286882	277.006949	1.0164802	0.04277548	817.079793	0.1396094
PM18AJ228	E19JL11a359.csv	118081.942	1.29298785	1.0477839	0.0049647	<0.00246	67.9550354	64.3163474	<0.0175	0.00582378	280.025786	0.74957671	0.03191114	926.032342	0.09898558
PM18AJ228	E19JL11a360.csv	134887.455	1.10456673	39.1780462	0.00584568	<0.00256	46.5931642	48.451596	<0.0195	0.00885533	189.531066	0.60787689	0.02320941	629.182266	0.03656405
PM18AJ228	E19JL11a361.csv	125478.221	1.14325121	3.99200298	<0.00318	<0.00334	51.07613	44.4835454	<0.0267	0.02724723	274.733228	1.24337577	0.01344981	841.667644	0.01277272
PM18AJ228	E19JL11a362.csv	135039.006	1.22115572	33.9120654	0.00355283	<0.00248	43.5331153	48.422292	<0.0213	0.02980039	226.741171	1.32982902	0.04463527	816.066321	0.1319362

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ228	E19JL11a363.csv	120736.982	1.20032817	1.1075211	<0.00236	<0.00248	81.0217774	83.8089278	<0.0226	0.0102077	280.455365	0.72520227	0.02377547	1150.53053	0.01720217
PM18AJ228	E19JL11a365.csv	135052.932	1.22212069	14.4511859	<0.00489	0.00729781	54.9591201	53.254523	<0.054	0.73145632	277.739441	8.30350137	0.4351641	790.629641	1.41824204
PM18AJ229	E19JN25a007.csv	152665.249	1.92112637	10.3945751	<0.00139	0.01018259	32.6284828	33.6784428	0.06148812	0.00825151	169.524459	0.85984082	0.08213862	324.021149	0.52666327
PM18AJ229	E19JN25a008.csv	150852.811	1.86348147	9.11235255	<0.00139	0.00262502	27.7018545	28.048654	0.03863319	0.00276165	200.331867	0.39637367	0.0491554	307.534546	0.34956682
PM18AJ229	E19JN25a009.csv	150783.229	1.85798532	7.70934185	<0.00143	0.00359526	47.8497359	48.0069113	0.07033779	0.00645508	184.019536	0.41444774	0.06036017	327.208829	0.8335789
PM18AJ229	E19JN25a010.csv	152034.287	1.93769761	6.69535445	<0.00147	<0.00191	15.5428859	16.0454881	<0.0297	0.00225136	221.051075	0.10523277	<0.00507	268.867604	0.75699551
PM18AJ229	E19JN25a011.csv	152541.911	1.69012277	8.67697588	<0.00143	0.00769886	30.6391804	30.8245554	0.04512033	0.01137073	197.2274	0.19578658	0.04948598	277.42478	0.33766115
PM18AJ229	E19JN25a019.csv	155255.139	1.65146159	9.48621036	<0.00145	0.00345674	17.3588645	17.7955457	0.04706102	0.00488983	191.718016	0.14389608	0.02016788	319.539524	0.12044402
PM18AJ229	E19JN25a021.csv	184607.711	1.58050096	16.7153309	<0.00137	<0.00176	44.186919	45.4425958	<0.0165	0.00590062	321.042806	0.29619802	0.09532447	149.337864	0.58914097
PM18AJ229	E19JN25a022.csv	152214.785	1.58271613	7.1686844	<0.0014	0.0040586	42.0570688	41.2656906	0.06499612	0.00471044	183.450561	0.49250684	0.0649952	362.188408	1.18235128
PM18AJ229	E19JN25a023.csv	150081.114	1.63349703	12.2733485	<0.00172	0.02238915	40.3507413	42.5194815	0.1029554	0.0029427	170.224909	0.59568084	0.05938845	341.515017	0.42627748
PM18AJ229	E19JN25a024.csv	173771.877	1.42939886	16.2741604	<0.00231	<0.00299	6.4501354	7.29098226	<0.0262	0.00556983	347.567652	0.10678004	0.01782508	365.697263	0.55979183
PM18AJ229	E19JN25a025.csv	152105.988	1.52416566	6.00790292	<0.00149	0.00202088	17.1112019	17.1729238	0.0620583	<0.00197	204.658402	0.12522292	0.02130863	282.378941	0.10076968
PM18AJ229	E19JN25a040.csv	150981.814	1.74092715	7.48675653	0.00264049	0.00706801	35.2178293	37.8355874	0.07574926	0.00344389	163.599731	0.52504194	0.03883771	337.842111	0.3950792
PM18AJ229	E19JN25a054.csv	168618.093	1.52924063	15.5868452	<0.00144	<0.00181	77.2369168	79.22928	<0.02	0.00207782	153.806082	0.28782249	0.09718922	261.526595	1.43380576
PM18AJ229	E19JN25a056.csv	152455.099	1.48412772	18.7588384	<0.00159	0.01326212	35.758788	36.9727777	0.05914992	0.00714579	172.981249	0.70485245	0.10863076	311.513965	0.3169989
PM18AJ229	E19JN25a057.csv	159141.449	1.68901177	29.3491543	<0.00172	0.00757893	57.2359635	61.1842003	0.09548582	0.0065454	142.336522	0.34540007	0.09231151	327.646353	2.24709833
PM18AJ231	E19JL15a125.csv	126227.585	1.75166308	3.15236791	<0.00233	0.71205988	49.3506458	52.1013176	<0.0161	0.01792388	151.459465	1.80051648	0.0586196	403.033354	1.16541412
PM18AJ231	E19JL15a126.csv	128711.892	1.73389075	2.61616074	<0.00216	0.80913039	30.0036847	28.5642392	<0.015	0.0214004	110.717751	2.15749026	0.06472492	194.320369	1.21447844
PM18AJ231	E19JL15a127.csv	129059.334	1.56645489	4.93931836	<0.00215	0.59846113	29.820376	31.0324624	<0.0149	0.01106251	111.204387	1.46945587	0.07018698	227.183605	0.78684454
PM18AJ231	E19JL15a128.csv	127450.854	1.55189433	2.54212555	<0.00217	69.8928757	53.3388312	50.1193184	<0.0151	0.09497333	152.051561	1.35307399	0.05605034	457.031292	0.95878496
PM18AJ231	E19JL15a129.csv	128187.747	1.5994073	2.29716263	<0.00211	0.13982867	80.5813363	83.1951455	<0.0147	0.00951555	188.080702	0.89667638	0.01722345	599.006374	0.09721722
PM18AJ231	E19JL15a130.csv	127629.625	1.44392284	4.83823907	0.00359622	0.93431642	42.5280211	45.0232955	<0.0153	0.0538579	183.542262	3.03995329	0.05979655	288.411817	1.02564761
PM18AJ231	E19JL15a131.csv	128158.505	1.52010836	4.57606081	<0.00216	0.78926739	37.6300447	43.1933105	<0.0151	0.02617668	131.424642	1.48546224	0.05584544	250.895663	0.83693556
PM18AJ231	E19JL15a132.csv	124859.108	1.53591353	1.72094161	<0.00212	0.35533779	61.9833365	62.5965032	<0.0149	0.02233421	161.136961	1.26004885	0.04025423	343.391743	0.43859411
PM18AJ231	E19JL15a133.csv	133053.985	1.46138129	6.67877414	0.01601943	0.33513138	95.769642	102.74329	<0.0177	0.02905557	101.712773	2.98320034	0.04253874	247.900229	0.87145499
PM18AJ231	E19JL15a134.csv	130138.623	1.39321666	7.25052362	<0.00214	0.49299385	81.3000714	80.9912581	<0.0151	0.03351301	115.511413	4.06855944	0.05955941	261.217879	0.85434358
PM18AJ231	E19JL15a135.csv	125569.431	1.72179898	3.75061379	<0.00224	0.33018796	48.0764623	43.4783703	<0.0158	0.00603732	134.046415	1.03045033	0.02346012	169.576064	0.25764652
PM18AJ231	E19JL15a136.csv	134356.707	1.62553394	2.61131832	<0.00251	0.16054475	78.5173313	80.5877546	<0.0178	0.01426139	177.968828	2.9686399	0.0632666	74.0213697	0.23257677
PM18AJ231	E19JL15a137.csv	128674.723	1.43707865	6.94178562	<0.00246	0.62150711	48.3861339	48.3719629	<0.0175	0.01034001	147.289433	12.1963789	0.63374194	162.202925	0.94555172
PM18AJ231	E19JL15a138.csv	132921.835	1.41542066	4.39378848	0.00372142	0.5128182	70.0959064	68.7101673	<0.0154	0.01083122	118.894117	4.72488613	0.14248326	223.183787	0.22469089
PM18AJ231	E19JL15a139.csv	134287.728	1.66406281	5.53010968	0.01425745	0.35798903	90.1704202	81.7834226	<0.0225	0.02341476	172.294425	7.94100449	0.20177793	218.433788	1.68284243
PM18AJ231	E19JL15a140.csv	124183.931	1.41057042	4.7228187	<0.00223	1.15926018	37.1692427	37.7799383	<0.016	0.02182725	93.5806176	1.96423597	0.09185952	201.021048	0.52791573
PM18AJ231	E19JL15a141.csv	121749.671	1.55558056	3.81089164	0.00334213	1.54580247	68.3364093	70.9819721	<0.0153	0.08318937	124.908073	2.31807407	0.07717261	194.217213	0.97963729
PM18AJ231	E19JL15a142.csv	120255.888	1.51042351	2.8529174	<0.00242	0.33471989	62.7522421	60.6088332	<0.0177	0.02075136	166.825024	1.25575201	0.06140543	296.798097	0.44898671
PM18AJ231	E19JL15a149.csv	127451.144	1.97253726	4.68206121	0.00227509	0.25821706	69.6009913	72.7556296	<0.0163	0.01562865	143.951172	2.83689108	0.05843045	272.242311	0.42236969
PM18AJ231	E19JL15a150.csv	130844.5	1.8086146	3.58510719	0.00502128	0.31542632	52.2530864	51.3427694	<0.016	0.02301902	129.864634	2.96832648	0.0354622	228.018108	0.43297131
PM18AJ233	E19JN25a125.csv	119328.261	1.27212369	34.1936937	<0.0015	0.00881769	41.8996661	42.073079	0.01648108	0.00710222	331.053339	0.43766989	0.0671761	544.723711	0.06363174
PM18AJ233	E19JN25a126.csv	119137.387	1.31759344	25.7281057	<0.00149	0.01096658	35.4188292	36.319106	0.01837849	0.00457999	355.074619	0.31055119	0.02136185	543.433076	0.10901895
PM18AJ233	E19JN25a127.csv	141467.168	1.12989675	91.3852324	<0.0018	0.0139134	51.3422488	50.0065019	0.01757516	0.01514175	272.389068	0.60857481	0.0882745	467.41343	0.23585966
PM18AJ233	E19JN25a128.csv	122320.491	1.20148926	21.9049893	<0.0019	<0.0023	50.5932293	50.6268073	<0.0177	0.00692816	215.561215	0.39270972	0.02353256	676.620799	<0.00376
PM18AJ233	E19JN25a129.csv	113702.272	1.17156375	9.99051359	<0.00146	<0.00177	68.382562	71.2107478	<0.0137	<0.00175	235.678381	0.24082048	0.03366584	656.871344	0.05186427
PM18AJ233	E19JN25a130.csv	113073.353	1.18362741	16.9752772	<0.00157	0.00330981	71.35104	75.4476047	<0.0147	<0.00189	185.652456	0.3706811	0.03989275	692.627737	0.00538734
PM18AJ233	E19JN25a131.csv	108289.26	1.08598927	3.95575414	<0.00155	<0.00187	72.5949449	68.50791	<0.0145	<0.00185	218.664056	0.17691899	0.00995986	674.687117	0.01414714
PM18AJ233	E19JN25a132.csv	132905.927	1.23915917	18.0665675	<0.00285	<0.00344	36.4192512	38.6404939	<0.0268	0.05444307	221.668371	1.80896518	0.13917792	713.802198	0.12682333
PM18AJ233	E19JN25a133.csv	116645.019	1.33820794	5.54964919	<0.00155	0.00766072	33.5786592	31.9266019	<0.0146	0.0027625	200.835245	0.09900945	0.0220405	743.698437	0.02108916
PM18AJ233	E19JN25a134.csv	115265.141	1.35461157	5.26103506	<0.00152	0.003925	43.9512487	43.5441598	<0.0144	<0.00181	179.788192	0.11239483	0.02425368	770.102709	0.04423877
PM18AJ233	E19JN25a136.csv	120595.177	1.21526758	25.9290768	0.0024485	0.01828389	43.6284787	45.3088343	<0.0145	0.01108475	225.310886	0.73582639	0.07198397	759.332123	0.17623829
PM18AJ233	E19JN25a137.csv	117246.623	1.26743619	9.45921472	<0.00199	0.00416456	36.5592429	37.2262854	<0.0189	<0.00237	244.117389	0.89058119	0.08986662	701.438725	0.16517754
PM18AJ233	E19JN25a138.csv	157787.567	1.38552658	88.2328572	<0.00286	0.0437134	52.3972105	50.2582626	0.12664658	0.06665017	197.607782	2.60735637	0.20394563	252.245455	1.26361069
PM18AJ233	E19JN25a139.csv	119504.06	1.31595273	4.54446719	<0.00242	<0.00293	51.5450118	50.4233924	<0.0231	<0.00288	263.539714	0.11625707	0.01293234	789.13392	0.04212114
PM18AJ233	E19JN25a140.csv	116616.597	1.41659327	67.6275506	<0.00151	0.05646338	96.4910432	93.7652977	0.02053591	0.05321808	179.418114	1.02217809	0.11896434	716.154509	2.23293382

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ233	E19JN25a142.csv	137268.553	2.93962205	14.1618138	<0.0029	0.03485791	30.9131426	30.6780494	0.47892062	0.12927923	267.798609	4.53209048	0.53020639	496.855386	0.56049794
PM18AJ233	E19JN25a143.csv	126820.463	1.34664916	46.5988073	<0.00212	0.10950449	64.9082176	58.9229645	<0.0205	0.03374936	160.75	0.96421155	0.09645135	699.719651	1.25396221
PM18AJ233	E19JN25a168.csv	133151.385	1.32195875	66.8734117	<0.00159	0.02249084	43.7298682	43.9186935	<0.0162	0.00613773	231.372371	0.52750041	0.02527105	655.273375	0.31031532
PM18AJ233	E19JN25a169.csv	119000.539	1.32849989	124.725713	0.00559245	0.04620748	46.9107289	45.3672311	<0.0218	0.12042112	243.93445	3.73368021	0.18160755	704.478503	0.41019719
PM18AJ233	E19JN25a170.csv	118053.117	1.25840413	18.0175136	<0.00153	0.00381058	36.1574985	35.8637605	<0.0155	0.00328371	374.757515	0.16545948	0.04162446	529.526983	0.0336784
PM18AJ242	E19JL15a058.csv	133013.053	2.5641202	11.591547	<0.0028	<0.00279	69.2653128	69.3923911	<0.0228	0.00463204	326.777491	0.91360725	0.0759215	349.262935	1.36334688
PM18AJ242	E19JL15a059.csv	128541.245	2.31305198	15.1698621	<0.00304	<0.00303	65.0659603	65.0574948	<0.0249	0.0258858	336.965096	0.60664545	0.03577275	335.678416	1.03329589
PM18AJ242	E19JL15a060.csv	138498.287	2.12513482	13.80846	0.00631184	0.02055967	74.653717	78.9503025	<0.036	0.01619864	323.046236	0.65826548	0.04816483	359.984132	1.10936384
PM18AJ242	E19JL15a073.csv	132020.86	1.44151496	37.2566349	<0.00349	0.00719644	36.7676751	36.5314882	<0.0293	<0.00294	322.507568	0.74509127	0.21969964	310.978435	1.36736662
PM18AJ242	E19JL15a076.csv	142757.918	1.96192679	36.2150415	<0.00386	<0.00373	54.6236128	46.4783445	<0.0322	0.00399225	312.502701	0.49811019	<0.0096	350.302835	0.24948203
PM18AJ244	C19AU08C169.csv	135505.748	3.44410663	23.105285	0.00280886		48.8646825	48.6794134	<0.0311		227.261736	0.76655505	0.07753534	198.923985	2.49979987
PM18AJ244	C19AU08C170.csv	136341.307	4.34187427	22.6606857	<0.00213		50.4893921	53.3353426	<0.029		236.940026	0.69219484	0.09443325	196.114431	2.10823706
PM18AJ244	C19AU08C171.csv	137318.757	3.09300645	21.0907671	0.00791548		54.8375293	50.7518445	<0.0292		237.325632	0.65289206	0.08872207	199.332434	2.33980204
PM18AJ244	C19AU08C173.csv	133579.879	2.69160849	22.2949304	0.00471065		49.4104384	52.5261364	<0.0274		251.966597	0.67975981	0.08686595	191.409188	2.02209378
PM18AJ244	C19AU08C174.csv	134966.611	3.12738348	22.0318379	<0.00219		46.7388269	48.9269511	<0.0262		255.552425	0.74426251	0.08615648	195.618315	1.79976641
PM18AJ244	C19AU08C175.csv	138661.16	1.29281185	21.2565782	<0.00231		46.3840494	49.377465	<0.0268		244.781835	0.74634414	0.06003564	200.009975	2.41744985
PM18AJ244	C19AU08C176.csv	131863.509	2.78785129	22.2317483	0.00515563		49.5616737	50.9745505	<0.0246		248.193505	0.69877819	0.08982882	192.620495	2.26617655
PM18AJ244	C19AU08C177.csv	133921.869	2.58099761	22.2142235	<0.00216		50.5214975	53.5449535	<0.024		244.182356	0.74180433	0.09997792	191.448777	1.85800266
PM18AJ244	C19AU08C178.csv	134904.42	1.50611552	26.0975137	<0.00211		40.4770528	44.922049	<0.0231		204.351787	0.84116889	0.1326418	193.154237	2.95518089
PM18AJ244	C19AU08C181.csv	136453.993	1.56066271	29.4310635	0.01244443		54.3868994	55.3852705	<0.0227		201.740794	0.94643933	0.17458833	182.197562	2.09062621
PM18AJ244	C19AU08C185.csv	134847.503	2.00484229	25.9967097	<0.00231		70.0226799	65.6184116	<0.024		246.632699	0.85187329	0.12694576	170.590276	2.96286188
PM18AJ244	C19AU08C186.csv	135106.105	2.38461018	22.2904592	<0.00218		43.0581931	42.8551302	<0.0226		221.547456	0.71947304	0.08584911	188.830405	2.8609405
PM18AJ244	C19AU08C187.csv	134728.333	2.47803732	23.8460438	<0.00211		43.8549992	42.9368058	<0.0219		220.313552	1.4762446	0.12934022	184.959198	2.69573686
PM18AJ244	C19AU08C189.csv	130990.183	2.15924175	23.5182741	<0.00213		79.2591605	79.8058532	<0.0221		213.687985	0.85546577	0.06458482	178.516629	2.91199753
PM18AJ244	C19AU08C190.csv	131326.953	3.71002538	22.0794878	<0.00212		55.5532906	58.8973881	<0.022		235.958692	0.72573076	0.05950719	180.496403	2.40835186
PM18AJ244	C19AU08C191.csv	141460.716	0.76398853	21.4316228	<0.00186		58.9413912	58.204442	<0.0194		150.381858	1.23888652	0.1298648	238.861744	2.96296534
PM18AJ244	C19AU08C194.csv	134499.619	1.77976975	22.6168052	0.00262337		53.3577586	55.5054906	<0.022		224.114929	0.6811475	0.08648426	186.093844	2.52122304
PM18AJ244	C19AU08C195.csv	133034.125	0.50658895	19.7256388	0.00259528		47.5388232	47.4363391	<0.0218		250.448818	0.83582339	0.07657711	184.976597	2.28135195
PM18AJ244	C19AU08C196.csv	135778.641	1.48319476	23.2922758	0.00371617		42.5904086	40.8883185	<0.0251		232.443123	0.68226425	0.12235218	190.364301	2.41001838
PM18AJ249	E19JN25a256.csv	133882.452	1.29878376	2.84829632	<0.00179	<0.00204	154.124686	152.761304	<0.0139	0.09628528	310.579333	0.27943195	0.04263516	984.471492	0.34695313
PM18AJ249	E19JN25a258.csv	136822.989	1.38978628	3.42231439	<0.00239	0.04028953	116.258088	132.35147	<0.0189	0.13007427	295.177151	0.98593771	0.18073358	926.666675	1.30785838
PM18AJ249	E19JN25a261.csv	127322.659	1.14885842	2.90423764	<0.00211	<0.0024	107.057022	104.730862	<0.0171	0.01680878	265.163623	0.11660908	0.01639441	977.832563	0.14614935
PM18AJ249	E19JN25a262.csv	127720.634	1.2505117	3.30753148	<0.00193	0.00881329	58.806384	61.5613473	<0.0158	0.05193467	249.805783	0.34824469	0.03459806	945.559008	0.43223788
PM18AJ249	E19JN25a263.csv	135541.906	1.39052187	2.96471712	<0.00359	0.04714967	71.6333118	78.8764444	<0.0297	0.15657353	279.160712	0.2887896	0.04940483	1006.55901	0.41268769
PM18AJ249	E19JN25a264.csv	131438.93	1.32369318	2.53908292	<0.00174	0.00322351	74.4147085	73.0810294	<0.0145	0.08804353	275.999489	0.14573496	0.03014851	980.290466	0.2236542
PM18AJ249	E19JN25a265.csv	139961.368	1.34994621	2.15670623	<0.00287	0.00443905	42.4307811	48.9618291	<0.0242	0.04487945	268.273705	0.22808227	0.05125565	1058.31215	0.48616339
PM18AJ249	E19JN25a267.csv	134695.508	1.41998987	1.06407921	0.00276428	<0.00259	56.4146922	52.8083813	<0.0197	0.01159051	156.894194	0.01683743	<0.00719	1170.8914	0.02188627
PM18AJ249	E19JN25a268.csv	131342.118	1.25647868	1.07245391	<0.0018	<0.00205	46.94265	45.0829586	<0.0156	0.01248665	165.320358	0.03052489	<0.00564	1110.31447	0.03178164
PM18AJ249	E19JN25a270.csv	135239.657	1.1376012	7.27553153	<0.0021	0.20882842	49.0725011	54.8584099	<0.018	0.30433344	216.717915	0.68152449	0.08944669	943.804139	0.48933171
PM18AJ249	E19JN25a277.csv	131342.77	1.22747139	3.30957364	<0.00205	<0.00232	102.21632	103.045315	<0.0188	0.04318642	318.398621	0.29979485	0.03742459	994.553193	0.38315039
PM18AJ249	E19JN25a278.csv	139379.673	1.39795936	58.4285363	0.00269093	0.35260465	130.513778	130.752046	<0.0219	0.20457337	593.986787	0.75336131	0.06023884	920.549334	0.22779141
PM18AJ249	E19JN26a007.csv	170177.363	4.60028933	58.2679463	0.02362177	<0.0121	72.4225129	74.581129	<0.192	<0.00939	690.471662	0.51744225	<0.0344	509.732943	0.19952757
PM18AJ249	E19JN26a026.csv	136647.839	1.84581652	34.9028035	0.0088986	0.03385711	67.6920213	74.9167315	<0.0534	<0.0047	665.585183	1.40740851	0.06143468	815.361036	1.46904343
PM18AJ249	E19JN26a028.csv	163303.032	2.21870045	48.8423409	<0.00369	<0.00474	22.8045857	22.214704	<0.0441	0.01067352	787.575741	0.80715243	0.03563579	458.674911	0.2943526
PM18AJ249	E19JN26a033.csv	149663.819	1.99487717	20.8413765	<0.00446	0.00807384	32.7270518	33.4851859	<0.0519	0.0132032	1015.76273	0.75250417	<0.0166	469.171232	0.50171879
PM18AJ252	E19JL15a234.csv	145415.687	2.85419751	13.5740564	<0.0025	0.1305023	61.9472705	58.0125536	0.30616333	0.0056764	512.104437	18.6888845	0.69063656	577.529871	1.7839205
PM18AJ252	E19JL15a236.csv	144240.032	1.98218352	17.0377251	0.00295382	0.02519155	603.415031	603.268339	0.1370778	0.0050079	599.121694	11.6364586	0.55730653	458.555665	0.33244201
PM18AJ252	E19JL15a237.csv	142494.253	1.98240557	17.6353268	<0.00232	0.00255474	81.0250627	79.1987154	0.06503218	0.00489091	330.834087	10.9208214	0.49247508	558.704274	0.24770112
PM18AJ252	E19JL15a238.csv	147669.763	1.96610731	15.5412957	0.00522996	0.01298931	23.9795146	26.7021142	0.14719921	<0.00227	634.446175	15.9346677	0.84263743	504.471009	0.34925453
PM18AJ252	E19JL15a240.csv	153419.986	2.08510781	8.76772348	<0.00256	0.05048936	24.5210293	24.7189163	0.24396137	0.01064176	677.202131	12.374889	0.93439171	540.026971	0.52521477
PM18AJ252	E19JL15a244.csv	149369.915	1.72940241	7.25341868	<0.00347	0.08719524	33.8321049	31.1271063	0.14306825	0.00368187	511.594321	12.0229378	0.75293573	573.626649	0.17217007
PM18AJ252	E19JL15a330.csv	142630.304	2.44603387	19.4829887	<0.00317	0.09975696	190.665821	188.281428	0.80350197	0.0097894	637.202642	36.72261	1.38117145	630.393261	1.75701801

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ264	E19JL15a078.csv	129058.452	1.40162375	13.2837446	<0.00277	0.0141207	24.171738	20.1152828	<0.0229	0.08118803	188.676128	0.90106668	0.03432594	471.603446	0.38418151
PM18AJ264	E19JL15a079.csv	135672.469	1.57240442	10.743026	<0.00215	0.01696422	37.8825574	35.2996771	<0.0177	0.08405746	182.563207	1.21955258	0.09487049	516.105883	0.56781199
PM18AJ264	E19JL15a080.csv	137833.961	1.62100812	10.2800438	<0.00279	0.01318338	27.6596597	27.3071327	<0.0228	0.04087029	185.726919	1.24549248	0.14081917	533.441885	0.48511978
PM18AJ264	E19JL15a081.csv	138480.834	1.49347082	10.8836058	<0.0021	0.02312747	26.511724	26.1661507	<0.0172	0.01775063	140.305701	1.35031029	0.09571863	501.682342	0.2737612
PM18AJ264	E19JL15a082.csv	132401.004	1.46572231	12.4959157	<0.00216	0.01941998	21.9318176	21.3848742	<0.0175	0.03558987	192.659481	1.26179872	0.10589721	497.516764	0.70181836
PM18AJ264	E19JL15a083.csv	138282.372	1.51359361	11.6574256	<0.00217	0.01078665	22.5445061	26.3085643	<0.0175	0.01332326	176.791981	1.33259718	0.08349213	510.904592	0.34154444
PM18AJ264	E19JL15a084.csv	142115.408	1.4444098	33.7274005	<0.00212	0.01499278	30.7902168	28.4549215	<0.017	0.060012	153.942461	1.28434783	0.09194788	516.41909	0.77289479
PM18AJ264	E19JL15a087.csv	136470.675	1.69912989	23.8014957	<0.00211	0.02617704	29.997642	29.8477762	<0.0167	0.07557231	194.875576	1.17069825	0.07932848	528.872334	0.58377826
PM18AJ264	E19JL15a088.csv	137838.05	1.58664318	11.3672449	<0.00207	0.02716258	27.2456238	24.4121902	<0.0163	0.01822228	139.964469	1.41852072	0.15008456	517.385025	0.30975812
PM18AJ264	E19JL15a089.csv	139524.623	1.54738173	11.562379	<0.0021	0.03184787	26.293833	26.8801525	<0.0164	0.0282092	140.237024	1.58777714	0.1350448	486.78055	0.48622953
PM18AJ264	E19JL15a092.csv	131457.571	1.58730071	24.4279813	<0.00224	0.01646317	35.0817988	35.5693009	<0.0172	0.18602878	261.246067	1.58352522	0.08667251	488.375279	2.0938831
PM18AJ264	E19JL15a093.csv	137468.593	1.4146417	51.1180619	0.01056044	0.00610519	29.8037448	31.6171592	<0.0167	0.03019644	185.085925	1.03223237	0.06783176	508.816932	0.93283704
PM18AJ264	E19JL15a095.csv	129954.21	1.460663	17.3911677	<0.00266	0.09650439	43.5662409	44.3859655	<0.02	0.10046633	216.652177	2.88763593	0.1547576	501.598855	0.80409054
PM18AJ264	E19JL15a096.csv	135999.143	1.53262035	19.1198183	<0.0021	0.04281498	22.3019306	21.7981301	<0.0157	0.06432612	218.162529	1.29642399	0.05938511	519.09	0.9390405
PM18AJ264	E19JL15a097.csv	137701.626	1.45412812	12.1679018	<0.00207	0.03645794	25.8664848	25.8551663	<0.0154	0.02141946	139.688846	1.38826403	0.08340906	516.251062	0.38729487
PM18AJ267	E19JL15a169.csv	126781.833	1.25705765	15.6447201	<0.00223	0.01203262	75.3100893	72.5435545	<0.0167	0.0197955	460.542128	0.88194425	0.02487212	212.21977	1.21733805
PM18AJ267	E19JL15a171.csv	131992.805	1.26799875	10.0352782	0.00383108	0.01670772	92.6821184	98.4950678	<0.0252	0.16918084	460.648379	1.61395489	0.05471692	286.013335	2.0094284
PM18AJ267	E19JL15a172.csv	129410.731	1.17088839	9.95238105	<0.00205	0.00960669	103.296625	104.429096	<0.0153	0.11508578	446.523076	1.58784458	0.04883579	273.314159	1.14325578
PM18AJ267	E19JL15a173.csv	125672.396	1.11889865	6.29016334	<0.00228	0.00880626	94.356801	97.1776779	<0.0169	0.04430458	482.12151	0.52962648	0.03593669	205.699894	0.99060039
PM18AJ267	E19JL15a174.csv	128966.156	1.22937684	9.35435258	0.0043063	0.00803827	102.068005	101.792729	<0.0169	0.15857343	476.686839	1.48982071	0.08531281	266.993563	1.78885361
PM18AJ267	E19JL15a175.csv	133059.252	1.3541137	6.85188972	<0.00316	0.01051376	65.3999935	66.7767343	<0.0234	0.01663184	470.265552	1.10086951	0.02884714	231.934393	0.81289662
PM18AJ267	E19JL15a177.csv	125803.155	1.15099583	9.42434544	<0.00214	0.06549476	76.2784208	76.1756353	<0.0157	0.0646665	442.993403	1.57097635	0.06271012	209.447936	0.95293737
PM18AJ267	E19JL15a181.csv	120853.766	1.15493332	9.1904964	<0.00326	0.01053802	77.9521112	82.7730634	<0.0236	0.04206801	464.007805	1.02173469	0.01103554	211.441314	1.81829263
PM18AJ267	E19JL15a182.csv	126051.767	1.41435491	15.2073841	<0.00257	0.48436153	105.191666	106.254762	<0.0185	0.20535385	467.848951	8.41575518	0.74406962	261.941404	1.58636744
PM18AJ267	E19JL15a184.csv	120071.554	0.9763478	8.9366236	<0.0032	<0.00323	83.2834795	89.9927481	<0.0229	0.0519999	458.264873	0.91806488	0.07277215	213.943479	0.56792513
PM18AJ267	E19JL15a187.csv	122623.796	1.36008347	129.055363	<0.00242	0.23798897	103.585637	106.320335	<0.017	0.28018152	488.299131	1.96288888	0.21005943	168.144103	2.67679514
PM18AJ268	E19JL11a294.csv	132819.299	1.13194388	3.78369754	<0.00315	<0.00337	96.4905012	95.9570368	<0.0257	0.00547045	232.849657	0.03278806	0.02232857	164.594932	0.03421137
PM18AJ268	E19JL11a296.csv	126032.528	1.12419955	2.62374412	<0.0024	0.00317604	270.239442	275.092707	<0.0197	0.00266458	213.053313	0.04523884	0.01420108	174.25071	0.02343109
PM18AJ268	E19JL11a302.csv	144652.676	1.25437575	6.82235041	0.00454318	0.00671301	521.814613	509.561652	0.04189392	0.00951328	310.335085	0.86319767	0.12495768	128.501043	2.6644367
PM18AJ268	E19JL11a313.csv	134618.397	1.06169688	5.41974244	<0.00281	<0.00306	252.267261	242.957411	<0.022	<0.00276	311.786879	0.04080884	0.02606575	135.802536	0.01909567
PM18AJ270	E19JN26a160.csv	113907.853	2.01713999	2.45053341	<0.0015	<0.00188	97.6260386	94.5089024	<0.0122	0.00679388	262.485315	0.00913542	<0.00549	493.144477	0.00435697
PM18AJ270	E19JN26a162.csv	123170.328	1.97772116	3.26230713	<0.00192	0.00311598	247.050194	241.439787	<0.0158	0.00861696	603.546437	0.07195407	0.00838888	620.548812	0.17049506
PM18AJ270	E19JN26a165.csv	147727.71	3.07156506	8.81982534	0.05920926	0.00982802	916.711801	1003.05306	<0.0298	0.03588168	500.10256	29.4697565	2.4187781	523.335057	2.77891474
PM18AJ270	E19JN26a166.csv	110942.049	1.85350793	3.51509524	<0.0017	<0.00216	87.8309187	88.9522453	<0.0142	<0.00188	248.16257	0.00774277	<0.00623	465.627842	0.00973703
PM18AJ270	E19JN26a167.csv	117802.506	1.80602411	3.7511162	<0.00144	<0.00182	120.979509	120.378586	<0.0121	0.00274137	262.172856	0.01995261	<0.00529	430.531781	0.08375981
PM18AJ270	E19JN26a168.csv	116584.974	1.71040498	2.60470763	<0.00142	<0.00179	101.518087	101.973864	<0.012	<0.00155	246.581544	0.03272948	<0.00522	469.330872	<0.00335
PM18AJ270	E19JN26a170.csv	115915.17	1.62371235	5.87404679	<0.00239	0.01415851	305.545781	292.511561	<0.0204	0.03706903	218.457319	0.26975299	0.01052456	421.102711	2.05502878
PM18AJ270	E19JN26a171.csv	116016.362	2.02242642	5.91362399	<0.00163	0.0058769	260.551271	266.481238	<0.014	0.00265154	252.083384	0.0248196	<0.006	547.879929	0.22906736
PM18AJ270	E19JN26a172.csv	128057.931	2.07220244	4.26149779	<0.0015	<0.00189	67.802656	67.8170286	<0.0129	0.00344005	138.554349	0.03966269	<0.00551	484.76067	0.18725088
PM18AJ270	E19JN26a173.csv	139718.282	2.30098317	7.09721201	0.00536426	<0.00296	70.4726725	74.9485541	<0.0203	0.020412	115.041486	0.14604367	0.03704238	452.886778	0.75389943
PM18AJ270	E19JN26a174.csv	118487.253	1.98063775	3.49868104	<0.00145	<0.00182	91.5921155	87.4043667	<0.0126	0.00331791	216.797222	0.01932913	<0.0053	484.671226	0.04380052
PM18AJ270	E19JN26a175.csv	111046.284	1.70416494	1.31777089	<0.00154	<0.00197	103.870222	108.518542	<0.0135	0.0059174	286.446401	0.01857653	<0.00565	448.497528	0.11341696
PM18AJ270	E19JN26a176.csv	117091.217	1.7345545	2.22445457	<0.00147	<0.00185	108.548841	107.871022	<0.0128	<0.00161	256.348644	0.01993519	<0.0054	475.687314	0.00638893
PM18AJ270	E19JN26a177.csv	116178.199	1.75200903	1.80357323	0.00236011	0.00403973	128.199106	139.587214	<0.0171	0.00364225	265.573634	0.00545584	<0.0073	350.399478	0.02578723
PM18AJ270	E19JN26a179.csv	119558.926	2.20365889	4.35921006	0.00333252	0.0031694	415.881386	425.142065	<0.0149	0.00286513	216.14941	0.15743942	0.02353492	601.50585	0.18084806
PM18AJ270	E19JN26a181.csv	114404.727	1.69703695	6.29847607	<0.00186	<0.00237	98.9612294	100.833186	<0.0169	0.00723781	248.604977	0.06006664	<0.00685	421.605566	0.01370911
PM18AJ270	E19JN26a182.csv	116331.372	2.07052577	1.28559987	<0.00142	<0.00178	105.535378	103.221108	<0.013	0.0020615	284.687025	0.01086595	<0.0052	477.87207	<0.00339
PM18AJ270	E19JN26a183.csv	120428.41	1.96412246	8.8826529	<0.00146	<0.00184	87.2252259	88.76806	<0.0134	0.00396189	257.168393	0.00642684	<0.00536	478.13981	0.10594086
PM18AJ270	E19JN26a184.csv	115486.934	1.81676413	3.8318312	0.00200346	<0.00183	82.23025	83.1160417	<0.0134	0.00319772	244.667651	0.03863456	<0.00534	548.348059	0.19387373
PM18AJ272	E19JL15a262.csv	116835.011	2.15976547	3.44283582	0.02956013	0.24611702	179.272399	185.131636	<0.0177	0.91192749	117.718909	1.43520426	0.18828339	446.701246	0.26701291
PM18AJ272	E19JL15a263.csv	130114.107	1.59336594	3.20932151	0.00747928	0.23769619	89.1094995	85.14656	<0.0145	2.54137155	137.489106	2.95641317	0.7060089	428.414633	0.82679354
PM18AJ272	E19JL15a264.csv	122840.848	3.71896755	2.98485003	0.0156755	0.06418529	220.17939	213.985352	<0.0145	0.56116839	131.536586	0.86765061	0.09443445	463.448366	0.04519074

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ272	E19JL15a265.csv	120966.745	5.5820846	2.94182243	0.03377071	0.04069052	272.542607	261.812586	<0.0149	0.3660238	120.768629	0.54462356	0.11920505	489.521868	0.07397357
PM18AJ272	E19JL15a266.csv	118473.646	4.08942221	2.37306411	0.0141299	0.09400934	292.082872	284.943183	<0.0151	0.48038848	139.914498	0.65140401	0.08441885	455.657223	0.20169424
PM18AJ272	E19JL15a269.csv	128466.73	1.13562492	2.48977289	<0.00218	0.09820732	77.7580876	77.9482595	<0.0168	0.32042971	93.3749106	0.45267471	0.03473506	419.79221	0.08149567
PM18AJ272	E19JL15a270.csv	122118.587	0.98111598	2.81591291	<0.00215	0.13939872	27.7503642	29.2467373	<0.0165	0.29954669	101.488519	0.43143018	0.05315975	370.18422	0.05693964
PM18AJ272	E19JL15a271.csv	130029.628	1.17013934	2.04975385	<0.00205	0.12521336	19.4960352	16.9849089	<0.0158	0.23071172	100.083595	0.3794279	0.03008541	271.248925	0.02267265
PM18AJ272	E19JL15a272.csv	122031.634	1.02189146	2.61213872	<0.00218	0.06360581	67.9239258	63.4129586	<0.0169	0.19672793	95.5374567	0.22391461	<0.0075	472.15141	0.04686487
PM18AJ272	E19JL15a274.csv	127849.08	1.05212544	2.96680555	<0.00196	0.06452052	43.7859661	41.1501477	<0.0152	0.69105641	102.495943	0.41264359	0.04460005	266.692442	0.08616934
PM18AJ272	E19JL15a281.csv	126647.267	2.32329471	4.57075687	0.00551116	0.60701953	157.232896	155.326211	<0.0154	1.4628945	155.897063	0.68889131	0.08604326	436.013882	0.61297018
PM18AJ272	E19JL15a282.csv	125205.113	1.79917914	2.45653557	0.00451399	0.02141938	107.664686	108.631863	<0.0155	0.2623701	153.934291	0.34837896	0.03273727	352.35844	0.07821129
PM18AJ272	E19JL15a283.csv	123645.36	1.5832406	3.33598139	0.00213399	0.32903499	13.5655862	13.0123567	<0.015	0.60311041	95.6357737	0.63751229	0.02994295	461.674385	0.21524472
PM18AJ272	E19JL15a284.csv	128984.644	1.68962353	3.10026363	<0.002	0.04800463	71.3564937	72.378365	<0.0149	0.53502859	115.43898	1.98428983	0.30174905	497.855598	0.33201228
PM18AJ272	E19JL15a286.csv	119918.517	1.0817379	2.66487038	0.00303131	0.10627633	70.8804301	76.5463992	<0.0181	0.28350352	99.6636713	0.46937659	0.02279471	384.705981	0.04604412
PM18AJ272	E19JL15a287.csv	125845.723	1.32019075	1.71165016	<0.00265	0.00515049	17.6064501	18.1042437	<0.0192	0.15201314	99.2349451	0.35495718	0.04088361	435.825201	0.02047581
PM18AJ274	E19JN25a171.csv	105760.388	1.33031982	0.4606802	0.00251915	<0.00195	132.364544	134.242891	<0.0167	0.52191726	67.4835353	0.45996356	0.02253245	817.823625	0.02146033
PM18AJ274	E19JN25a172.csv	107877.721	1.35798184	1.55909903	<0.00178	<0.00213	163.463228	163.097316	<0.018	2.1616233	94.3905513	1.58546622	0.06741419	1170.2618	0.04629573
PM18AJ274	E19JN25a173.csv	109556.773	1.36451744	2.88542077	<0.00179	<0.00212	170.714753	171.969834	<0.0181	2.38918799	105.89829	2.39927502	0.0602396	1218.69859	0.07099564
PM18AJ274	E19JN25a174.csv	109874.751	1.49562617	1.10540325	0.00531395	<0.00227	144.775119	145.750868	<0.0196	1.84888934	89.3488222	1.22193218	0.07419952	1156.84776	0.02923525
PM18AJ274	E19JN25a181.csv	102993.24	1.70167952	22.1839312	0.0098603	0.01252204	151.423522	164.419727	<0.0232	2.16339674	106.274468	2.0370606	0.0636388	1222.07563	0.15795402
PM18AJ274	E19JN25a186.csv	123005.681	1.61922992	461.83823	0.00900956	0.00801687	230.063507	215.146866	<0.0181	4.18987363	120.538982	4.2571199	0.16616532	1007.51684	0.15140793
PM18AJ274	E19JN25a187.csv	119897.397	1.25957622	24.8075881	0.00287879	<0.00209	132.771669	132.121571	<0.017	0.8405723	56.5976712	0.63519979	0.03473968	702.536561	0.0126919
PM18AJ274	E19JN25a188.csv	116298.151	1.39233269	1.26128833	<0.00332	<0.00398	135.29445	135.739751	<0.0316	0.55139804	65.9194818	0.33484075	<0.0106	829.903859	<0.00656
PM18AJ274	E19JN25a189.csv	115632.641	1.89253555	1.02317416	<0.00251	0.00302995	162.965292	172.564325	<0.0237	0.93727163	139.630073	0.59881002	0.04606307	968.20279	0.07741479
PM18AJ274	E19JN25a191.csv	140013.768	1.3892079	49.1245969	0.00254434	0.03653844	66.6551295	68.6437456	0.02657892	1.3056112	131.028407	0.45463714	0.02386894	919.638613	0.46904515
PM18AJ274	E19JN25a192.csv	119553.702	1.36570031	2.11865993	0.00200271	0.01100826	77.3612527	79.7361657	<0.0178	0.1840262	143.097553	0.13777413	<0.00614	1267.85486	0.06830328
PM18AJ274	E19JN25a193.csv	130185.521	1.56231087	3.49132644	0.01334058	0.06257014	102.345946	100.839907	<0.0194	0.48216592	137.683841	1.61229101	0.10637317	1381.75191	0.45497017
PM18AJ274	E19JN25a194.csv	126755.738	1.44537319	2.60144455	0.0024813	0.02884571	62.1990758	64.419856	<0.0153	0.40131505	153.871638	0.3718732	0.02516341	1310.3286	0.87416395
PM18AJ274	E19JN25a195.csv	117938.38	1.30449744	1.24279573	<0.0016	0.01563942	103.906179	99.440687	<0.0145	0.24430264	253.757869	0.14610394	0.01869506	1443.76476	0.15606313
PM18AJ274	E19JN25a196.csv	130636.22	2.33389163	556.406983	<0.00342	0.01449562	168.113344	153.112234	<0.0307	3.70825223	127.890988	5.04144471	0.26180071	1020.12504	0.31415033
PM18AJ274	E19JN25a222.csv	110694.644	1.48143765	3.53891303	0.01976973	0.0992023	263.131118	259.121535	<0.0179	4.04400247	165.969688	1.047553	0.02757482	952.030644	0.52545057
PM18AJ274	E19JN25a223.csv	131161.316	1.33863962	1.50503405	<0.00178	0.01222918	187.976138	184.475047	0.01556579	1.67965082	153.471403	0.44077905	<0.00562	971.214369	0.12480133
PM18AJ274	E19JN25a224.csv	111952.747	1.66347911	20.6707018	0.002796	0.00878394	178.705512	191.381321	<0.0133	1.57689461	201.617511	0.92031978	0.04777356	941.985916	0.23977341
PM18AJ275	E19JN26a041.csv	131185.275	4.0315415	1.06064465	0.00738425	<0.00442	59.2964677	57.6119877	<0.0403	0.00973983	550.760542	0.72478071	0.09745233	1032.87816	0.0329021
PM18AJ275	E19JN26a042.csv	151555.861	4.77265029	13.4758772	<0.0035	<0.00448	53.914247	52.1504752	<0.0409	0.00563183	825.424702	1.79536736	0.1392924	849.319597	0.30727654
PM18AJ275	E19JN26a043.csv	135464.47	4.571847	2.1300045	<0.00354	<0.00453	50.4772344	48.2784508	<0.0415	0.04008085	788.004563	1.62817853	0.11680232	987.401406	0.17899889
PM18AJ275	E19JN26a044.csv	135320.161	4.61477237	4.19444743	<0.00403	<0.00514	41.6860475	38.9049986	<0.0475	0.04559514	874.956015	1.98874872	0.24632068	770.706653	0.41404801
PM18AJ275	E19JN26a045.csv	143762.131	4.40156471	2.45843788	<0.00625	<0.00786	43.9339348	37.8208832	<0.0738	0.00790575	781.799815	1.32033181	0.07029149	1026.35356	0.24570609
PM18AJ275	E19JN26a046.csv	131496.986	3.87478499	1.46324965	0.00731484	<0.00646	41.2964547	38.0876597	<0.059	0.02901139	720.354685	1.09143225	0.05329577	1060.33208	0.0715457
PM18AJ275	E19JN26a047.csv	134165.353	3.75418514	3.81684529	<0.00426	<0.00565	51.331729	51.7294522	<0.0506	0.02458416	651.930644	0.78578808	0.10502898	1056.7637	0.12470632
PM18AJ275	E19JN26a051.csv	133567.544	4.62045891	4.98827698	<0.00341	<0.00436	27.8101997	30.1616339	<0.0411	0.01351283	1107.699	2.78670534	0.19529916	854.745601	0.2411047
PM18AJ275	E19JN26a052.csv	129116.436	5.37240619	2.65138622	0.01455109	<0.00464	45.695047	46.0367891	<0.0433	0.0279716	1161.7953	2.48572265	0.27568123	1074.92234	0.22956784
PM18AJ275	E19JN26a053.csv	138245.389	4.44806623	2.60462381	0.00942377	<0.00527	56.6089483	58.9477697	<0.05	0.00810162	788.867603	1.51829933	0.10415885	1073.00467	0.16939461
PM18AJ275	E19JN26a054.csv	183598.617	4.19471814	28.5722295	<0.00541	0.01622654	55.8384966	53.5335979	0.07461189	0.01428917	636.679405	1.13029871	0.08643909	719.807596	0.20097728
PM18AJ275	E19JN26a056.csv	137242.678	5.2522711	2.3040526	0.00560911	<0.00702	28.8625332	29.3802368	<0.0662	0.01815755	1041.64173	2.37968558	0.10286608	1203.69972	0.20252988
PM18AJ275	E19JN26a057.csv	133887.056	5.43159359	2.2720281	0.00505951	<0.00488	24.9120944	24.5134458	<0.0462	0.02216426	1107.22106	2.34792186	0.23923339	1124.87439	0.0700086
PM18AJ275	E19JN26a058.csv	134870.263	5.05583463	2.34348593	<0.00364	<0.00473	37.5624455	35.1548512	<0.0448	0.02448487	1051.58103	2.38818493	0.10899182	1145.19579	0.17020813
PM18AJ275	E19JN26a059.csv	162962.727	4.20564779	15.3810034	<0.00604	0.01543294	39.9186479	42.9970422	<0.0744	0.05524726	816.040144	1.92505226	<0.0225	1050.48927	0.02772699
PM18AJ275	E19JN26a061.csv	136388.46	4.66533551	3.9630459	0.01337957	<0.00652	21.7320478	20.5524044	<0.062	0.08096619	906.108965	1.99627043	0.26807919	1050.25743	0.17533245
PM18AJ275	E19JN26a062.csv	137064.605	4.68812744	2.22957046	<0.00427	<0.00544	39.3498171	35.9533153	<0.0519	0.00887548	1081.81779	2.14187844	0.17087522	1028.15169	0.1787859
PM18AJ275	E19JN26a066.csv	142366.461	4.32430589	2.00325059	<0.00514	<0.00667	42.022821	42.0083362	<0.0635	0.00961122	765.66193	1.57635895	0.08953646	1102.55864	0.2611404
PM18AJ279	E19JN26a266.csv	139643.437	1.5904062	9.42201391	<0.00151	0.05115688	11.6689148	12.4962551	<0.0127	0.05085521	89.9135833	0.47123663	0.0644488	573.269728	0.0985922
PM18AJ279	E19JN26a267.csv	131837.738	1.44164545	26.954644	0.00185368	0.21244508	13.3229014	13.439858	<0.0134	0.1055859	90.7242748	12.8685712	0.86287687	533.270726	0.27919925
PM18AJ279	E19JN26a268.csv	139431.014	1.59456842	9.03359246	<0.00157	0.00875275	10.70682	11.7035077	<0.0131	0.02436835	100.335122	0.13838617	0.01137446	564.679264	0.05662328

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ279	E19JN26a275.csv	131266.996	2.29561627	10.2960402	<0.00202	0.00772462	16.0504245	14.3638805	0.01752774	0.03410033	103.119399	0.1086699	<0.00742	499.68578	0.07365843
PM18AJ279	E19JN26a276.csv	140939.248	2.21718751	12.9189691	<0.00158	0.06811306	16.6441766	17.958792	<0.0124	0.0673912	95.6286414	0.93457907	0.15068176	506.981891	0.3367835
PM18AJ279	E19JN26a277.csv	160174.46	2.00097639	10.2316167	<0.00173	0.02493141	34.0715029	32.6355436	<0.0135	0.03950139	97.947738	0.27567	0.05647554	557.42449	0.38132847
PM18AJ279	E19JN26a278.csv	130820.728	1.63322583	10.8334184	<0.00176	0.00630653	11.8559317	13.2502254	<0.0137	0.05771193	106.279849	0.09222854	<0.00646	528.377181	0.39837307
PM18AJ279	E19JN26a279.csv	134032.521	1.61411567	34.6762139	0.00221068	0.42636859	20.9460103	21.6902548	<0.0132	0.24147841	92.5432972	23.7302865	1.32766852	489.693698	0.80789147
PM18AJ279	E19JN26a280.csv	137291.242	1.75652117	8.98568392	<0.00148	0.00861346	12.4308451	13.2946754	<0.0114	0.0920834	96.94293	0.16377025	0.02641367	598.697742	0.21208378
PM18AJ279	E19JN26a281.csv	139283.357	1.57354708	14.6134395	<0.0015	0.04231475	13.406877	14.6725684	<0.0114	0.04036095	83.8205814	0.59235553	0.11999804	547.554713	0.56782093
PM18AJ279	E19JN26a282.csv	143937.21	1.71020391	14.4630472	<0.00174	0.0318133	18.0661916	16.3660822	<0.0132	0.02490818	86.6035235	0.4395326	0.08617991	558.31664	1.73309702
PM18AJ279	E19JN26a283.csv	164769.513	1.50841477	12.9828083	0.00545262	0.01225117	14.8728024	13.4278389	<0.0132	0.01734038	91.9329782	0.1441311	<0.00641	481.972815	0.32963025
PM18AJ279	E19JN26a286.csv	164674.986	1.76407394	13.8065502	0.00543592	0.1459386	283.16057	290.739792	<0.0237	0.10727274	78.6419927	1.86473625	0.3040175	534.472099	1.12613001
PM18AJ279	E19JN26a287.csv	133571.053	1.34778857	8.3316888	<0.00154	0.01121027	27.1821205	25.3521725	<0.0115	0.0488522	101.408808	0.21933714	0.03812053	513.295988	0.11772366
PM18AJ279	E19JN26a288.csv	137292.188	1.68784519	10.4559641	<0.00149	0.07822891	12.6199021	11.4400446	<0.0111	0.04286866	89.3073507	0.69729395	0.11209943	571.442953	0.32763074
PM18AJ279	E19JN26a289.csv	156950.281	1.39948732	9.34367079	<0.00196	0.00565752	12.5066891	11.5021917	<0.0145	0.03273723	86.9697685	0.07993099	<0.00721	470.671216	0.42002488
PM18AJ279	E19JN26a290.csv	138486.98	1.58699412	11.2999667	<0.00224	0.03369881	8.81578581	8.34019957	<0.0165	0.03920067	92.6045518	0.21053384	0.05883201	534.111421	0.16255625
PM18AJ279	E19JN26a291.csv	136154.062	1.40139547	18.9808933	0.00459185	0.01090167	29.7019334	28.0796109	<0.0156	0.06198797	95.5723015	1.16015265	0.09189753	406.314932	1.4969809
PM18AJ279	E19JN26a292.csv	133125.358	1.46508688	12.5462516	0.00170037	0.04180847	16.1753303	13.9786759	<0.0121	0.02493396	110.134572	0.55676664	0.09110703	510.377066	0.31381488
PM18AJ279	E19JN26a293.csv	134298.374	1.41715495	13.458296	<0.0015	0.02226414	41.5555622	46.9850742	<0.011	0.04417158	109.19875	0.37073699	0.04251244	499.040907	0.29405434
PM18AJ279	E19JN26a294.csv	142765.493	1.70346224	11.1924721	<0.00217	0.01189693	16.2336548	12.887329	<0.0159	0.08681943	103.477285	0.15908094	0.03145429	581.683252	0.53932596
PM18AJ279	E19JN26a295.csv	139119.731	1.55258585	9.7951011	<0.00149	0.00588256	19.4458829	18.0447888	<0.0109	0.04083872	98.9194793	0.19595108	0.0319645	574.993368	0.20455581
PM18AJ281	E19JL11a317.csv	122776.162	2.47353613	3.99129847	<0.00277	0.00924713	120.848671	120.290638	<0.021	0.01929352	144.243883	0.09043201	<0.00902	290.807778	0.38858461
PM18AJ281	E19JL11a318.csv	164578.433	2.06402984	72.7680248	<0.00301	0.01298504	86.9955302	85.2216126	<0.0227	0.01446004	99.2571701	0.07305545	<0.00979	195.254348	0.28432592
PM18AJ281	E19JL11a320.csv	129080.461	1.67091609	1.39841971	<0.00479	<0.00527	117.920811	125.430776	<0.0349	0.05197328	136.654414	0.25124521	0.03091544	296.410016	0.24801766
PM18AJ281	E19JL11a327.csv	118488.411	1.93370332	0.63407367	<0.00262	<0.00278	121.48358	118.079734	0.02186369	0.0442639	135.560667	0.20559666	0.00874161	291.146345	0.14185035
PM18AJ281	E19JL11a328.csv	122095.249	1.68644415	0.66800864	<0.00249	<0.00268	114.680301	112.81894	<0.0161	0.0576166	133.782245	0.21887167	0.01920887	295.368554	0.14084459
PM18AJ281	E19JL11a329.csv	121918.131	1.94119595	6.18562807	<0.00307	0.00730313	112.409589	111.603639	<0.0196	0.08349496	147.756602	0.51504381	0.03240849	281.23799	0.19751063
PM18AJ281	E19JL11a330.csv	113654.08	5.8722418	1.28927054	<0.00362	<0.0038	130.988357	119.525475	<0.0227	0.10243996	147.543828	0.75154126	0.04358184	284.061442	0.47825425
PM18AJ281	E19JL11a331.csv	121600.432	1.67859535	1.1263901	<0.00296	<0.00321	110.817454	114.31284	<0.0182	0.06448008	139.620521	1.11621572	0.0706365	303.752137	0.17019143
PM18AJ281	E19JL11a332.csv	124334.352	2.40107266	0.58167956	<0.00279	<0.003	106.912835	107.529815	<0.0169	0.05929225	142.171896	0.73220226	0.04868978	299.236483	0.25830934
PM18AJ281	E19JL11a333.csv	126534.304	2.31627056	0.66869205	<0.00279	<0.00295	108.660912	106.535037	<0.0166	0.05897644	142.218272	0.70394812	0.021814	304.941849	0.18463028
PM18AJ281	E19JL11a334.csv	118223.959	3.28501915	0.68398299	<0.00259	0.00953904	105.988474	109.520956	<0.0151	0.03200421	140.881577	0.78306742	0.01419191	293.185113	0.62005948
PM18AJ281	E19JL11a336.csv	124428.288	1.81415691	0.74011027	<0.00263	<0.00281	106.12825	101.460814	0.01808589	0.06096389	143.106677	1.47782702	0.08275784	303.812996	0.3028318
PM18AJ281	E19JL11a337.csv	123217.469	2.01930887	0.51376105	<0.0032	0.0048306	115.867173	117.197132	<0.0177	0.00634416	138.547104	0.49371766	0.01180182	282.125918	0.19283128
PM18AJ281	E19JL11a338.csv	113724.015	2.25705891	0.90786211	<0.00331	<0.0034	112.621062	113.01287	<0.0181	0.02422271	147.245698	0.12982984	<0.0105	287.775973	0.71908538
PM18AJ281	E19JL11a339.csv	124473.509	2.86235514	0.86666591	<0.00272	0.00468123	104.728801	101.02606	<0.0146	0.02358641	136.910108	0.17622532	0.0134136	295.566835	0.6655166
PM18AJ281	E19JL11a341.csv	117791.849	1.53977578	0.89313624	<0.00273	<0.00285	116.019997	115.875309	<0.0144	0.100833	133.125285	1.1309994	0.07433942	286.316983	0.17948168
PM18AJ281	E19JL11a342.csv	126886.947	1.34700349	19.7948805	<0.00288	<0.00299	121.174223	118.063246	<0.015	0.04419873	141.203406	0.11704577	0.01508566	260.623395	0.23418296
PM18AJ283	C19AU08C259.csv	134152.023	0.14876599	1.11822374	<0.00209		41.0757422	43.3829909	<0.0174		171.933338	0.20013979	0.03832899	342.676912	0.42138745
PM18AJ283	C19AU08C261.csv	133551.719	0.13154001	0.86917256	<0.00208		36.1797367	34.9457039	<0.0174		149.692846	0.13195176	0.01204413	339.057265	0.13669657
PM18AJ283	C19AU08C262.csv	133685.081	0.16582267	1.91328243	0.00700719		24.8975766	26.1988929	<0.0176		145.346999	0.11026114	<0.00541	358.613136	0.18111109
PM18AJ283	C19AU08C264.csv	135908.874	0.11480157	2.31959215	0.00258449		29.1762342	31.3146632	<0.0178		151.302831	0.22619098	<0.00546	416.305823	0.30262992
PM18AJ283	C19AU08C266.csv	133614.558	<0.0791	1.74977967	<0.0021		27.5602859	27.9042103	<0.0178		146.77888	0.26669426	0.02990639	410.799511	0.22072138
PM18AJ283	C19AU08C267.csv	131506.965	0.18549999	0.6392455	0.02424162		135.853554	139.725991	<0.0206		175.856238	2.3206025	0.20767541	286.308751	1.27640124
PM18AJ283	C19AU08C268.csv	134783.545	0.12530166	2.34776495	<0.0022		42.6395372	43.3981332	<0.0187		162.705373	0.20622018	0.02337383	431.04503	0.29463267
PM18AJ283	C19AU08C269.csv	136591.837	0.28154766	3.41520927	<0.00208		71.2411099	69.9015364	<0.0177		207.597634	1.13840259	0.0808768	377.545253	1.67951687
PM18AJ283	C19AU08C270.csv	130542.424	0.14773339	3.61740465	<0.00219		27.2482569	30.8768565	0.02018834		167.763057	0.184236	<0.00576	374.459942	0.42604673
PM18AJ283	C19AU08C272.csv	138899.322	0.18084571	1.62410062	0.00816008		25.9038826	23.509131	<0.0258		155.35938	0.18248904	<0.00787	407.150256	<0.00593
PM18AJ283	C19AU08C273.csv	134193.979	0.28025007	2.64937272	<0.00286		32.342419	30.3253392	<0.0246		165.206618	0.36270795	0.13400471	416.97878	0.18309498
PM18AJ283	C19AU08C280.csv	141061.325	0.27984118	2.30310051	<0.0021		102.917709	103.4557	<0.0188		183.40278	2.50877443	0.21621498	360.121204	2.15044219
PM18AJ283	C19AU08C281.csv	131965.173	0.18217957	1.59170903	<0.0021		31.4577743	33.3587758	<0.0188		163.724893	0.14226004	0.03782028	397.332421	0.3202097
PM18AJ283	C19AU08C284.csv	130497.24	0.20467402	8.93915702	<0.00263		48.6310991	50.1715905	<0.0238		197.086502	0.38770371	0.08180012	393.204481	1.18444015
PM18AJ283	C19AU08C285.csv	135099.04	0.16864477	2.28671608	<0.0021		55.947731	58.1638828	<0.0191		158.618743	0.43783384	0.01958048	373.825433	0.65447014
PM18AJ283	C19AU08C286.csv	134635.655	0.14894604	1.67812404	0.00242834		47.5784417	51.7336052	<0.0193		158.350313	0.07102312	0.02491321	442.651011	0.09584054

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ285	E19JL15a105.csv	137346.181	2.01945647	9.67592369	<0.00326	<0.00323	209.307604	213.017035	0.02681998	0.00399275	138.692496	0.08286215	0.02907209	130.599513	0.12009993
PM18AJ285	E19JL15a106.csv	126091.774	1.67569649	0.74348095	<0.00274	0.00707581	213.08097	214.998456	0.05081411	0.00476325	167.649156	0.05056959	0.00829554	123.703611	0.07096963
PM18AJ285	E19JL15a107.csv	127595.448	1.57733041	4.52208383	0.00445487	<0.00272	218.345193	211.936408	<0.0189	<0.00233	146.573619	<0.00268	<0.00703	90.2888365	0.04392365
PM18AJ285	E19JL15a108.csv	131515.63	1.9611493	0.43573546	<0.00273	<0.00274	224.867984	222.940028	<0.0192	<0.00236	169.669179	0.16149858	0.01151227	118.170557	0.22533117
PM18AJ285	E19JL15a109.csv	137373.274	1.74425905	2.44849513	<0.00345	<0.00346	153.264043	158.008468	0.03247246	0.00529529	103.154055	0.20968619	<0.00909	237.961839	0.56124029
PM18AJ285	E19JL15a110.csv	122781.384	1.50108846	0.45785719	<0.00272	<0.00273	217.860189	222.471224	0.03260108	<0.00238	174.238455	0.05463179	0.01914579	87.0022163	0.13803881
PM18AJ285	E19JL15a112.csv	133843.623	1.87712655	1.34615818	<0.00408	<0.0041	28.943999	29.2888058	<0.0284	<0.00352	109.038074	0.03125249	<0.0108	271.595439	0.04090869
PM18AJ285	E19JL15a113.csv	142863.894	1.46551068	29.0637774	<0.00236	0.00441993	155.344498	161.35453	0.01887572	0.00304711	128.69679	0.03274891	0.01106741	121.195901	0.15778043
PM18AJ285	E19JL15a114.csv	131772.939	1.61941035	1.9019164	0.00362591	0.00709356	359.994276	363.7125	0.0180878	0.00792965	159.80439	1.1075803	0.15457646	142.19155	2.13268004
PM18AJ285	E19JL15a116.csv	129358.868	1.51823386	2.67994907	<0.00278	<0.00279	182.347636	181.844204	<0.0192	0.0081226	94.3351051	0.32563295	0.06271972	233.309355	0.32795085
PM18AJ285	E19JL15a117.csv	126408.517	1.72378445	0.45670607	<0.00225	<0.00226	269.614028	266.490054	0.02587939	0.00301332	170.003787	0.04877372	0.00925712	94.5865148	0.07680132
PM18AJ285	E19JL15a118.csv	125813.407	1.47053129	1.60320408	<0.00264	<0.00265	244.119794	246.194505	0.03445471	0.01459597	117.776991	0.93472791	0.05758176	157.55007	1.92887057
PM18AJ285	E19JL15a119.csv	129372.529	1.47172334	2.11495398	0.00864052	0.00508355	425.461516	429.387431	<0.0169	0.00460668	146.934644	1.75776647	0.14848291	112.937654	1.65251255
PM18AJ285	E19JL15a120.csv	129186.498	1.28971848	2.52765919	<0.00249	0.00359036	76.1400876	74.4504401	0.03144816	<0.00216	79.7610093	0.09622179	0.00919848	237.442081	0.21722303
PM18AJ285	E19JL15a121.csv	128550.631	1.35307207	1.3154382	0.00374779	<0.00244	48.0921228	48.643793	<0.0167	<0.0021	86.7185185	0.13616325	<0.00652	228.412115	0.30317549
PM18AJ285	E19JL15a122.csv	128666.188	1.48665405	1.76307257	<0.00225	<0.00226	100.015638	96.0464608	0.03246461	<0.00194	161.314442	0.06513	0.01773362	206.659072	0.04904769
PM18AJ285	E19JL15a123.csv	127876.213	1.63151848	3.14170764	<0.00268	<0.00269	85.8582806	82.7345781	0.02339831	0.01792488	156.110117	0.07982515	<0.00723	213.176466	0.0679527
PM18AJ286	E19JL15a245.csv	123410.55	2.46742511	7.08180203	<0.00404	0.03012484	74.9934775	69.1724426	<0.0261	0.03930824	515.360251	1.22273486	0.02888367	375.147897	0.3447281
PM18AJ286	E19JL15a246.csv	134717.685	2.30562981	11.2647953	0.00291182	0.00823048	69.6811719	68.6415252	<0.0147	0.00846269	404.720549	0.21760461	0.01851317	345.853093	0.23888589
PM18AJ286	E19JL15a247.csv	128086.763	2.14242748	12.2621211	<0.00214	<0.00219	70.9939141	73.7204968	<0.0141	0.00871472	416.722502	0.26762867	0.02063975	413.320868	0.21728869
PM18AJ286	E19JL15a248.csv	129186.297	1.69682186	17.6025848	0.0025637	0.00851276	70.0958288	71.3850987	<0.014	0.01343478	383.826812	0.41488137	0.03458489	456.356831	0.38788143
PM18AJ286	E19JL15a249.csv	130142.689	1.43504078	17.9113787	0.0023129	0.01031264	65.699717	68.2432714	<0.0141	0.00437228	360.656096	0.37516917	0.02946539	452.106124	0.36399677
PM18AJ286	E19JL15a250.csv	129587.006	1.44618057	16.295346	<0.00213	0.01549718	73.9983302	69.105611	<0.0143	0.01238028	373.157856	0.32918094	0.00866579	456.375436	0.2730119
PM18AJ286	E19JL15a251.csv	128998.563	1.53127934	17.9154415	0.00236009	0.01353985	66.9501753	69.3443221	<0.0142	0.02118694	371.288185	0.34049116	0.03277367	445.352979	0.33606237
PM18AJ286	E19JL15a253.csv	125791.783	2.03307353	11.1501025	0.00230693	0.00871168	79.3436738	77.9863322	<0.0145	0.03661351	438.622759	0.27802192	<0.00702	388.407169	0.35753655
PM18AJ286	E19JL15a254.csv	141503.122	1.89634079	13.4125177	<0.00228	0.02638451	129.938782	132.034296	<0.0159	0.06193813	354.05748	0.3440794	0.0351616	391.835537	1.03644708
PM18AJ286	E19JL15a256.csv	130527.528	1.50824941	18.3559017	0.00235302	0.00571271	71.7812007	67.9030806	<0.0151	0.03943266	381.5663	0.42187468	0.0144318	437.37968	0.31547109
PM18AJ286	E19JL15a257.csv	136401.385	1.74701583	21.1151255	<0.00214	0.00573493	75.2805312	72.387577	<0.0153	0.12020748	391.195496	0.7077845	0.03916581	432.531137	0.41894339
PM18AJ286	E19JL15a258.csv	176726.651	1.26809589	9.80941552	<0.00214	<0.00218	55.9444747	52.7070586	<0.0154	0.02456026	257.614426	0.12588332	<0.0072	342.367376	0.29421995
PM18AJ286	E19JL15a261.csv	130691.669	1.22056044	19.528331	<0.00218	0.01311805	94.5661067	92.554306	<0.016	0.09799648	357.53474	0.58021187	0.05251795	454.171921	0.56130354
PM18AJ290	E19JL15a188.csv	134432.942	1.75634677	1.68760342	0.01414321	<0.0047	52.0127565	47.9693389	<0.0324	0.00613116	299.173724	0.5869888	0.07910087	258.029518	0.14771031
PM18AJ290	E19JL15a189.csv	122840.95	1.39753455	42.816254	<0.00212	<0.00215	72.5940027	77.9982978	<0.0148	<0.00192	303.434414	0.4845756	0.08691353	203.927706	0.01248024
PM18AJ290	E19JL15a191.csv	125450.88	1.59483627	1.19747304	<0.00214	0.00270255	137.925998	141.184791	<0.0147	0.00314759	272.212288	0.05372981	<0.00647	203.863576	0.07203066
PM18AJ290	E19JL15a192.csv	124099.943	1.37230972	1.60164457	<0.0021	0.00627787	109.065581	106.829063	<0.0144	0.00315518	335.772031	0.15541268	0.00838587	212.957085	<0.00407
PM18AJ290	E19JL15a194.csv	118624.452	1.27178162	2.40373287	0.0055515	<0.00329	83.6935474	78.936359	<0.022	<0.00294	332.02822	0.15822214	0.02481124	196.339225	0.02584451
PM18AJ290	E19JL15a195.csv	126191.557	1.54847161	1.69019076	<0.00212	<0.00213	83.3596394	84.1322416	<0.0142	<0.00191	325.674947	0.30119215	0.02965471	216.559079	0.0117828
PM18AJ290	E19JL15a196.csv	116420.309	1.25010593	1.0568523	<0.00304	<0.00309	123.704075	123.377508	<0.0203	<0.00276	289.76269	0.05216247	<0.00927	185.242183	<0.00579
PM18AJ290	E19JL15a197.csv	127309.631	1.31294046	1.23785873	<0.00205	0.00532173	23.9692278	24.5176083	<0.0136	0.00282977	271.040683	0.38322616	0.03695444	229.784487	0.19772868
PM18AJ290	E19JL15a198.csv	118355.508	1.1143038	2.55083909	<0.00244	0.00599085	58.0585958	56.608114	<0.0161	0.00536013	317.220828	0.95968656	0.03228422	209.861819	0.06229033
PM18AJ290	E19JL15a199.csv	121897.531	1.03104066	1.20502017	<0.00231	<0.00234	47.398577	43.5406991	<0.0151	0.00410394	334.134678	0.38974578	<0.007	209.932335	0.00712356
PM18AJ290	E19JL15a200.csv	125641.123	1.34118709	2.13412778	<0.00207	<0.0021	39.7712187	38.4917224	<0.0135	0.00421771	311.712218	0.5230861	0.0143016	230.638481	0.02235389
PM18AJ290	E19JL15a201.csv	127125.2	1.14772498	1.74108769	<0.00203	0.00306109	16.0971957	15.7128371	<0.0131	0.00412063	216.173032	0.35492083	0.00803335	240.827012	0.03097554
PM18AJ290	E19JL15a202.csv	125700.129	1.15521514	2.31449569	<0.00204	<0.00207	34.2426845	34.2335254	<0.0131	0.00287221	258.956926	0.52747109	<0.00627	238.439114	0.05822761
PM18AJ290	E19JL15a203.csv	127739.851	1.19215023	6.17482786	<0.00203	<0.00206	13.481156	12.8153309	<0.013	<0.00185	159.432335	0.14970996	<0.00626	286.375386	0.02109548
PM18AJ290	E19JL15a204.csv	129051.277	1.2620191	3.8052109	<0.002	0.00572914	29.3149973	30.0077724	<0.0127	0.00343033	189.719664	0.66102359	0.08986987	242.081464	0.92755651
PM18AJ290	E19JL15a205.csv	121635.491	1.08481628	1.96767248	<0.00239	<0.00243	30.6191278	31.843734	<0.0151	0.00503843	298.105849	0.23302107	0.02224622	217.994543	<0.00472
PM18AJ299	E19JL11a271.csv	122194.805	1.74120263	1.51029705	0.01145149	<0.00416	65.9014156	70.883952	<0.0269	0.21184199	126.43636	0.10893637	<0.0132	1486.41354	<0.0074
PM18AJ299	E19JL11a276.csv	117198.873	1.12875156	3.16050004	0.00502845	0.00522762	67.9170598	74.042839	<0.0238	0.24876855	138.388792	0.10828087	<0.011	1321.45149	0.01875171
PM18AJ299	E19JL11a277.csv	126349.8	1.30174129	3.4168289	<0.00219	<0.00245	149.744574	149.006112	<0.0166	0.06783331	166.849935	0.11827095	<0.00758	1137.57888	0.02257799
PM18AJ299	E19JL11a278.csv	122620.515	1.3182258	1.92236643	<0.00258	<0.00292	63.7921919	58.9884184	<0.0197	0.04289277	109.990826	0.04418	<0.00892	1741.74894	0.0580048
PM18AJ299	E19JL11a279.csv	127889.829	1.34859681	2.43976835	<0.00237	0.00417906	53.9146743	55.611443	<0.0182	0.11680728	127.547055	0.15981255	<0.0082	1437.56673	0.02635418
PM18AJ299	E19JL11a281.csv	118440.845	1.30275764	2.38429228	0.04098089	0.00960009	145.087697	154.802853	<0.0168	0.21186191	141.539106	0.41103104	0.04940289	1511.0926	0.18920217

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ299	E19JL11a282.csv	121170.339	1.08861612	2.80971728	0.00400572	<0.00237	69.5745562	67.9819882	<0.0166	0.04471738	148.530228	0.1062988	<0.00733	1415.1608	0.06503583
PM18AJ299	E19JL11a283.csv	135634.696	1.21256763	10.2763057	0.00263752	0.00953505	21.5919185	24.1051684	<0.0178	0.45710193	129.754223	0.24588923	0.01222761	1379.95336	0.16461518
PM18AJ299	E19JL11a284.csv	123058.169	1.25162125	2.79593948	0.00233496	0.29883279	57.9869769	58.3295833	<0.0171	0.08806676	135.493019	0.0986285	0.01095506	1517.88898	0.32916305
PM18AJ299	E19JL11a285.csv	121624.451	1.15594228	4.43945738	<0.00317	<0.00362	54.4066171	52.2173194	<0.0251	0.2217995	121.189758	0.16004339	<0.0108	1600.26863	0.01578695
PM18AJ299	E19JL11a287.csv	141265.855	1.04467183	182.836363	<0.00363	0.01067635	45.3433977	45.8539631	<0.0296	0.30780752	121.63656	0.64464547	0.05258544	1223.78805	0.51960076
PM18AJ299	E19JL11a289.csv	114698.051	0.95001028	2.10746788	<0.00232	<0.00255	92.2575938	91.9616704	<0.0187	0.00719514	168.285531	0.06566055	<0.00789	1421.9236	0.00671014
PM18AJ299	E19JL11a290.csv	119641.269	2.38970017	2.02556581	<0.00224	0.00265012	59.7475143	58.0845807	<0.0181	0.00324171	128.931524	0.0615426	0.01254771	1440.61256	0.11118418
PM18AJ299	E19JL11a291.csv	120232.823	1.07922911	1.88101554	0.00512569	<0.00352	91.1543471	91.3957878	<0.0268	0.02629463	135.769083	0.1571903	<0.0112	1454.45316	0.46024404
PM18AJ299	E19JL11a292.csv	116909.566	1.80244281	2.69219572	<0.00222	0.02829106	342.371274	345.099578	<0.0181	0.02874417	202.090286	0.22688484	0.05228735	1255.09868	0.0894974
PM18AJ302	E19JL15a207.csv	143022.829	1.91845415	23.1890602	0.00469172	1.97905111	28.9688225	24.0611476	<0.0134	0.80455361	80.3028126	14.4405082	0.53152199	411.890742	0.67918531
PM18AJ302	E19JL15a208.csv	156101.546	2.19851247	22.0557259	0.00595326	2.58180006	104.12487	118.741975	<0.0273	1.80281536	84.6765225	24.0212323	1.54839041	474.876835	1.41697783
PM18AJ302	E19JL15a215.csv	141965.94	2.067903	23.6648426	0.00706971	1.53028604	75.2228862	72.4003904	0.01668621	3.26812481	98.057075	28.4341027	1.78021061	353.387002	1.66067629
PM18AJ302	E19JL15a216.csv	148722.914	1.80723993	24.7976887	0.00756326	1.59786831	54.4832458	50.5954487	0.01816816	1.07917676	100.855362	25.1262669	1.28651807	421.794576	1.19676742
PM18AJ302	E19JL15a217.csv	149162.173	1.46023019	16.4544927	0.00452911	2.32978583	34.4092254	31.1678094	<0.0112	0.65541731	58.4681138	15.6127635	0.60428537	338.345658	1.11725083
PM18AJ302	E19JL15a219.csv	137813.936	1.29799431	11.9777236	0.01273383	4.66575386	90.0160367	95.8112802	<0.0116	1.08346288	70.2110361	9.59207155	0.4411599	385.937234	2.48739883
PM18AJ302	E19JL15a220.csv	127843.241	1.43666305	5.30614653	0.00347956	3.2678621	65.7279075	65.0603397	0.02174991	0.31455312	75.0142236	4.69884475	0.25025217	467.721162	0.57444607
PM18AJ302	E19JL15a221.csv	125535.2	1.28493966	4.99918311	<0.00197	3.57919728	79.7511747	77.8489507	0.01193201	0.45908063	77.5998723	8.73380805	0.53160596	452.973804	0.83815316
PM18AJ302	E19JL15a222.csv	123284.047	1.30395477	4.92571186	0.00505541	2.93858664	83.5144013	79.8914101	<0.0146	0.3313879	77.473723	8.2538535	0.37624331	452.605741	1.15248679
PM18AJ302	E19JL15a223.csv	127123.865	1.34484562	2.86595262	0.0049486	2.06850847	70.5929866	68.6558593	<0.0119	0.18570646	77.7192628	2.28133984	0.12033685	473.246311	0.35985144
PM18AJ302	E19JL15a224.csv	121400.791	1.33615814	2.2600038	0.00579089	0.50813959	25.1513517	24.0724577	<0.0126	0.07683392	89.1988842	1.0011847	0.06170108	356.80316	0.13240302
PM18AJ302	E19JL15a225.csv	117211.074	1.12241915	1.45713895	<0.00228	0.02662294	20.9039065	21.0405528	<0.0134	0.05697487	105.988083	0.27655028	<0.0072	372.761037	0.00833397
PM18AJ302	E19JL15a226.csv	151677.378	1.3617141	16.3996173	0.00785082	2.28908483	48.0339904	48.1001978	0.01874549	3.55283289	84.0211632	30.726513	1.63289629	315.724823	0.94011926
PM18AJ302	E19JL15a228.csv	124130.978	1.27585779	1.39623009	<0.00204	1.2882801	80.3121177	79.0125229	0.01514314	0.2763222	69.7561631	1.52974632	0.10232592	668.946503	0.60519356
PM18AJ302	E19JL15a229.csv	126787.687	1.36530238	2.54812494	<0.00202	0.6695412	27.1026018	25.4485021	<0.012	0.168023	61.6852666	2.36278868	0.14095031	352.627305	0.23382804
PM18AJ302	E19JL15a230.csv	124025.498	1.39694847	2.21061458	<0.00202	0.72128119	69.5888075	68.3401972	<0.012	0.07984492	56.3278071	1.67032846	0.05567688	258.975579	0.18464385
PM18AJ302	E19JL15a231.csv	151006.498	1.87499361	24.8541026	0.00594531	2.15317314	63.1923834	62.6671304	<0.0109	1.69652675	84.7925622	24.3948168	1.19164708	423.238574	0.69998333
PM18AJ304	E19JN25a065.csv	128479.012	1.77406314	1.38609317	<0.00153	0.02287171	61.5645707	60.0732761	<0.0215	0.09101778	199.230084	0.17644559	0.01497248	655.329528	0.46159475
PM18AJ304	E19JN25a066.csv	124313.125	1.48722524	3.60275655	0.01401532	0.07792683	73.5278241	69.9156267	<0.0278	0.26594235	126.200248	0.62420493	0.0677565	648.624968	0.87471884
PM18AJ304	E19JN25a067.csv	126979.716	2.26899655	3.98981494	0.0043042	0.27630235	56.9508451	55.4258934	<0.0231	0.3970144	174.866698	1.32740135	0.06296832	626.634588	2.6056914
PM18AJ304	E19JN25a069.csv	123738.906	2.65300121	1.47282236	<0.00213	0.13757506	59.6517015	55.3393979	<0.0297	0.04686299	261.966866	0.39003123	0.03456678	617.503032	1.12989242
PM18AJ304	E19JN25a071.csv	124903.818	3.37468543	1.165154	0.00183988	0.12669792	56.5625413	58.671586	<0.0211	0.08732258	592.759702	0.20516321	0.01824787	582.797772	0.82652796
PM18AJ304	E19JN25a072.csv	131467.212	2.8532936	1.24740665	<0.00214	0.11096354	52.3859041	53.5358422	<0.0293	0.10905326	365.960409	0.23578992	0.03412193	730.874867	0.82335932
PM18AJ304	E19JN25a086.csv	129473.342	1.64290003	2.32253293	0.00273076	0.18106694	54.1630665	53.6621128	<0.019	0.18150422	144.65723	0.50960847	0.06648474	728.466722	0.36567243
PM18AJ304	E19JN25a087.csv	134614.384	1.54418845	3.33925144	<0.00151	0.21242727	47.266416	43.0304667	<0.0183	0.21872992	121.678229	0.74241135	0.06354305	696.732633	0.53123528
PM18AJ304	E19JN25a088.csv	134677.965	1.45995765	3.11225344	<0.00149	0.33452756	42.7520283	46.7331854	<0.0178	0.29042032	120.635387	0.7026937	0.07596899	702.452998	1.46285915
PM18AJ304	E19JN25a089.csv	119347.781	1.77771301	2.31946893	<0.00257	0.14958693	58.6939513	66.0579218	<0.0305	0.16253557	366.591585	0.42761776	0.03042395	554.340333	1.43492987
PM18AJ304	E19JN25a090.csv	128258.972	1.85837895	2.75398237	<0.00153	0.12072855	75.7316532	75.1127717	<0.0179	0.15688393	237.79522	0.64909953	0.05030096	709.620684	1.1493944
PM18AJ304	E19JN25a091.csv	118005.232	1.57875398	2.43462565	0.0184114	0.16275389	173.128965	186.429052	<0.0322	0.17411336	234.009643	0.66709643	0.11526027	629.147641	2.3168472
PM18AJ304	E19JN25a092.csv	129764.753	1.47675471	2.57193308	<0.00152	0.35594956	57.4814591	57.0546894	<0.0175	0.26145931	119.989866	0.53261078	0.03630112	730.988568	1.72403752
PM18AJ304	E19JN25a093.csv	129115.724	1.46493902	2.97515978	0.00333767	0.31607229	60.768289	61.9881744	<0.0173	0.26161516	114.520305	0.58484962	0.06560581	729.144014	1.32871335
PM18AJ304	E19JN25a095.csv	133736.525	1.41970148	4.68207732	<0.00229	0.48540048	57.5897074	59.7320074	<0.0249	0.28645107	103.282095	1.99898057	0.17042842	758.592223	0.52533695
PM18AJ304	E19JN25a096.csv	132829.095	1.33131762	2.55335967	0.00257114	0.25696404	61.4505755	59.167144	<0.0168	0.39576649	112.329511	0.74743409	0.06062686	659.690129	0.57841287
PM18AJ304	E19JN25a097.csv	134789.726	1.494266	2.7954156	0.00518134	0.28561713	51.700237	53.2664976	<0.021	0.21163195	125.979827	0.67555306	0.08690775	679.022966	1.70062642
PM18AJ304	E19JN25a101.csv	121556.287	1.75878173	1.99099625	<0.00179	0.16751537	67.728904	67.9417931	<0.0189	0.12071879	175.533091	0.37902789	0.05350052	647.063464	1.06659684
PM18AJ304	E19JN25a102.csv	127116.936	3.7783127	8.3855555	0.00390308	0.13303354	47.5270133	47.4312156	<0.0159	0.12895199	828.984945	0.50644463	0.10135009	575.258077	1.3603089
PM18AJ304	E19JN25a103.csv	117906.451	1.49622153	1.35203619	0.00395753	0.04284048	88.1998919	90.0744238	<0.0214	0.0531131	153.686666	0.25799577	0.01686578	713.459114	0.46147227
PM18AJ304	E19JN25a104.csv	127401.754	1.82046317	1.66166792	0.00408762	0.03891541	51.4502951	47.6840291	<0.0185	0.07137317	133.785515	0.60611957	0.04474992	798.007615	0.6588633
PM18AJ305	E19JL15a151.csv	138697.965	1.69243171	67.2682774	<0.00201	0.13690775	52.6814273	53.8946352	<0.0148	0.20772147	472.484349	4.06359836	0.56939328	391.26736	1.8525634
PM18AJ305	E19JL15a152.csv	140399.612	1.75097822	52.6423312	0.00447276	0.16294402	59.1013468	59.9978685	<0.0143	0.14549079	442.920204	4.07753251	0.59162359	390.397794	1.4408939
PM18AJ305	E19JL15a153.csv	138456.455	1.6193256	57.9373732	0.00200018	0.33470953	65.5676079	65.336107	<0.0148	0.16819308	461.638543	5.06901153	0.71266513	400.752159	1.83068556
PM18AJ305	E19JL15a154.csv	138858.061	1.56283966	55.5705786	<0.00223	0.05145656	65.794497	62.3786787	<0.0166	0.16344445	430.117653	5.80491008	0.91750349	391.951617	1.74635217
PM18AJ305	E19JL15a155.csv	142954.161	1.51455588	61.0150888	0.00497061	0.15645239	59.7559265	60.2304129	<0.0153	0.15266524	453.55488	3.87098962	0.43365474	359.388234	1.38596369

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix G:
Pemberton Hills Chlorite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Si29	Sn118	Sr88	Ta181	Th232	Ti47	Ti49	Tl205	U238	V51	Y89	Yb172	Zn66	Zr90
PM18AJ305	E19JL15a156.csv	130887.9	1.42794201	88.5264982	0.01094363	0.1934777	51.6099284	50.9963858	<0.0213	0.29120913	432.110413	3.66098278	0.40709875	358.058885	1.30767022
PM18AJ305	E19JL15a157.csv	134942.224	1.49819901	77.5439907	0.00688625	0.21767303	53.4477498	51.2357428	<0.0149	0.23698658	436.742508	4.25522203	0.59074577	392.759757	1.85850597
PM18AJ305	E19JL15a158.csv	138941.254	1.48812135	49.4722426	0.0099363	0.2343811	71.8865982	72.8650948	<0.0152	0.1770382	428.587509	5.71234489	0.80031035	422.452042	2.14017781
PM18AJ305	E19JL15a159.csv	139353.282	1.3172114	61.6009735	0.00346796	0.15501765	55.2968205	56.0867514	<0.0167	0.17448201	408.943348	4.70609417	0.68694446	416.06265	1.50684377
PM18AJ305	E19JL15a160.csv	138139.407	1.40830389	73.6799911	0.0068924	0.2789251	48.340599	48.311335	<0.015	0.23410699	425.039384	3.5741912	0.43520237	393.303202	1.90347751
PM18AJ305	E19JL15a161.csv	135824.132	1.29379514	70.7256151	0.0138141	0.22947006	49.8494221	47.3039616	<0.0154	0.25620714	451.073716	3.76567087	0.48955387	381.785206	2.04603383
PM18AJ305	E19JL15a162.csv	138355.94	1.39205218	59.7321752	0.01158947	0.19644309	58.1955314	58.7448034	<0.0149	0.20782413	465.361351	4.29547166	0.69228292	385.15262	2.19316742
PM18AJ305	E19JL15a163.csv	177979.28	1.23508631	48.551922	<0.00257	0.12156112	77.7345882	71.9440801	<0.0195	0.18602249	386.088062	5.30553914	0.61911273	334.742156	1.51170879
PM18AJ305	E19JL15a164.csv	147401.755	1.235317	79.3747607	0.0032392	0.12323435	60.1421331	62.0796871	<0.0145	0.19826233	427.486731	4.21183503	0.57004743	382.40651	1.59559226
PM18AJ305	E19JL15a165.csv	141176.439	1.29975815	67.600069	0.00672263	0.34452848	63.8634747	64.3856831	<0.0213	0.20331097	390.071272	11.7926314	1.02783467	437.853561	1.78582216
PM18AJ305	E19JL15a166.csv	138109.836	1.19355096	76.86317	<0.00201	0.19116858	54.8768095	53.9345845	<0.0151	0.21793044	432.881767	3.85980439	0.4744972	377.32818	1.65849334
PM18AJ305	E19JL15a168.csv	131794.398	1.03257871	47.748571	<0.00217	0.3911228	65.7012678	65.9719373	<0.0163	0.19159778	433.102145	5.94779118	0.83850948	377.358466	1.66480836
PM18AJ309	E19JL15a308.csv	155118.101	5.0926417	26.849197	<0.00243	<0.00253	8.93872834	8.53856911	0.01452619	0.01154324	78.2800997	0.04592003	<0.00883	4518.9025	0.10675203
PM18AJ309	E19JL15a309.csv	190677.478	2.93874651	26.2212854	<0.00206	<0.00212	7.83670927	7.7866684	0.0164426	0.01119374	67.3909972	0.05239197	<0.0075	6476.8724	0.09526281
PM18AJ309	E19JL15a310.csv	163880.52	1.04712569	19.9287662	<0.00208	<0.00216	12.0246282	8.25221714	0.02661253	0.00649752	61.709546	0.00592377	<0.0076	1358.38558	0.33110358
PM18AJ309	E19JL15a311.csv	172739.17	1.04397256	17.8427354	<0.00226	0.00426823	11.6422522	11.5632101	0.01969172	0.00374107	69.1709712	0.04359248	<0.00827	1656.81933	0.33063861
PM18AJ309	E19JL15a312.csv	177949.836	1.0423409	24.0693965	<0.00242	<0.0025	11.0961928	10.3455246	0.03489139	0.00608418	79.0390421	0.0401929	<0.00862	959.938992	0.46427727
PM18AJ309	E19JL15a314.csv	187644.284	1.73506915	11.5766996	<0.00265	<0.00273	13.3923605	10.9551015	0.02076677	0.01277277	85.020499	0.08242188	<0.00973	755.756042	0.47511445
PM18AJ309	E19JL15a315.csv	158496.951	1.32177488	19.737871	0.00347959	<0.00266	12.1284754	11.6091201	0.02687258	0.0080013	113.471903	0.04411201	0.02541015	344.28277	0.41493483
PM18AJ309	E19JL15a316.csv	173875.203	1.78276528	12.9558467	0.00477042	<0.00419	27.2077027	28.6087227	<0.0198	0.00851766	102.254021	0.08302966	<0.015	374.474568	0.84712687
PM18AJ309	E19JL15a317.csv	158569.522	1.09626586	27.3047747	<0.00221	<0.00228	10.7806326	11.8992688	0.01453516	0.00969573	118.975117	0.03708318	<0.00811	286.897898	0.42277243
PM18AJ309	E19JL15a318.csv	155803.382	1.16653673	11.5599061	<0.00202	<0.00208	5.67636471	6.33857563	<0.0103	0.01599891	81.28218	0.0528287	<0.00745	3093.11439	0.18210421
PM18AJ309	E19JL15a319.csv	164767.006	7.6912868	11.3485733	0.0039392	0.07016098	23.7388006	27.6306894	0.01808331	0.05276793	79.5659213	0.48655412	0.01096651	1760.78537	1.11388928
PM18AJ309	E19JL15a323.csv	161355.968	1.00338597	23.5661107	<0.00341	0.01026311	295.54343	303.386799	<0.0222	0.00907184	74.7027463	0.199813	<0.0127	875.013608	0.7177192
PM18AJ309	E19JL15a324.csv	176575.153	0.75121432	21.2305192	<0.00325	0.38161262	51.2802682	65.488819	<0.0225	0.10560973	75.7395382	0.09741914	<0.0121	924.522268	0.28608622
PM18AJ309	E19JL15a325.csv	160970.325	1.04490264	45.8492477	<0.00203	0.00301322	7.68696281	7.378861	<0.0151	0.00396745	72.4851111	0.02986632	0.01220705	2722.68908	0.11082688
PM18AJ309	E19JL15a326.csv	173143.024	1.02652675	18.902719	<0.0021	<0.00217	8.10824637	7.6035528	0.01820893	0.00598153	76.6220622	0.01911586	<0.00785	2739.8685	0.13674504
PM18AJ311	C19AU08C197.csv	136174.57	0.3682651	21.0812013	<0.00216		133.846547	142.891508	<0.0229		484.1078	5.76329983	0.60586272	393.907782	1.34531782
PM18AJ311	C19AU08C198.csv	139373.033	0.49246318	21.7160892	0.01728062		150.865422	162.460206	<0.0213		471.109375	9.50930993	1.01039884	400.382093	1.39061862
PM18AJ311	C19AU08C199.csv	131876.023	0.49776398	23.2079129	<0.00257		152.038155	158.122349	<0.0273		474.875857	9.21940728	0.830672	369.122645	1.64622575
PM18AJ311	C19AU08C206.csv	136593.943	0.59957164	24.0031706	<0.00342		151.822527	187.026897	<0.0366		481.907064	8.00720279	0.95729377	418.838808	2.15746122
PM18AJ311	C19AU08C207.csv	138956.742	0.3177482	18.7859861	0.0023602		136.643554	136.642561	<0.0204		542.927485	4.86150644	0.51763637	394.891936	1.62687015
PM18AJ311	C19AU08C208.csv	143433.472	0.34023263	19.8396575	<0.0029		143.47568	148.902617	<0.0309		505.437935	4.82068874	0.42560847	382.287929	1.75071479
PM18AJ311	C19AU08C209.csv	131464.983	0.36672369	12.8102786	<0.00194		144.074519	145.613245	<0.0206		466.789935	1.81302036	0.21742412	410.385596	0.49651467
PM18AJ311	C19AU08C211.csv	134778.348	0.44221772	18.2798099	0.00240888		133.381849	132.049242	<0.0207		593.329101	6.55426589	0.59188289	390.85192	1.26700232
PM18AJ311	C19AU08C212.csv	135471.539	0.45121563	20.9143152	0.00239805		123.152064	125.099106	<0.0205		537.495857	5.51621507	0.43059434	387.345141	0.82003796
PM18AJ311	C19AU08C213.csv	135492.284	0.42356907	25.6937475	0.00251125		118.178554	119.581502	<0.0205		541.137422	7.55985048	0.75775679	377.754788	1.24811015
PM18AJ311	C19AU08C215.csv	136708.177	0.43361027	27.4756554	0.00526935		139.054405	138.493937	<0.0209		509.090179	12.3959127	0.96724941	353.443089	2.08737563
PM18AJ311	C19AU08C216.csv	133955.62	0.39955861	21.773719	0.00293529		133.920833	134.456233	<0.0198		553.066801	6.33147064	0.67970502	368.356868	1.80460764
PM18AJ311	C19AU08C218.csv	131117.725	0.28180605	24.3460104	0.03878022		144.540378	137.579178	<0.0239		490.245149	10.3175343	1.09220604	395.234441	1.35080892
PM18AJ311	C19AU08C219.csv	134757.907	0.57120861	21.5829052	0.00234993		136.167597	135.526102	<0.0196		488.71611	9.37554159	0.98973907	392.946487	1.3735447
PM18AJ311	C19AU08C220.csv	133723.772	0.43308401	20.4290974	0.01084193		136.573198	137.325975	<0.0194		573.673048	6.58386305	0.60313548	382.06451	1.32176335
PM18AJ311	C19AU08C222.csv	135572.759	0.43657208	19.0874014	0.00247332		132.618052	134.140327	<0.0194		557.528078	7.93523259	0.85393789	383.638712	1.34722298
PM18AJ311	C19AU08C223.csv	140966.072	0.43096695	21.4962998	0.01411595		141.025959	139.278896	<0.0316		549.81178	5.40989341	0.59037243	374.373204	1.18147809
PM18AJ311	C19AU08C224.csv	129921.251	0.38240726	22.2182647	0.0147354		134.715982	127.869872	<0.0209		588.549933	5.45180092	0.54210807	375.228147	1.83149176
PM18AJ311	C19AU08C225.csv	138575.571	0.48557762	20.814117	<0.00369		147.229731	131.111137	<0.036		564.496738	5.43234167	0.3682103	400.380087	0.84595597
PM18AJ311	C19AU08C226.csv	140247.852	0.75983774	19.4764241	<0.00477		130.902284	139.797403	<0.0462		584.097556	4.52836009	0.50181347	412.756298	1.09766414

Samples PM18AJ212, PM18AJ244, PM18AJ283, and PM18AJ311 did not have Pb isotopes 206 and 207 measured. All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ027	D19AU19a262.csv	0.03646109	15.6699771	68.2127982	<0.003	0.015385	24.1679157	0.04604333	42.3349381	<0.240	1.81418617	464670.6474	0.13479	0.49336389	<2.676	18.7638938	1.41025115	0.02833086	<6.479	<0.001	23.3997477
PM18AJ027	D19AU19a267.csv	<0.031	0.60285491	80.7792136	<0.003	0.00714323	41.7832085	<0.015	20.4084971	<0.233	0.42817337	465311.3341	<0.004	<0.002	<2.585	0.57121217	1.25180911	<0.008	<6.238	<0.001	86.5022164
PM18AJ027	D19AU19a272.csv	<0.029	3.8243557	93.2486918	<0.003	0.00295268	69.1591208	<0.012	15.5658875	<0.220	0.19793073	465227.8119	<0.004	0.11825974	<2.423	1.81922338	0.35968027	<0.008	<5.759	0.00324862	61.1729286
PM18AJ027	D19AU19a273.csv	0.6699301	5.34247619	105.77345	0.00493014	0.02330137	<23.238	0.0440142	346.92802	<0.251	762.89111	463771.8691	0.03762524	0.24143969	<2.768	3.16752658	1.20459079	<0.009	<6.643	0.00867564	137.161096
PM18AJ027	D19AU19a274.csv	<0.033	8.47197101	7.03949705	<0.003	0.00602187	34.1867348	<0.013	285.235275	<0.250	0.35706805	464787.4884	<0.004	<0.002	<2.748	9.9346417	0.49490167	<0.009	<6.589	<0.001	370.712984
PM18AJ027	D19AU19a255.csv	0.06023742	9585.10575	358.845793	0.01021017	0.04128847	5344.54784	0.06679536	47.8297624	<0.309	36.4101729	436550.7872	0.0943941	0.15744848	151.013333	73.3572321	10.457366	<0.011	1490.21173	0.30833259	74.3146117
PM18AJ027	D19AU19a256.csv	0.10313755	1487.12841	45.8965622	0.00522105	0.04294636	49.834616	<0.018	41.4409308	<0.234	24.1381293	461959.1513	0.04030293	0.68214369	13.7331755	22.1420227	12.8540541	0.01981689	<6.356	<0.001	62.6769366
PM18AJ027	D19AU19a257.csv	25.2020567	142.839018	14.3699632	0.00589206	0.17395583	267.365014	2.2464173	792.863583	<0.228	936.278723	461568.6626	<0.004	0.08783413	8.7592563	176.307886	20.3145994	0.02141634	410.965176	0.00153842	41.5661879
PM18AJ027	D19AU19a258.csv	0.04484422	4324.3511	93.8410329	<0.004	0.03977348	1850.96046	<0.022	11.9110747	0.35694058	8.87066317	442120.5821	0.59791864	0.84213457	206.024299	46.0786149	5.63938914	0.04271532	1511.32221	0.06124174	79.5594366
PM18AJ027	D19AU19a259.csv	0.09357111	232.024708	23.2665714	<0.003	0.07405779	<22.821	0.12036663	881.083844	<0.225	122.538824	462255.0503	2.06327783	0.72034974	5.10482686	295.188147	17.2545671	<0.008	<6.090	0.00390824	35.6227911
PM18AJ027	D19AU19a260.csv	0.08199108	5328.17665	123.042642	<0.004	0.14512732	1644.5873	0.02360852	71.3022896	<0.296	29.2167943	430690.0537	0.69977657	2.45411324	319.543838	475.405696	45.5747559	0.06253396	1271.52017	0.21436506	42.5928833
PM18AJ027	D19AU19a261.csv	0.12307546	5512.02864	159.964341	<0.003	0.06086832	6350.35608	0.07603028	16.4129399	0.97854276	10.0865108	446870.8773	2.16010781	0.45618547	165.049105	151.803373	107.908158	<0.009	77.3310064	0.18359052	37.6970679
PM18AJ027	D19AU19a264.csv	0.35141671	23.0778494	20.9614387	<0.003	0.42090617	27.668598	<0.019	641.302004	<0.280	14.5067135	462990.69	0.02330214	0.08201698	<3.115	12.3897389	1.33330943	<0.010	<7.534	<0.001	155.04646
PM18AJ027	D19AU19a265.csv	<0.029	3.70578416	20.8633574	0.00481586	<0.002	<19.998	0.0337827	360.135771	<0.222	0.78176479	464783.0442	<0.004	<0.002	<2.468	2.66207679	0.28790685	0.00950891	<5.965	<0.001	201.708932
PM18AJ027	D19AU19a266.csv	0.25781908	664.447852	125.820989	<0.003	0.14582688	3906.06308	<0.016	68.7144604	3.15884102	59.1510803	455631.7142	1.49935625	0.54861161	5.92610164	211.583725	24.118704	0.01222995	7.11538268	2.63745957	58.6057961
PM18AJ027	D19AU19a268.csv	0.06021502	570.691061	436.304676	<0.003	0.00723499	<19.422	<0.014	85.6943618	<0.222	27.620549	463763.852	<0.004	<0.002	16.4847057	21.3270264	2.38853478	0.01445127	<5.936	<0.001	57.2507649
PM18AJ027	D19AU19a269.csv	0.17104448	4802.6284	41.9065005	<0.003	0.06016261	1856.80419	0.10251005	2132.85405	<0.266	158.998703	445177.5311	0.0639176	0.19276006	89.6276458	92.8883552	7.54848196	0.35976409	1713.92682	0.10006527	159.948565
PM18AJ027	D19AU19a270.csv	<0.032	1859.15795	750.162279	0.00332937	0.09787291	5564.6103	0.0162037	43.1667983	<0.245	82.8004289	452797.0754	3.25817173	4.28222602	113.135365	432.149187	41.7807526	1.20975847	142.109438	3.70723125	34.7065041
PM18AJ027	D19AU19a271.csv	0.03935291	2064.22726	218.085742	<0.003	0.04875352	26.9169439	<0.015	32.8287028	<0.260	31.7554601	458105.0366	0.04618599	0.02056499	33.9207139	115.888472	11.465719	<0.009	11.1285328	0.00900853	162.564821
PM18AJ027	D19AU19a275.csv	<0.035	29.4360864	359.741302	<0.003	0.00704492	<27.112	0.02613234	80.2431871	<0.273	8.93243803	464746.2692	<0.005	0.01742697	<2.995	11.2323533	1.34386875	<0.009	<7.176	0.00648286	35.7096532
PM18AJ031	D19AU12a167.csv	0.38809289	<0.244	1171.7562	0.00718507	0.93806091	<29.332	<0.041	1.66786016	0.38980206	30.1168915	464306.3536	0.01626913	<0.001	3.98860198	0.03282211	1.96113729	0.02292461	13.3775188	<0.001	815.013467
PM18AJ031	D19AU12a175.csv	<0.009	<0.320	244.017149	<0.003	<0.002	<38.004	<0.054	30.3304847	<0.232	0.59719695	465332.416	0.01073489	<0.002	<2.624	<0.043	<0.288	<0.011	<7.315	<0.001	2.61595057
PM18AJ031	D19AU12a189.csv	2.23645385	5.0218867	1553.67238	0.03939939	0.8448988	68.3186861	1.24980907	254.628134	<0.208	2319.21879	461808.4557	<0.003	<0.002	<2.350	22.6134122	18.2719077	<0.010	<6.540	<0.001	50.9353166
PM18AJ031	D19AU12a190.csv	0.35190118	<0.257	987.054244	<0.003	0.02084154	<29.903	<0.042	0.09033966	<0.187	45.9666412	464889.8088	<0.003	0.00356554	<2.118	0.084699	1.00337707	0.0286477	<5.895	<0.001	241.47766
PM18AJ031	D19AU12a193.csv	0.32686403	1.79016887	922.531278	0.01124686	0.54909315	624.213119	0.04696761	3.01472597	<0.198	30.5225806	464606.9669	0.01296109	<0.002	9.09290749	4.60695384	5.30258148	0.02331721	26.6721856	<0.001	78.0234768
PM18AJ031	D19AU12a166.csv	0.0883866	651.960811	659.825917	<0.003	0.13845796	682.186783	<0.050	504.541182	<0.213	25.9103857	460826.749	0.00384177	0.0046818	153.384378	456.7005	26.3538607	0.26706366	19.3055587	0.02030004	130.314319
PM18AJ031	D19AU12a170.csv	0.04281382	944.987957	214.820934	<0.003	0.15154965	3999.33641	<0.046	347.542539	<0.197	9.32496584	454169.5774	1.23559988	2.51785082	136.891995	280.997748	29.3686466	1.22899045	40.8223858	8.2452827	14.19162
PM18AJ031	D19AU12a171.csv	0.06796888	1036.80012	723.401442	0.00760028	0.29723863	943.208552	<0.053	29.037656	<0.229	3.0275074	461277.821	0.29616358	1.11806157	82.6308212	89.9509675	6.83107085	0.24953651	227.981358	0.10949411	97.1629117
PM18AJ031	D19AU12a172.csv	0.02597016	239.029508	29.6495271	<0.003	0.04723848	2328.81968	<0.048	88.1441635	0.27023701	1.97093588	459787.7782	0.85497389	2.13538159	37.5705752	48.7108343	8.8666351	0.57665704	9.74758985	5.51782141	2.57147903
PM18AJ031	D19AU12a173.csv	0.32706779	566.80432	957.357058	<0.003	1.26468948	<36.033	<0.051	96.6536825	<0.221	132.794947	461880.4096	0.01056746	<0.002	554.955126	696.233034	15.4835925	0.01746834	<6.914	0.01310901	212.524652
PM18AJ031	D19AU12a174.csv	0.03792283	44.1571398	821.983163	0.00521822	0.04714146	246.065083	<0.049	434.462036	<0.212	24.1089597	464103.2801	<0.003	0.03023349	10.2270063	94.3613004	8.74050397	<0.010	<6.629	<0.001	91.7979329
PM18AJ031	D19AU12a177.csv	0.07480743	428.589478	216.003071	<0.002	0.09702769	238.129995	<0.041	59.9948394	<0.180	8.45094355	462686.2131	0.20498327	0.82610453	201.402381	92.0176467	6.22278459	0.96064122	72.5433834	1.15439373	11.5035708
PM18AJ031	D19AU12a178.csv	0.02804211	158.569058	1004.70501	0.00342926	0.07894007	797.239226	<0.047	328.106569	<0.204	3.35389327	462190.6835	0.29149987	0.15840712	5.27650629	450.7429	38.4462093	0.13554176	30.2691091	0.0286362	15.4230699
PM18AJ031	D19AU12a179.csv	0.02521339	92.6700753	133.338596	<0.003	0.15483591	1916.06324	0.07412865	112.46786	<0.219	5.05239239	462869.6737	0.50222005	0.91902426	10.6855016	27.994213	20.2521692	0.41771273	55.8876159	0.67741279	8.60354301
PM18AJ031	D19AU12a180.csv	0.0361602	325.616064	456.450691	<0.003	0.08100245	1983.05268	0.09729798	228.360064	<0.228	2.37507495	460050.5534	0.90301727	1.63396178	67.4315256	171.811845	7.37250638	0.2246803	31.2744794	4.31507362	132.507976
PM18AJ031	D19AU12a181.csv	0.18848878	686.9166	404.937057	0.00856035	1.39941579	188.375207	<0.103	101.642563	<0.450	14.3274809	462768.4997	<0.007	0.87456998	157.888226	273.638106	15.3276724	0.07203908	43.8799632	0.06200644	12.1949679
PM18AJ031	D19AU12a182.csv	0.60797237	536.244711	673.63523	0.00531052	1.07787315	643.103773	0.26681957	23.4753007	<0.216	212.307631	461306.1557	<0.003	<0.002	40.9630854	51.415809	16.0762717	0.02833259	53.9288532	0.00256915	1258.97823
PM18AJ031	D19AU12a191.csv	1.0284137	3360.75917	879.264539	0.013451	0.61709723	388.95768	1.85827688	32.6400428	<0.270	620.246749	447116.0141	<0.004	<0.002	3040.94074	3997.56615	113.54085	0.0221139	30.6015084	0.01613099	150.441393
PM18AJ031	D19AU12a192.csv	0.12579317	783.812511	689.198625	<0.003	0.32080697	882.07019	<0.047	13.2147769	0.36542071	5.05413097	461874.1134	0.83259095	1.01925604	39.7133819	25.342004	6.28627481	0.43134007	244.464867	0.63189469	11.3673823
PM18AJ031	D19AU12a194.csv	0.04197712	400.00799	389.247405	<0.003	0.0570217	189.644541	<0.044	162.054984	<0.193	6.91606948	463289.4955	0.19448236	1.15264358	56.9848182	317.780016	19.5525784	0.20710558	32.4259057	0.17404582	27.2193234
PM18AJ201	D19AU19a057.csv	<0.081	<0.865	<1.705	0.01199188	3.85524393	<121.710	<0.209	197.807701	<0.600	1.30477515	465164.89	0.0143371	<0.005	<7.148	3.51141754	<0.780	0.03193132	<15.731	<0.004	0.62577616
PM18AJ201	D19AU19a058.csv	<0.089	<0.928	18.7938044	<0.011	1.57439765	<129.765	<0.227	2919.34701	<0.645	0.9698447	462514.2383	0.01163981	<0.006	<7.699	<0.135	<0.840	0.04484539	<16.950	0.00775236	14.4503853
PM18AJ201	D19AU19a059.csv	<0.081	<0.845	26.6780519	<0.010	<0.047	<117.428	<0.207	6.58472996	<0.589	<0.262	465285.7936	<0.009	<0.005	<7.033	0.12695738	<0.767	<0.023	<15.494	<0.004	35.7867089
PM18AJ201	D19AU19a223.csv	<0.034	<0.348	25.1010751	<0.003	0.17540957	49.0385862	<0.031	39.8566134	<0.243	46.2030362	465180.802	<0.004	<0.002	<2.828	0.05818244	<0.289	<0.009	<6.821	0.00341694	33.5146634
PM18AJ201	D19AU19a225.csv	<0.032	<0.333	39.3712212	<0.003	<0.006	94.5970737	<0.029	74.0478502	0.29921577	<0.115	465250.4728	<0.004	<0.002	<2.685	<0.054	<0.274	<0.009	<6.482	<0.001	0.09247209
PM18AJ201	D19AU19a226.csv	<0.042	<0.430	20.4308472	<0.004	<0.007	<44.447	<0.037	2.12373571	<0.299	0.49357536	465202.4255	<0.005	<0.002	<3.456	<0.070	<0.352	<0.011	<8.355	<0.002	136.942158
PM18AJ201	D19AU19a227.csv	1.14924377	<0.367	17.9020992	0.00440633	0.91166191	<37.854	0.56311116	169.82716	<0.255	2258.0837	462935.6358	<0.004	<0.002	<2.940	<0.059	1.44454339	<0.009	<7.109	<0.001	58.0220581
PM18AJ201	D19AU19a228.csv	<0.035	<0.365	22.8505771	<0.003	0.09616247	<37.632	<0.030	145.480548	<0.253	0.82852116	465157.939	0.01191084	0.00517093	6.52353638	<0.059	1.44088708	<0.009	14.8285582	<0.001	20.5797628
PM18AJ201	D19AU19a229.csv	<0.029	<0.298	14.8875668	0.00867519	0.12065063	<30.614	<0.024	58.3294165	<0.206	0.3389736	465364.5211	<0.004	<0.002	<2.376	<0.048	<0.242	<0.008	<5.750	0.00578472	0.11744713
PM18AJ201	D19AU19a230.csv	<0.032	0.76328581	21.7535409	<0.003	<0.005	<35.159	<0.027	36.7831363	<0.237	0.22496544	465307.021	0.01028078	<0.002	<2.730	0.97454676	<0.277	<0.009	<6.607	0.00289917	24.8102175
PM18AJ201	D19AU19a233.csv	<0.036	<0.375	20.4262701	0.00462134	0.02585946	<38.191	<0.029	32.5764406	<0.260	0.98356072	465312.6068	<0.005	<0.002	<2.977	0.11647345	<0.302	<0.010	<7.219	<0.001	14.1985483
PM18AJ201	D19AU19a234.csv	<0.033	<0.347	83.6812722	<0.003	<0.005	<35.206	<0.027	346.422129	<0.241	0.44628451	464959.6472	0.01148164	<0.002	<2.752	<0.056	<0.279	<0.009	<6.676	<0.001	7.07080053

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ201	D19AU19a235.csv	<0.034	<0.353	19.4218209	0.00580295	0.31018247	<35.794	<0.027	139.406651	<0.246	2.1581887	465212.7318	0.00518847	<0.002	<2.807	<0.057	<0.284	<0.009	<6.809	<0.001	8.21999125
PM18AJ201	D19AU19a236.csv	<0.032	3.2205818	29.625351	<0.003	0.0263679	<33.700	<0.025	11.7701278	<0.232	<0.112	465235.4707	0.02530399	0.00250538	<2.665	3.79392376	0.68662414	0.02401119	<6.468	<0.001	106.174824
PM18AJ201	D19AU19a237.csv	<0.036	<0.384	44.70719	<0.003	0.0079822	<38.570	<0.028	190.356352	<0.268	<0.127	465153.0581	<0.005	<0.002	<3.051	<0.062	<0.309	0.06153139	<7.409	<0.001	0.46878842
PM18AJ201	D19AU19a239.csv	<0.032	<0.330	29.2584669	0.00335016	0.57078492	<32.930	<0.024	2.41499502	<0.232	26.9884687	465264.2408	<0.004	0.0021153	<2.635	2.42225241	0.47471249	<0.008	<6.402	<0.001	83.3618587
PM18AJ201	D19AU19a240.csv	<0.030	<0.305	75.9214911	<0.003	<0.004	<30.293	<0.022	16.4808882	<0.215	0.18503271	465265.9048	0.0070647	<0.002	<2.439	<0.050	<0.247	0.01002644	<5.926	<0.001	72.2298774
PM18AJ201	D19AU19a241.csv	<0.035	<0.366	11.8350185	<0.003	0.46443659	<36.122	<0.026	421.490295	<0.259	3.34392934	464949.9002	0.01258199	<0.002	<2.934	0.09874836	<0.297	<0.009	<7.133	<0.001	17.2809459
PM18AJ201	D19AU19a242.csv	<0.029	<0.305	7.29523846	<0.003	<0.004	<29.967	<0.021	35.2275393	<0.216	0.62763422	465355.0732	<0.004	<0.002	<2.453	<0.050	<0.248	<0.008	<5.965	<0.001	25.802746
PM18AJ201	D19AU19a243.csv	<0.037	<0.377	14.9784879	0.0038793	0.05193941	<36.750	<0.026	124.283308	<0.268	0.3721892	465268.1726	<0.005	<0.002	<3.038	0.68302547	<0.307	<0.010	<7.389	<0.001	5.37039475
PM18AJ201	D19AU19a244.csv	<0.031	0.38660111	19.8975251	<0.003	0.01568982	<30.402	<0.022	18.3890976	<0.224	0.25401602	465351.6882	<0.004	<0.002	<2.540	1.19442797	<0.257	<0.008	<6.179	<0.001	29.8475496
PM18AJ201	D19AU19a246.csv	<0.037	<0.375	40.476057	<0.003	0.2153812	<35.817	<0.025	418.508333	0.30333002	1.59301102	464898.7473	<0.005	<0.002	<3.067	<0.063	<0.311	<0.010	<7.464	0.0063778	64.6265349
PM18AJ201	D19AU19a254.csv	<0.031	0.44996171	22.1037127	<0.003	0.10647332	<25.867	<0.019	20.5567011	<0.227	0.71072522	465352.6199	<0.004	<0.002	<2.545	1.84274291	0.2897546	<0.008	<6.188	<0.001	7.62264538
PM18AJ201	D19AU19a060.csv	0.17740471	3.7703391	49.3459239	<0.014	0.51217256	211.272642	<0.285	1280.45505	<0.815	116.330846	462675.6853	<0.012	<0.007	<9.745	21.970013	2.228941	<0.031	<21.487	<0.006	1227.33915
PM18AJ201	D19AU19a224.csv	<0.034	5.9183328	69.2315125	<0.003	0.03149322	<37.186	<0.031	74.3762433	<0.250	3.46003732	465233.4687	<0.004	<0.002	<2.900	0.60082366	<0.296	<0.009	<6.998	0.01054892	13.1016117
PM18AJ201	D19AU19a231.csv	0.71445164	5.68451997	39.0347757	0.01238171	1.44487645	<36.697	0.35181432	5.44940003	3.66759595	1147.78009	463624.9727	0.06185963	0.00522762	<2.851	2.96120014	4.08039751	<0.009	<6.905	0.00593324	581.727387
PM18AJ201	D19AU19a232.csv	<0.035	<0.371	34.152652	<0.003	0.06307068	<37.918	<0.029	3.55142311	1.21076979	0.78449772	464888.0529	0.01286345	<0.002	<2.950	<0.060	<0.299	<0.009	<7.145	<0.001	454.666521
PM18AJ201	D19AU19a245.csv	<0.035	5.06286922	24.2430797	0.00380554	0.21000894	43.6855713	<0.024	10.7975422	0.29989625	2.67930395	465194.1046	<0.004	<0.002	<2.878	28.5442207	1.90172827	<0.009	<6.998	<0.001	25.8389286
PM18AJ201	D19AU19a247.csv	<0.048	5.01413257	1.63899179	0.00538144	0.46179006	98.0287415	<0.033	420.663979	<0.341	1.32074382	464923.9763	<0.006	<0.003	<3.851	0.67551534	1.0995296	6.95768588	<9.380	0.00882286	1.74723287
PM18AJ209	D19AU12a406.csv	0.23551332	647.764357	13.2356472	<0.003	0.21642977	<23.239	0.03317555	615.560294	0.24675724	32.3731391	462291.5269	0.01816261	0.19989773	<2.165	704.996161	43.7891525	0.19509549	<6.182	<0.002	282.040129
PM18AJ209	D19AU12a407.csv	0.27387085	1110.57231	70.3036782	0.00461603	0.17715238	206.556131	<0.029	144.00597	<0.193	5.44390734	460412.5247	0.10811239	0.26357454	35.5728591	5.16820488	1.71495759	0.0082974	596.302182	<0.002	40.2996632
PM18AJ209	D19AU12a408.csv	0.05141232	79.6911252	46.6984573	<0.004	0.21543085	30.0326735	<0.031	700.578038	<0.206	2.84776528	464403.9029	<0.003	0.01942163	5.40735033	4.01479112	<0.250	0.00800454	8.50532615	0.00527155	16.2896615
PM18AJ209	D19AU12a409.csv	0.10234478	1586.08326	99.9238378	<0.003	0.42922779	16310.9693	0.04206603	447.108503	0.99342707	4.08872036	448838.1053	6.75428611	0.04184715	6.22107883	583.992315	48.6703719	0.04298382	309.351294	0.23658774	128.886066
PM18AJ209	D19AU12a410.csv	0.30303124	1408.1484	192.310321	0.00799236	1.63524259	798.470165	0.07580633	2579.78941	<0.192	4.83618201	458275.5004	<0.002	0.19464353	<2.132	14.227126	1.20597034	0.03912895	338.179083	<0.002	25.6002118
PM18AJ209	D19AU12a411.csv	0.45894135	1225.75459	77.6890333	0.00733228	0.26150234	460.305492	<0.029	241.215637	0.30562369	2.98643582	461228.9561	<0.002	0.00803898	10.0585947	291.635995	22.9706249	0.00693916	193.587281	0.00249235	95.7251191
PM18AJ209	D19AU12a413.csv	0.57034019	907.747343	277.998523	0.01536448	0.93799549	2664.17365	<0.032	229.463259	0.97475199	88.4677197	454588.8251	0.31018709	2.14084552	12.9986214	213.357029	341.216843	0.09594974	196.112715	2.60422479	454.859557
PM18AJ209	D19AU12a415.csv	1.261771	409.169333	35.4035002	0.00545306	0.34520848	416.882948	0.03615345	222.923545	0.40402934	3.41663047	463740.3796	0.65427947	0.8091028	<2.196	127.612821	17.4696192	0.05470974	<6.262	0.00246092	42.930986
PM18AJ209	D19AU12a416.csv	0.60626697	1278.05929	122.850341	0.02346716	0.86056987	523.662511	0.06920346	96.0153644	<0.183	130.315197	459534.4641	0.09980861	0.41462757	551.211184	116.476284	3.43559529	0.49709048	82.6071261	0.00275847	1056.2964
PM18AJ209	D19AU12a419.csv	7.17133736	348.704676	166.99924	0.09794899	5.13664425	707.030382	0.2888922	4529.74478	0.9176541	1363.48205	455788.7357	0.08318049	0.25795732	<2.276	357.437795	21.2896931	1.40273946	54.281825	0.6799682	343.939178
PM18AJ209	D19AU12a420.csv	6.0989694	1645.99235	32.7008379	0.34415564	0.11269366	40.8140247	0.07628689	7.38942882	0.40911501	12.225154	460135.086	<0.002	<0.001	<2.244	1858.82227	146.35194	0.08346996	<6.408	<0.002	4.27848006
PM18AJ209	D19AU12a421.csv	0.61978275	1188.15395	28.2949222	0.01388552	0.9208602	400.925092	<0.028	437.387347	0.48909034	14.6974691	460638.9302	0.01121034	0.26651065	67.76255	511.177099	38.253417	6.86973016	43.4932945	0.00247906	115.8593
PM18AJ209	D19AU12a422.csv	2.41955562	2235.98249	128.205964	0.04098973	0.70335118	26.6234622	0.09301796	209.174073	5.14292125	33.7758878	450313.0316	0.0280975	<0.001	237.276895	1908.72762	97.633833	0.08452565	110.21357	0.00485464	23.6926803
PM18AJ209	D19AU12a423.csv	3.5263055	1899.33087	182.647741	0.1399412	0.70389206	8680.64003	1.05838166	251.723781	2.44063335	238.485769	451788.6849	1.50366178	1.20574202	185.551264	475.616861	94.7142364	0.0892895	651.658816	0.11822892	36.9403321
PM18AJ209	D19AU12a425.csv	0.44827088	3692.60902	142.485765	0.01353334	2.32965953	78.7281128	0.05002755	134.805468	3.26465099	22.8300623	452370.8879	0.44684786	0.00362544	19.0279387	3260.55458	209.983964	0.05932838	530.772822	1.87689461	29.239615
PM18AJ209	D19AU12a428.csv	0.34361586	564.829561	60.6181438	0.01077784	1.56697815	163.57198	<0.025	208.489818	1.11226941	43.4717516	463077.307	0.00580879	0.25670417	41.9465726	357.209986	45.525287	7.25757175	26.5003417	0.00565564	22.5790676
PM18AJ209	D19AU12a429.csv	0.13152397	1297.88578	143.027602	0.01141918	2.28551166	307.221045	0.03854664	253.297741	0.54067746	4.54149438	459275.7105	0.00496781	0.26685269	5.09705468	1193.50617	51.4604698	0.07149661	201.377756	0.01628151	234.862187
PM18AJ215	D19AU12a043.csv	0.06979686	7.09516455	11.7511182	<0.005	0.02769381	827.284043	<0.128	403.842296	<0.468	1.53948612	463970.1407	0.10367493	0.34664124	<4.945	5.31764663	1.56268467	<0.028	<12.983	<0.003	537.890615
PM18AJ215	D19AU12a052.csv	<0.026	12.1798417	35.4239316	0.00994068	0.00969198	<103.737	<0.155	452.373067	<0.573	<0.442	464706.5839	<0.011	0.0237073	<5.946	11.3820751	1.3338236	<0.034	<15.770	0.00664417	87.2607202
PM18AJ215	D19AU12a054.csv	0.0258612	5.87111628	<1.349	<0.006	0.0171098	339.361744	<0.133	26.0821019	<0.515	12.704991	465094.8735	0.24909935	0.09233651	<5.328	11.8997634	1.79688639	<0.031	15.2543478	0.01975489	64.4051078
PM18AJ215	D19AU12a038.csv	7.92703753	1437.14918	49.9216577	0.01309063	6.12818631	923.389879	0.43293237	869.518652	<0.671	37.5871061	450664.5624	0.37541855	0.91280573	48.8695869	106.411793	13.4774067	0.62388757	235.575794	0.27441895	164.07138
PM18AJ215	D19AU12a039.csv	0.60630614	10341.1783	68.3234118	<0.009	2.61284074	2802.63299	0.51446091	518.490073	4.64016839	31.1064887	420534.4244	0.20800354	0.58746086	180.542483	438.764512	16.8028012	0.05554035	5226.53945	0.3080098	151.567103
PM18AJ215	D19AU12a040.csv	0.45082636	11765.9356	94.5501501	<0.012	2.1937001	37305.0888	<0.280	47.7861139	6.22794522	28.7911518	355472.57	12.3402063	6.6962231	317.804143	1229.80856	53.0181777	0.18942579	3564.38897	50.4115097	10.7546846
PM18AJ215	D19AU12a041.csv	0.21787851	5084.87135	119.353853	<0.009	0.22955852	6020.43857	<0.214	383.622445	3.8412074	15.0681815	437903.8226	1.65261076	1.71334791	123.302293	613.200689	21.5740842	0.09919893	1784.04141	5.16304841	61.5843512
PM18AJ215	D19AU12a042.csv	0.05552181	712.825885	59.8771156	0.01694244	0.40984611	496.430477	<0.156	284.86361	1.61883324	5.14773589	461695.4935	0.77832641	3.12823013	63.0800733	55.8863744	3.95241569	0.196696	370.966875	0.02441767	148.36315
PM18AJ215	D19AU12a045.csv	0.04478034	1079.44566	4.57892264	<0.007	0.62809381	132.865653	<0.155	43.2060251	<0.565	3.70100956	460443.7912	0.1659751	1.16586419	25.0408632	154.930011	14.3100084	<0.034	448.551591	0.00431814	394.639047
PM18AJ215	D19AU12a046.csv	0.18456423	5875.65808	60.484878	<0.008	0.25476158	1612.78956	<0.188	134.00399	4.33075122	8.06953754	442542.9025	0.4529315	1.92338107	122.311363	296.87849	12.5067565	<0.042	2768.60902	0.027313	53.6450534
PM18AJ215	D19AU12a047.csv	0.0552307	672.639457	40.8322535	<0.007	0.21128631	3754.38674	<0.152	57.8641974	3.77641404	9.42715547	460499.7206	1.43648093	0.2195091	6.59782399	249.362707	20.1803828	0.04884831	207.791875	0.00673146	17.2690699
PM18AJ215	D19AU12a048.csv	0.31030203	1422.76013	107.383668	<0.010	0.21911658	11402.9262	<0.232	871.945509	0.96792157	11.1839745	442917.324	6.38969405	3.80757245	37.4000801	486.167074	43.9121076	0.45885033	249.196222	13.4913715	115.963983
PM18AJ215	D19AU12a049.csv	0.13825939	13327.8255	149.988862	<0.031	3.43739882	10244.1351	<0.708	295.187325	19.9382036	16.9346525	412187.3072	1.04611939	1.06011258	254.108992	1208.57286	45.5703581	<0.150	3157.01137	5.54263398	12.1431891
PM18AJ215	D19AU12a050.csv	0.08080507	1384.02791	51.6819831	<0.007	0.06296919	602.25315	<0.169	338.437791	2.23501514	2.2586201	459641.0149	0.14912031	0.61817736	18.044182	169.497992	6.46979949	<0.038	599.195223	0.04240374	87.5330161
PM18AJ215	D19AU12a051.csv	0.04689744	173.622856	71.2006948	0.01621195	0.07758604	<94.606	<0.137	1267.04064	<0.521	3.08702453	462955.3228	0.19055372	1.90206141	<5.422	3.6533733	<0.661	0.27974055	98.1926772	<0.003	382.522791
PM18AJ215	D19AU12a053.csv	0.21238916	2231.89896	47.7157217	<0.008	0.08758087	789.886029	<0.190	77.1491543	2.49847395	6.05924013	455912.9039	0.08576326	0.24965699	48.3752296	221.056309	9.52308014	<0.042	1022.91473	0.28932262	26.6700792
PM18AJ215	D19AU12a374.csv	0.17036734	2388.64404	1.08327266	0.00456449	0.72153025	506.336579	<0.032	11.1077308	<0.190	5.09898005	456594.2824	0.10096182	0.37540159	48.2284448	522.344348	59.228664	16.045947	512.576883	0.01598163	72.1897007
PM18AJ215	D19AU12a375.csv	0.0255448	34.8072537	8.33101412	<0.003	0.03116131	25.7401018	<0.032	287.125617	<0.194	1.3276852	464834.4896	0.09457403	1.17782799	<2.172	12.9419665	1.45650538	0.01100343	9.43449126	<0.002	78.9669996

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ215	D19AU12a376.csv	0.89566192	92.2828883	38.3668111	0.01234906	0.12036711	34.5377133	<0.032	1414.60451	0.29587628	5.48415395	463573.5119	0.08077049	1.36040955	<2.161	50.7698432	3.22368443	0.03725964	28.0335331	<0.002	71.4939303
PM18AJ215	D19AU12a377.csv	0.03134597	48.8573969	24.2606157	<0.003	0.03472662	332.675166	0.10743324	2005.98675	<0.179	0.86000549	462770.6774	0.09476257	0.30156831	<2.009	2.47162672	0.6968833	0.33640081	18.0709542	0.32414491	42.5132049
PM18AJ215	D19AU12a378.csv	0.15502366	1478.36658	56.0404908	<0.003	0.04529927	537.656787	<0.035	92.3597842	<0.209	2.3211055	459644.2778	0.08276945	0.117319	21.7038633	45.8315899	2.85357696	0.00844543	633.328885	0.33809717	46.6211513
PM18AJ215	D19AU12a379.csv	0.07186642	4780.83896	93.0208116	<0.004	0.09654345	3415.85336	<0.042	1369.22497	4.35247302	4.99350016	440641.5597	0.63044271	0.86342887	101.697988	573.043415	27.7474304	0.16524591	2094.85476	3.03401573	58.5408247
PM18AJ215	D19AU12a380.csv	0.80086944	18317.9381	35.4356431	0.01223917	4.0658043	7785.76042	<0.056	157.850064	25.8997501	36.1651321	397797.6012	0.34220261	0.39560466	457.688208	2385.7151	94.0082572	0.01984487	5895.7858	0.18141154	8.32082804
PM18AJ215	D19AU12a381.csv	0.09858652	3783.99164	71.658535	<0.004	0.1340168	5837.76896	<0.035	405.988229	4.73228698	8.33336902	443112.0519	2.01620452	1.32562021	66.8956297	357.0986	16.8756465	0.09089541	1244.78825	6.23483571	69.5599899
PM18AJ215	D19AU12a382.csv	0.63146811	4465.1727	99.2162809	0.02517741	0.41345307	10951.9774	0.06170605	244.794885	3.22604081	20.3233486	430343.7579	5.2827292	3.40009026	104.735323	950.186006	65.8156093	0.03786213	1262.45968	12.3239398	43.2112412
PM18AJ215	D19AU12a384.csv	0.06565766	2972.46825	91.4912742	<0.004	0.06989919	656.6032	<0.039	546.72962	1.06963624	4.37806194	452416.2993	0.08042348	0.18730731	65.1572435	143.439647	6.31158752	0.00663815	1362.6491	0.09914517	74.7420487
PM18AJ215	D19AU12a385.csv	0.29343121	5840.44376	41.1915048	0.00653831	0.13636994	8243.57835	<0.041	252.280373	4.78286332	13.8120341	432720.2144	2.8787597	1.99040171	114.761442	601.350682	27.9736946	0.03676496	2025.2384	9.25155913	13.3907877
PM18AJ219	D19AU19a192.csv	<0.039	444.942924	1.56120918	<0.004	0.01848381	464.078398	<0.048	35.9653163	0.27996592	0.95643653	463792.2082	0.4214924	<0.002	<3.378	1.4378454	12.6400742	0.01412715	<8.022	<0.002	16.8825019
PM18AJ219	D19AU19a193.csv	63.7764205	364.262429	5.67329732	0.21522099	1.26109803	418.675458	<0.042	72.7049359	<0.246	8.75537128	462763.0853	0.02056747	0.03462697	38.2225827	503.341291	25.7408841	<0.009	<7.128	<0.001	33.7826538
PM18AJ219	D19AU19a194.csv	<0.029	34.847582	3.72608493	<0.003	0.0186541	954.228401	<0.035	19.2964235	<0.207	0.55745442	462932.222	<0.003	0.0081198	<2.523	556.78714	30.9224948	<0.008	<5.999	<0.001	17.2188865
PM18AJ219	D19AU19a195.csv	2.59389149	1870.68352	6.09706802	0.06892772	2.67696724	1963.72424	0.09594043	202.211254	2.41935926	38.8740359	455416.4523	0.55764028	0.43527909	208.285889	1143.18924	76.6858734	0.07234117	177.000814	0.79183926	183.226665
PM18AJ219	D19AU19a197.csv	0.3836456	23609.2019	8.24843111	0.01135656	0.82939924	29173.5841	0.07457732	189.345236	14.9853937	372.976058	391226.0688	21.911255	<0.003	56.7112635	485.891574	458.063476	0.0147555	34.6619418	<0.002	423.252478
PM18AJ219	D19AU19a198.csv	88.2044893	8760.0932	4.35698758	0.13899123	3.40847044	869.541279	0.06093867	139.315276	1.82600789	36.2619359	433929.8902	0.29414172	1.21291577	2027.60521	4277.41099	495.110895	0.13677307	990.645558	0.53306445	128.650469
PM18AJ219	D19AU19a199.csv	8.53429636	11283.8577	6.91547142	0.23730011	3.19109738	11521.0425	<0.045	331.25088	14.0217394	20.4285519	427525.6717	1.33656503	0.16162864	211.561207	1061.93589	287.963056	0.01693628	85.1587727	0.00790562	250.8028
PM18AJ219	D19AU19a200.csv	11.578405	4996.54616	9.4799531	0.193569	2.68478578	1075.35743	<0.039	201.215323	2.04625874	22.5566979	448898.5955	0.39959774	0.37459732	66.1408024	3827.38479	349.428202	<0.009	186.988506	0.00787902	127.321001
PM18AJ219	D19AU19a202.csv	43.3126766	1708.69217	3.24433266	0.04877847	3.84484481	1541.31228	<0.039	70.674619	<0.243	11.1057136	458689.0497	<0.004	0.00416736	44.0093962	50.6038036	4.07789239	<0.009	68.1381449	<0.001	62.7179823
PM18AJ219	D19AU19a204.csv	8.17457578	1787.8479	5.43342247	0.04824767	3.84898713	1524.64231	0.07198733	174.184075	1.14335794	15.2559429	457418.0153	0.02728577	0.0607067	109.924575	325.146293	9.64808479	0.01679034	69.3001754	0.18753678	169.3254
PM18AJ219	D19AU19a205.csv	2.13879284	3134.14818	5.44892012	0.04477644	4.98862653	4056.27621	<0.035	226.22867	7.93880055	10.5766021	455576.9241	3.32624599	0.02476202	10.0501314	38.2794312	48.4810772	<0.009	<6.621	<0.001	170.705905
PM18AJ219	D19AU19a206.csv	0.62632375	282.51124	4.13952208	0.00444617	1.28577934	1674.23515	0.09838139	557.480353	70.9592619	13.6743184	459531.1507	0.87673899	0.16640528	25.1670059	226.429077	101.206448	3.40744248	9.474544	1.32071377	233.908427
PM18AJ219	D19AU19a207.csv	30.9279872	415.693265	4.5734726	0.16125991	5.04123552	93.0917719	0.05364686	202.589235	1.00682852	24.1654771	463531.3747	0.00836216	<0.002	50.5766985	419.634186	31.3416371	0.03166852	<6.033	<0.001	111.148689
PM18AJ219	D19AU19a208.csv	49.0456407	456.70901	5.96105165	0.43801186	4.47489102	337.098274	0.03586451	247.901933	3.67448254	157.287486	462364.9604	0.01883339	0.04205231	79.0076545	550.262597	15.2364116	0.02902867	<6.479	0.08461856	143.868327
PM18AJ219	D19AU19a209.csv	65.9475734	293.924855	13.1845284	0.20147564	8.59114384	317.292066	0.04831391	136.070042	0.46328895	33.7857865	463348.8753	<0.004	<0.002	56.083971	251.433752	26.653742	0.08246857	<5.854	<0.001	215.556373
PM18AJ219	D19AU19a210.csv	1.3140785	456.580384	2.90502457	0.01502806	0.94663527	400.022884	<0.031	209.144345	<0.209	8.66807576	463046.517	<0.004	0.04422345	<2.477	156.149088	9.66460912	<0.008	38.6825662	0.00511544	147.859161
PM18AJ219	D19AU19a212.csv	0.93357231	803.620493	10.6227272	0.02558526	1.43715254	1137.3398	<0.030	141.321851	3.19579055	17.3059843	459452.434	0.00836928	0.0088083	36.6116754	807.328269	37.2201983	0.01234156	22.0888362	<0.001	62.5871037
PM18AJ219	D19AU19a219.csv	<0.032	97.2023635	3.43746272	<0.003	0.15276902	232.885744	<0.031	250.984304	0.46630729	1.52716633	464164.9723	0.02996939	<0.002	<2.700	197.14482	8.10507871	<0.009	<6.498	<0.001	162.304448
PM18AJ219	D19AU19a220.csv	<0.029	128.180502	3.62627158	<0.003	0.1582649	245.991827	<0.027	821.672053	0.42946091	4.04993715	463539.8909	<0.004	0.06816885	4.65640244	56.2563122	8.36430775	0.57516662	11.3626954	<0.001	439.549838
PM18AJ219	D19AU19a221.csv	0.93968079	698.736834	13.2035733	0.05091419	1.70306919	744.772044	0.05067989	114.0789	3.35092787	64.1166921	462474.2176	0.42062001	<0.002	115.315996	236.609931	13.7521255	0.01063433	10.485044	0.00215299	224.299936
PM18AJ219	D19AU19a222.csv	0.52893031	2674.52776	4.87434961	<0.004	0.54104557	2906.59528	<0.034	290.725107	2.21518005	7.87742945	455027.9371	0.12577645	0.06189326	25.8345444	527.276795	65.0835099	1.00437281	28.2123919	<0.001	136.059108
PM18AJ222	D19AU12a288.csv	2.4388343	1000.10407	293.587237	0.03315626	24.8888841	2790.86217	0.11465311	410.625499	8.2939376	28.362307	451350.3407	0.01203943	0.09335231	220.67579	3060.24504	106.908938	<0.009	39.4657392	0.00276968	547.992567
PM18AJ222	D19AU12a299.csv	0.03208686	36.8249471	22.434983	<0.003	0.02267586	<26.532	<0.036	562.580368	0.36893078	1.52675169	464657.9787	<0.003	<0.001	<2.092	36.3738819	0.73610075	<0.007	<6.123	<0.001	115.697066
PM18AJ222	D19AU12a305.csv	1.62536929	2245.42677	151.009573	0.02753774	14.7994816	6377.48043	0.04869143	693.481855	29.6235343	25.2187558	432550.853	0.02189288	0.04266162	363.215045	6741.14603	621.115857	<0.009	95.8109162	0.00803911	999.722143
PM18AJ222	D19AU12a308.csv	0.87602299	49945.1091	121.747031	0.00776871	2.72417416	66781.6718	0.12099254	63.0715884	576.249677	10.3086933	300338.375	0.46292526	0.27642568	27.2617753	634.121272	314.799076	<0.016	459.508334	0.03266159	65.7140306
PM18AJ222	D19AU12a309.csv	4.06209747	1261.74279	275.878858	0.04081767	33.2982206	3468.9345	0.11007546	2679.57941	25.9971786	62.3652779	444927.3269	0.02233587	0.04354018	53.7047543	4425.47612	188.320304	<0.009	61.3808033	0.00307058	322.309046
PM18AJ222	D19AU12a310.csv	0.24109921	271.063645	56.977449	<0.003	5.0606553	1857.88372	0.04109394	150.978413	3.21668141	6.0937764	457488.5026	0.04795053	0.20840439	7.89838893	1700.17908	62.3658524	0.00983548	21.2534532	0.15699282	920.634132
PM18AJ222	D19AU12a287.csv	0.16385838	252.78634	138.02689	0.00895147	13.2715194	2091.97368	0.08654083	106.496218	4.56611021	7.71649192	454802.4656	0.0037952	0.01981742	17.2837203	2565.97395	100.714437	<0.008	24.6014273	<0.002	1081.71607
PM18AJ222	D19AU12a289.csv	0.54605664	2884.29055	232.383451	<0.003	11.898912	5592.18931	0.04963658	47.3815643	17.6826445	70.1606803	449561.8545	0.04937727	0.02138162	8.84050605	1850.19415	55.0668103	<0.008	<7.332	0.19055919	481.413455
PM18AJ222	D19AU12a290.csv	0.37080257	312.774033	267.744614	<0.003	2.16061984	728.452742	0.1745854	31.9675622	0.35666709	279.274285	461508.7908	0.00390726	0.17647931	9.18228881	603.807424	20.1700656	<0.008	29.5670166	<0.002	148.113321
PM18AJ222	D19AU12a297.csv	0.19088707	791.491444	195.865907	<0.003	10.281452	2556.75278	0.09373403	52.9812358	6.03220412	7.59698918	453680.5622	0.02644995	0.35762461	29.1872468	2425.16429	99.7234565	<0.008	65.818969	0.00951408	1020.26812
PM18AJ222	D19AU12a298.csv	0.13411766	440.511156	88.1975054	0.00353755	1.38761762	884.632562	<0.042	1116.35698	0.51280049	2.72918802	460909.839	0.03976555	0.05465308	21.8577297	320.042703	22.2674745	<0.008	26.5772929	0.23932259	379.014749
PM18AJ222	D19AU12a300.csv	0.19800109	1200.84602	13.3097937	<0.004	2.99198936	6555.86709	<0.049	10.3150294	2.97311703	7.27368538	448802.2063	2.26403697	0.52989145	33.2090032	326.01602	56.9893735	0.05526736	61.6070581	5.75098811	63.4455721
PM18AJ222	D19AU12a301.csv	0.14646958	3763.74473	170.5395	0.00770484	2.20353192	3344.67635	<0.043	1325.45591	7.27072483	19.007882	447689.9107	0.22681344	0.88157667	72.1477466	1336.17449	32.1747494	0.01638604	674.237357	0.00270112	513.944838
PM18AJ222	D19AU12a302.csv	0.20407156	540.394295	162.183683	<0.003	1.23591074	806.625982	<0.039	1116.37383	9.94888858	4.43472053	460518.0289	0.01744819	0.19266054	6.05449411	431.102725	15.9421794	<0.007	36.1085126	0.02657786	271.209098
PM18AJ222	D19AU12a303.csv	0.54617537	701.385332	154.504673	<0.003	11.3466581	2728.49269	<0.043	243.493884	1.23450137	11.0773784	452174.3716	<0.003	0.01482132	79.2250712	2812.98472	76.1933041	0.01612677	79.3061095	<0.002	1482.66859
PM18AJ222	D19AU12a304.csv	1.37650613	2110.44591	146.038122	0.038455	8.03744404	10363.0166	<0.047	341.068264	46.9732572	32.0225443	424479.3877	0.40137348	1.32060079	133.915178	8476.47916	296.113965	<0.009	66.7443609	1.70812293	508.276098
PM18AJ222	D19AU12a306.csv	0.70257842	1845.90944	152.161111	0.01832137	10.5451814	3907.93763	<0.109	61.6524538	7.75562924	15.5453145	444223.3271	<0.008	0.026965	58.4380864	4857.79846	156.918284	<0.020	110.494136	<0.004	980.012606
PM18AJ222	D19AU12a307.csv	0.17173865	828.191804	119.749269	<0.003	10.1527112	1858.29031	<0.041	386.829764	1.99204023	6.42324413	457253.3762	<0.003	<0.002	9.21867577	1058.34362	35.9776893	<0.008	38.9617568	0.00466771	974.857119
PM18AJ222	D19AU12a312.csv	0.09089994	1162.49251	167.734765	<0.003	6.05821276	1948.84333	0.14655051	29.2722911	11.1940663	2.68460614	457752.8907	0.04955545	0.8350651	142.640597	1076.97729	52.3574072	0.07763993	127.603858	0.07760163	79.7339797
PM18AJ222	D19AU12a314.csv	0.49521139	1844.63302	69.2128994	<0.003	1.36026771	1248.17555	<0.040	567.573996	6.92512212	8.43357552	457338.7141	0.0263485	0.04504404	81.0972478	490.362505	24.7729625	0.18523604	252.639605	0.00256107	158.721269
PM18AJ222	D19AU12a315.csv	0.2113566	1771.23894	43.2582225	<0.003	1.08559145	1466.14519	<0.042	326.493475	25.9340725	5.44720105	453489.7278	<0.003	0.20041813	56.7581886	3041.74028	118.083846	0.02805225	20.3408414	<0.002	516.903592
PM18AJ222	D19AU12a316.csv	0.23932374	392.861704	867.267631	<0.003	1.27640449	1599.02339	<0.033	1787.36204	4.44155234	8.48155607	454773.8029	0.02186859	0.16514534	16.3217969	1646.88374	60.1216471	0.01449761	62.6009905	0.00590373	1325.42287

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ249	D19AU12a201.csv	0.01150307	<0.266	14.5494633	0.00865852	<0.002	154.48446	<0.043	238.940039	<0.194	<0.168	465022.3406	<0.003	<0.002	<2.206	0.19807651	<0.238	0.01010022	<6.140	<0.001	68.8251197
PM18AJ249	D19AU12a203.csv	0.01305084	<0.290	101.579304	<0.003	0.02795129	<33.277	<0.047	87.4256846	<0.212	0.20236998	463489.8439	<0.003	<0.002	<2.406	<0.040	<0.259	<0.010	<6.696	<0.001	1881.02095
PM18AJ249	D19AU12a206.csv	0.01107706	<0.288	52.938813	<0.003	0.01112397	<32.927	<0.046	373.056825	<0.211	26.4732606	464584.2388	0.01008723	<0.002	<2.391	0.14383975	<0.257	<0.009	<6.657	0.00252506	437.160422
PM18AJ249	D19AU12a207.csv	0.01318565	<0.262	31.8412737	<0.003	0.01041446	<29.996	<0.043	156.457035	<0.194	0.58397492	465062.1498	<0.003	<0.002	<2.181	2.75984517	0.2735578	<0.009	<6.074	<0.001	189.171039
PM18AJ249	D19AU12a209.csv	0.22998976	1.30509053	0.81829748	0.00858956	1.24867103	<32.586	<0.046	41.6317117	<0.209	2.93678019	465297.4679	<0.003	<0.002	<2.376	2.0089352	0.40380097	<0.009	<6.619	0.01263624	118.626442
PM18AJ249	D19AU12a212.csv	<0.013	<0.492	8.70179971	<0.005	0.03919137	61.1452082	<0.079	22.1315772	<0.362	<0.313	465389.3334	<0.006	<0.003	<4.096	0.67632899	0.74103635	<0.016	<11.412	<0.002	13.5225817
PM18AJ249	D19AU12a216.csv	0.02618183	<0.720	28.6765027	0.00770419	0.01789583	<81.463	<0.116	401.108505	<0.530	0.52822107	464870.1601	<0.008	<0.004	<5.998	6.70934057	1.1539116	<0.023	<16.716	<0.004	121.022642
PM18AJ249	D19AU12a195.csv	<0.008	12.7809375	2.25395084	<0.003	0.13685558	73.2455323	<0.045	75.5064964	<0.199	1.14552852	465145.9965	<0.003	<0.002	<2.260	50.6566942	2.10440802	0.19475346	<6.289	<0.001	28.8613071
PM18AJ249	D19AU12a197.csv	0.04151999	97.1985961	10.7161649	<0.003	0.75788794	161.716446	0.06263272	61.2869231	<0.224	0.53060839	464965.1045	0.07585773	<0.002	<2.544	21.2766866	10.3170651	<0.010	<7.081	<0.001	32.7802876
PM18AJ249	D19AU12a198.csv	0.13043219	137.691485	37.3756946	<0.003	8.94609668	35.1135804	<0.049	47.3527939	<0.217	4.54365649	464696.4527	0.01746103	<0.002	<2.458	204.894846	90.2695279	0.01223195	<6.839	<0.001	16.073891
PM18AJ249	D19AU12a199.csv	0.6672837	2680.41825	441.570379	0.03230335	21.5573441	169.065326	<0.055	461.921662	<0.247	88.9538851	453193.6736	<0.004	<0.002	314.980405	106.375924	35.8069417	0.06024417	1604.44643	0.007752	26.1642178
PM18AJ249	D19AU12a200.csv	0.07083992	850.030725	12.4620144	<0.003	2.29107349	192.456226	0.29920974	100.390488	1.65898678	3.83687114	461903.6687	<0.003	<0.002	407.44557	205.528331	20.078839	<0.010	98.4901278	0.00254894	35.919997
PM18AJ249	D19AU12a202.csv	0.15816288	451.119939	36.4231391	0.00553516	6.90690964	700.51187	<0.047	69.104755	0.28819537	3.50038721	462249.7841	<0.003	0.00731466	23.7326886	426.52032	62.3472798	<0.010	46.8278173	<0.001	23.6910819
PM18AJ249	D19AU12a205.csv	0.0375586	21.4214162	47.3790736	0.00304632	1.4897931	<29.702	<0.042	5.27525593	<0.190	0.65550057	465314.5262	0.01862091	<0.002	<2.153	26.4922255	1.68547053	0.00996683	<5.994	<0.001	9.12517402
PM18AJ249	D19AU12a210.csv	0.04243212	400.480767	47.8369893	<0.003	0.87008015	187.00436	<0.048	18.2365442	0.37400624	1.68174513	462687.459	<0.003	0.00416318	278.39944	275.341793	69.7847874	<0.010	<6.931	0.00250252	10.9222932
PM18AJ249	D19AU12a211.csv	0.09850839	187.128271	8.97976602	<0.003	7.99306102	<38.864	<0.055	60.7252154	0.94873566	4.53768568	464538.3564	0.00708428	<0.002	<2.842	281.053317	31.2840393	<0.011	<7.923	<0.002	11.7451188
PM18AJ249	D19AU12a213.csv	0.16204752	24.2037973	34.3087853	0.01495856	5.4763976	232.169339	<0.039	173.95585	<0.180	10.8962289	464661.9927	<0.003	0.00299043	<2.042	51.6856445	23.9348906	0.01681763	<5.786	<0.001	17.3619603
PM18AJ249	D19AU12a217.csv	0.81173984	2638.59627	6.88531308	<0.003	0.51726183	1362.03352	0.64370786	413.093323	<0.222	487.576515	452497.1358	0.40047488	0.03365728	1257.67347	177.080034	15.930798	0.32320638	557.743195	0.19640746	49.1659237
PM18AJ251	D19AU19a175.csv	0.18725973	13.0575813	88.2207885	0.00690643	<0.007	<36.205	<0.044	361.384922	0.31056864	1.11457271	465035.5918	<0.004	<0.002	<2.834	14.5721486	0.60427566	<0.009	<6.689	0.00355919	31.0632295
PM18AJ251	D19AU19a161.csv	2.87409857	2589.29199	521.038651	0.0143764	0.06907012	3776.21887	0.31292644	399.731193	0.37607293	36.8235941	449711.9973	1.20983338	1.54755168	235.546155	373.565714	19.9398191	1.69162689	1024.32745	3.85476681	14.7846033
PM18AJ251	D19AU19a162.csv	5.49450748	1492.93661	356.698106	0.08922151	0.07320566	568.307813	0.11172999	988.203345	<0.245	27.6892206	457831.6104	0.0573015	0.12987244	380.001369	175.849517	11.1601575	0.50870157	352.055157	0.00633368	185.098395
PM18AJ251	D19AU19a163.csv	5.75360954	5728.89578	474.505466	0.12420456	0.10556935	12519.0128	0.11495145	670.868219	0.8716102	35.3356351	421974.2907	1.28712423	3.14949569	353.917494	1183.32076	52.8887318	0.26656569	1937.41693	7.45184231	35.5645532
PM18AJ251	D19AU19a164.csv	0.56360439	4254.54858	92.9253675	<0.004	<0.008	317.51377	0.09283753	135.509004	<0.251	52.15071	452924.0044	0.21400893	0.13460506	1950.27825	388.820507	10.6755359	0.71739581	319.412028	0.0100293	20.4595866
PM18AJ251	D19AU19a165.csv	0.15511741	1070.44987	152.424847	0.0063739	<0.008	2073.79241	<0.051	793.764346	<0.243	4.73814899	460765.0312	0.16194452	0.00521792	137.516021	19.643384	8.5957609	0.13842176	10.6611393	<0.001	40.9645331
PM18AJ251	D19AU19a166.csv	1.21537619	888.074212	699.196266	0.03765021	0.04983946	3745.58593	<0.051	750.475698	<0.245	22.2697503	456447.2709	1.25463868	1.63763404	30.4917766	33.787579	11.1186388	0.46175777	26.2807317	2.61997884	13.8765079
PM18AJ251	D19AU19a167.csv	3.91020878	5584.13347	280.632267	0.06529417	0.10317451	16410.9576	<0.053	220.449231	<0.256	27.6560028	440795.6792	2.83112472	0.04922488	3.88413034	67.3026163	71.9360972	4.04736992	83.4841674	0.01009503	20.8481575
PM18AJ251	D19AU19a168.csv	5.39900199	1363.39701	97.0075671	0.02788252	0.21300557	2120.14433	<0.050	335.25463	<0.241	22.1717358	459584.1017	0.45517733	<0.002	46.5894781	1115.26143	51.0879423	0.02413918	<7.168	0.0032707	45.4126539
PM18AJ251	D19AU19a169.csv	2.54593422	2627.10486	932.683349	0.06113604	0.07906708	<38.767	1.40358965	1318.91656	<0.237	166.736043	452964.9986	<0.004	0.00405021	14.7328453	2786.75631	102.343149	0.52625107	93.0062031	0.00270556	62.3922235
PM18AJ251	D19AU19a170.csv	5.31993034	71.8746368	46.5645025	0.1294936	0.06205542	<35.732	<0.044	204.451299	<0.219	7.40297607	465006.0101	<0.004	0.08286583	<2.762	61.4909255	2.88056601	0.00916572	<6.505	<0.001	18.8376936
PM18AJ251	D19AU19a171.csv	1.13134217	2416.56245	210.355374	0.02225238	0.06321367	<40.917	0.06345135	371.930941	<0.252	46.561566	454029.4186	0.0776142	<0.002	1099.22843	206.305008	6.57865927	6.58905829	358.309073	0.00518452	50.4962378
PM18AJ251	D19AU19a172.csv	0.83451514	260.74806	1680.88612	0.02502989	<0.007	<36.596	<0.045	282.406917	0.3463771	9.40107872	463920.4776	0.00516123	0.00203936	95.719456	61.695296	3.11701953	0.03635778	<6.698	0.00930354	12.842383
PM18AJ251	D19AU19a173.csv	7.08235709	834.304909	251.296689	0.03557728	0.13806652	392.049986	<0.054	370.46463	<0.273	32.0951516	461898.8051	0.00484722	<0.002	211.514501	28.6204666	1.21957228	0.04499445	117.501402	<0.002	112.02534
PM18AJ251	D19AU19a174.csv	2.05928491	6304.20138	115.948223	0.01825284	0.07932529	8924.73763	<0.054	430.951744	<0.274	27.1372594	442218.0072	0.89431501	1.17067019	10.789109	187.850737	81.8606556	0.42961549	283.344574	0.4183353	36.7220604
PM18AJ251	D19AU19a176.csv	6.89513615	65.8725204	1307.77155	0.11959095	0.15933508	642.652183	<0.048	684.078011	0.30633108	18.4235863	463682.7737	0.13210253	<0.002	<3.109	61.3375423	2.70134321	0.15818459	<7.341	<0.001	69.1940908
PM18AJ251	D19AU19a177.csv	2.01813404	265.010573	124.093648	0.01169332	0.0365353	1047.56686	<0.045	447.381661	<0.233	10.8095211	463226.7946	0.33961012	0.01369719	<2.912	55.6310068	7.92938347	0.49530581	<6.877	<0.001	9.29553923
PM18AJ251	D19AU19a184.csv	3.14635035	16.3013541	307.737979	0.05575101	0.01636322	131.879987	<0.042	430.849981	<0.230	10.5879968	464751.3723	<0.004	0.00486026	<2.836	0.1359196	<0.289	0.25986562	<6.716	0.00310981	7.9554802
PM18AJ251	D19AU19a185.csv	2.30357483	2316.7311	369.716372	0.05450483	0.08079812	2139.86756	0.06831175	614.480696	<0.211	70.3231811	455820.9662	2.72689906	1.97901281	152.598917	821.919908	45.933898	0.6390477	751.673475	0.00735567	45.3308311
PM18AJ251	D19AU19a186.csv	2.90180787	1606.28043	286.365173	0.02372186	0.04788111	<37.257	0.37904691	185.709573	<0.245	32.3364604	458949.6484	0.03983192	<0.002	68.2661086	1677.82427	58.1175951	2.76585346	64.7572132	0.038189	31.9887576
PM18AJ251	D19AU19a187.csv	1.22261021	2159.17479	193.550187	0.01465989	0.05538559	2901.48051	<0.044	137.331773	0.3049367	70.4929415	452024.4518	1.14543658	1.79939423	654.963547	516.039158	22.407567	1.13834998	192.076284	3.93535371	23.5226899
PM18AJ251	D19AU19a188.csv	2.34088851	2479.62151	126.665952	0.01753224	0.07881988	15151.2079	0.15779076	1118.74802	29.719821	37.5626225	428314.33	2.15827855	1.1370767	63.4463914	1158.42101	58.7559543	5.43764241	58.5668159	6.20705745	72.1092065
PM18AJ251	D19AU19a189.csv	3.32452476	2111.32464	178.533955	0.00830625	0.07125188	588.640916	0.42028613	336.839912	<0.252	39.1011392	456023.2579	0.01218881	0.05679497	51.5644313	10.3811372	0.65953815	0.01077275	1223.35419	0.30282223	8.55720249
PM18AJ251	D19AU19a190.csv	2.97172719	2135.62801	840.314254	0.04647263	0.08609194	2426.7991	<0.044	2007.16554	<0.255	14.4183722	450708.8211	1.41467386	0.2107332	346.599549	170.129547	9.10360163	1.25285279	774.363366	0.30439883	45.4321164
PM18AJ251	D19AU19a191.csv	3.63474189	2244.4611	500.343371	0.1019287	0.1006797	862.681992	0.08759002	900.571249	<0.224	55.3092928	456733.7807	0.10388903	0.00607528	385.46766	44.8975555	5.50718895	0.2700501	505.53773	0.01474807	168.692921
PM18AJ252	D19AU12a072.csv	0.17565242	836.830743	18.8907105	0.02585971	<0.005	<117.559	0.58417611	65.8641832	4.39314306	202.258174	454057.3155	<0.011	0.0759973	<6.804	1162.79865	48.9519194	0.89513747	<18.431	<0.003	21.406651
PM18AJ252	D19AU12a073.csv	0.5268285	5691.65954	28.8755842	<0.015	0.01932333	<216.866	<0.320	160.14979	4.21904573	402.133795	441998.6188	0.44994986	0.04419522	60.3399735	5807.75571	230.382894	0.23984378	791.922658	<0.007	65.2833997
PM18AJ252	D19AU12a074.csv	0.16175481	5657.30813	28.5392453	<0.009	<0.006	496.6206	0.22674469	80.3768947	26.287279	114.576044	439155.7972	1.37871131	0.44747796	599.827593	3465.65364	722.002877	5.4707815	<21.202	0.01909857	73.1184424
PM18AJ252	D19AU12a075.csv	0.14575026	4132.80246	34.6804647	0.01356648	<0.006	4430.31578	<0.192	46.7321555	17.3093153	188.844149	418563.0074	3.77835047	0.92784328	117.375717	3003.71387	1223.20172	4.10628473	20.6532402	0.08044329	31.5566911
PM18AJ252	D19AU12a076.csv	0.17957122	2574.77215	44.0066902	<0.010	0.01107774	1277.51985	0.44650449	121.877973	5.58909194	155.824501	418888.8482	0.89803253	0.53798505	71.1603226	3435.724	174.547888	4.91624491	192.444499	0.04275028	42.4351113
PM18AJ252	D19AU12a079.csv	0.04634497	1498.41344	307.622143	0.07705092	0.0747986	233.188889	0.18254357	473.804331	<0.572	95.981333	457950.9075	<0.010	0.24249539	57.2554111	1368.94857	59.7787977	0.88502375	260.126312	0.00699991	23.2332911
PM18AJ252	D19AU12a080.csv	1.91557597	4245.95831	1172.79982	0.40551184	1.07696401	10513.494	1.00002718	484.530565	9.42992539	547.647504	422315.8994	3.16751763	0.5717899	42.031112	2939.3572	184.780459	1.88742087	188.423512	0.48398913	149.245718
PM18AJ252	D19AU12a081.csv	0.47457646	2834.99289	277.106691	0.18350112	1.42932657	1403.44675	1.37609668	1048.96479	<0.638	197.628918	453463.2108	0.11186436	0.06168276	154.563508	1001.31744	64.9087593	0.11512998	427.103039	0.031561	20.4485558
PM18AJ252	D19AU12a082.csv	0.02907921	1206.4948	29.6102976	0.01663281	0.00597982	1365.83689	1.00674584	82.3998829	8.94080322	50.0708565	452799.365	0.22867551	0.02187121	29.8801863	3150.58424	215.069877	3.37070675	28.9182217	0.01510776	13.1491763

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ252	D19AU12a083.csv	0.88540104	6447.7946	122.208807	0.20207281	0.2465161	334.422184	<0.399	45.9554209	<1.542	287.660457	435409.5967	0.49050744	<0.014	157.02463	4768.01982	213.051178	0.75322022	1898.06925	<0.008	15.8768356
PM18AJ252	D19AU12a084.csv	0.65722019	614.860751	166.012767	0.04933611	0.04091567	356.167361	<0.161	105.67856	2.08132699	182.696646	439897.2359	<0.011	0.01171066	66.2034929	637.243369	45.1067664	2.55758407	80.0658096	<0.003	33.1209427
PM18AJ252	D19AU12a085.csv	2.42927287	8638.24047	43.5063254	0.27542709	0.16297096	2267.69644	0.72035289	309.167838	24.7947715	120.998726	430562.1964	0.20503202	1.35517858	109.775858	1682.43517	93.3655698	0.27235572	3734.81751	0.01242834	49.7698594
PM18AJ252	D19AU12a086.csv	0.04161846	1145.46064	13.6157109	<0.006	<0.004	468.425372	0.17431891	83.7296349	18.7382775	14.7799872	460562.9023	<0.009	0.01853479	12.0179455	284.073792	7.94344685	<0.028	468.778023	<0.003	12.7221772
PM18AJ252	D19AU12a087.csv	0.43759535	5923.55944	107.66732	0.12461285	0.09603	19390.3945	0.48450206	325.527553	21.1243847	28.8458773	415455.2909	0.30972046	0.33083904	31.114478	2249.62639	62.4616825	0.24365503	366.562936	6.03529512	36.6641725
PM18AJ252	D19AU12a088.csv	<0.025	196.672703	<1.522	<0.007	<0.005	379.890077	<0.146	0.08110523	0.98409358	7.14428015	464065.6863	0.17900778	0.03648574	15.0467909	176.013608	15.5694257	<0.032	<16.081	0.1513797	0.25072961
PM18AJ252	D19AU12a089.csv	0.20944151	2743.4237	70.1955785	0.0088337	0.02737587	945.172984	<0.170	45.4557549	1.00154592	24.0574421	451794.7106	0.26406895	0.07464467	72.5290023	41.4353633	4.9545701	0.09134603	1595.60182	0.21794402	15.7756593
PM18AJ252	D19AU12a090.csv	3.59731407	1021.3908	60.0450604	0.24886493	0.44779983	892.804068	6.4356466	535.509279	26.3285183	81.3567092	458268.9068	0.09941107	0.51431735	37.3403786	1303.17742	48.7686747	0.14767385	<14.966	0.27270179	69.9831576
PM18AJ252	D19AU12a091.csv	0.11876331	5601.34917	54.9398523	0.02123586	0.01413708	347.037972	<0.157	211.373023	72.2655057	64.7691436	442580.7018	0.10646817	<0.006	12.6505805	9385.92405	197.697518	<0.034	<16.930	<0.003	48.0754767
PM18AJ252	D19AU12a092.csv	1.4555796	634.109008	116.282995	0.1757897	0.04494261	1426.09766	0.23162219	85.9811168	12.3696633	366.782826	447146.662	0.02305942	<0.005	44.5527533	1687.28463	132.743738	12.9303164	47.9942946	<0.003	29.2815575
PM18AJ252	D19AU12a093.csv	0.51672975	2244.09391	276.842806	0.05358518	0.10838661	849.927524	1.16678115	349.646651	5.50763569	2095.94154	454242.792	0.05127993	0.00880713	118.806798	177.30086	9.91514559	0.25812815	876.347886	<0.003	42.3146939
PM18AJ260	D19AU12a229.csv	<0.008	1.97967082	117.182979	<0.003	0.01129749	83.6359377	<0.046	126.440305	<0.212	0.5036233	465080.8158	0.13661738	0.05099459	<2.392	0.33371063	0.59030018	<0.009	<6.690	0.04348239	88.6902809
PM18AJ260	D19AU12a022.csv	0.82029728	11250.4361	178.762639	<0.009	1.02204896	16976.6907	<0.228	55.6631645	<0.818	28.2379021	418089.9404	1.25556547	0.45925601	85.4424887	1454.43344	579.240618	<0.051	36.6418265	0.04291108	11.2829449
PM18AJ260	D19AU12a023.csv	0.16002804	2541.56296	75.0082788	<0.006	1.75881734	3508.08763	<0.158	188.884042	<0.560	10.3176395	454755.1931	0.16981566	0.56705198	6.38348713	519.442302	101.034783	0.05566757	<15.458	<0.003	37.0128304
PM18AJ260	D19AU12a024.csv	0.97221886	6537.97379	67.8692252	<0.007	1.0577776	11051.6117	0.27658751	126.758975	<0.648	54.4947028	440423.8382	2.4182684	0.17436853	155.725917	145.252014	273.279546	0.07951366	<17.908	<0.003	14.5116476
PM18AJ260	D19AU12a228.csv	0.03442748	527.300141	135.924173	0.00308727	0.1218154	360.057469	0.04696341	84.7863745	<0.200	3.04386199	463310.2342	0.2150508	0.91204931	14.2231339	188.58033	23.5211465	<0.009	97.7920082	0.00323042	19.0294285
PM18AJ260	D19AU12a232.csv	0.25610495	393.737866	249.271931	0.00547293	0.14077566	1498.89306	<0.047	211.61325	<0.223	3.15427799	461405.5766	0.52773564	1.40504632	<2.508	61.1992224	10.0447584	0.03020514	57.004198	1.11836541	87.1985353
PM18AJ260	D19AU12a233.csv	0.47885318	952.767552	112.651121	0.01009275	0.7997717	1297.02225	3.07915017	62.0423073	<0.199	9.39342628	461326.6139	1.26802535	0.80251853	220.352134	173.089256	26.3882771	0.13123069	83.8079126	0.06180507	36.7701552
PM18AJ260	D19AU12a234.csv	0.30253876	8040.49552	106.870149	<0.004	0.0759425	5625.54794	<0.054	18.5703315	<0.256	9.37986413	438606.7476	1.11101573	0.22805386	89.5355066	168.6036	23.6894544	<0.011	1881.12848	0.0078132	5.67204667
PM18AJ260	D19AU12a235.csv	0.02120159	203.775299	100.889385	<0.003	0.03032821	111.333753	0.04717811	56.7755128	<0.204	0.70494925	464762.874	<0.003	<0.002	<2.291	0.44738457	0.38741977	<0.009	27.791408	<0.001	37.4794683
PM18AJ260	D19AU12a236.csv	0.23757017	12079.3623	86.6744763	<0.010	0.01640766	8958.38398	<0.151	49.6010002	<0.721	10.46294	419691.9326	2.44115778	1.51019713	174.12705	348.931403	47.1378547	0.0386154	3425.98749	0.1926129	29.8137509
PM18AJ260	D19AU12a237.csv	0.21705354	2360.53448	156.131775	0.00395307	0.21344082	1212.709	<0.047	105.250022	<0.228	10.1671842	457226.9385	0.43610114	0.54345956	78.7874628	277.180046	32.986989	0.02615794	463.94151	0.06139991	30.6013901
PM18AJ260	D19AU12a238.csv	0.60317065	2227.89859	161.779473	0.00851189	1.25426577	2050.02687	0.23040205	67.9170496	0.30334369	408.085955	453840.9577	0.27889433	0.67576638	363.81216	748.779619	91.5213785	0.40705146	50.5160235	2.19785071	24.1022207
PM18AJ260	D19AU12a239.csv	0.3747082	1977.24602	165.684362	0.00885513	0.68627876	1726.23334	0.06458247	121.648468	<0.209	10.9782221	457813.4307	0.86842636	0.59783744	418.337322	522.178775	62.5897408	0.02978839	34.056428	0.50177437	34.1712924
PM18AJ260	D19AU12a241.csv	0.15941244	86.6847742	185.811206	<0.003	0.21700026	590.786076	<0.044	56.8137421	<0.211	3.03947527	464534.5154	0.8149556	0.95542378	<2.369	61.9085773	7.48157534	0.42874555	<6.665	0.0293977	25.9244765
PM18AJ260	D19AU12a242.csv	0.12618309	2709.50772	42.7665539	<0.003	0.48824198	7519.07618	0.13057515	16.8180869	<0.231	7.18033101	451973.1229	1.60639097	0.70287025	12.8051191	380.079208	214.879803	0.0220196	<7.266	0.11656396	7.30270478
PM18AJ260	D19AU12a243.csv	0.26968357	10491.6686	69.6825793	<0.004	0.96009901	16399.7026	<0.057	61.9292436	<0.281	14.2267905	426720.5909	0.68722123	1.46859523	10.2749352	381.370764	269.235904	0.10523157	19.772546	0.60435246	16.1254197
PM18AJ260	D19AU12a244.csv	0.80391971	10962.3673	191.258895	0.01094505	2.26030081	16334.3303	<0.056	100.787135	<0.271	22.9104503	426508.7403	1.27575965	1.12704741	15.7821685	302.672093	244.288612	0.05353709	20.0944354	0.06214214	21.140984
PM18AJ260	D19AU12a245.csv	0.05492497	722.45176	27.6598798	<0.004	0.15109182	1612.70016	<0.065	16.6003408	<0.314	4.41094235	405470.1017	0.04862854	0.231569	31.3300846	357.43994	80.4074019	<0.013	81.2417129	<0.002	25.6920919
PM18AJ260	D19AU12a246.csv	0.16183052	3300.68239	66.0457105	<0.003	1.76747504	5235.14009	0.08846548	24.9935596	<0.232	18.0469706	441326.8924	0.39296994	1.04844385	21.051463	663.832122	168.369281	0.02874693	17.4913256	0.01194931	4.19836658
PM18AJ260	D19AU12a248.csv	0.60359417	6030.07721	116.438827	<0.004	0.47324457	9705.56967	<0.054	58.4104908	<0.265	20.0590897	437727.0361	0.19364373	0.58907968	36.8493968	1560.71863	445.473312	0.02345558	50.7376061	0.02820092	20.1029427
PM18AJ260	D19AU12a250.csv	0.34094163	94.6951485	373.954068	<0.010	0.22467017	172.366002	<0.147	148.288773	0.91557261	0.83720206	464434.5829	<0.010	0.36719672	<8.237	37.5170884	7.94618894	<0.029	<21.361	<0.005	56.6438582
PM18AJ260	D19AU12a251.csv	0.06480951	17.677918	152.585206	<0.004	0.00426965	147.032746	<0.054	125.045072	<0.269	1.66945943	460587.4907	0.00546221	0.19113132	<2.996	58.4741518	11.5030456	<0.011	<8.478	0.00928254	83.4162732
PM18AJ275	D19AU12a055.csv	8.06094888	4.36587275	1014.20014	0.00853577	1.11137283	<107.580	<0.160	119.172061	<0.598	10.9111409	464977.0082	<0.011	<0.006	<6.171	0.19801955	<0.755	0.91356683	20.2063906	<0.003	25.8910506
PM18AJ275	D19AU12a056.csv	9.83698392	<0.649	<1.424	0.18001364	<0.005	<97.617	<0.146	22.3586865	<0.543	1.26003467	465298.0671	<0.010	<0.005	<5.600	<0.089	70.9273784	0.25695734	<14.930	<0.003	68.104602
PM18AJ275	D19AU12a059.csv	0.11882904	<0.648	1487.58279	<0.006	0.72558912	<97.522	<0.144	102.90105	<0.546	1.70713642	464924.9553	<0.010	<0.005	<5.602	0.25307975	<0.686	0.1204574	<14.998	<0.003	27.069422
PM18AJ275	D19AU12a060.csv	3.17070368	24.4761712	11.4240672	0.0092258	0.01304834	<90.451	<0.135	48.203205	<0.507	18.6896761	464890.0572	<0.009	<0.005	<5.197	1.51316407	180.96505	22.867004	15.713838	<0.003	178.904781
PM18AJ275	D19AU12a386.csv	0.8533097	27.0846143	105.916108	<0.003	17.1672432	213.512329	<0.032	23.8318747	<0.194	16.7833486	464643.9858	0.03409951	<0.001	<2.177	112.724175	13.4817861	1.81595831	44.7284049	<0.002	6.48894289
PM18AJ275	D19AU12a388.csv	0.08585594	<0.380	213.01678	<0.005	0.00451772	<34.105	<0.043	78.0647551	<0.270	<0.182	465309.2177	<0.003	0.01454276	<3.027	0.98289031	<0.337	<0.007	<8.743	<0.002	20.5736809
PM18AJ275	D19AU12a389.csv	0.30994671	<0.283	104.743412	<0.003	0.01730249	<25.393	<0.032	96.6729612	<0.202	0.26099713	465330.6556	0.00437279	<0.001	<2.260	0.10163428	<0.251	0.04099559	<6.521	<0.002	11.0887949
PM18AJ275	D19AU12a391.csv	0.32107031	<0.264	2765.80567	0.02737989	20.6281815	<23.541	<0.030	518.445687	<0.188	6.75918173	464113.0773	<0.002	<0.001	<2.107	0.47413582	<0.234	0.1206982	<6.069	<0.002	35.9152641
PM18AJ275	D19AU12a392.csv	0.01882515	<0.273	497.634936	<0.003	0.91846409	<24.354	<0.031	75.5743464	<0.195	3.2950453	465211.5425	<0.003	<0.001	<2.184	0.1975773	<0.242	0.18892889	<6.284	<0.002	39.3176085
PM18AJ275	D19AU12a394.csv	0.01188865	<0.263	208.438717	<0.003	1.48033354	<23.327	<0.030	36.534775	<0.188	0.61688227	465341.5001	0.00574641	0.01286255	<2.105	0.26897646	<0.232	0.04210953	<6.051	<0.002	23.7202061
PM18AJ275	D19AU12a395.csv	0.08242571	11.3601566	2543.91978	0.00566144	1.8714487	88.5278802	<0.033	129.071623	0.22851161	1.90027785	464299.9087	<0.003	<0.001	<2.353	90.4478864	3.36755717	0.17599857	<6.755	<0.002	27.5478677
PM18AJ275	D19AU12a057.csv	2.73166009	265.253254	4.34213157	0.05903158	0.0113476	118.468037	<0.126	82.1716536	<0.492	21.2579015	464118.1303	<0.009	<0.004	<5.056	0.21239048	133.983097	1.04700858	19.3857583	<0.003	269.45315
PM18AJ275	D19AU12a058.csv	4.50434109	597.712547	8.53177593	0.00785415	0.37629958	2715.65762	<0.174	100.09153	0.74382752	54.2720732	459749.5822	<0.012	0.01884999	1065.58403	2.22329578	14.3122162	6.43653421	23.4254002	<0.004	166.952574
PM18AJ275	D19AU12a062.csv	14.5889073	5787.9504	87.8035433	0.08094888	5.10436311	29156.8122	0.54292844	621.634398	<0.705	208.100652	403105.2952	0.65301047	0.0799179	<7.193	36.0816609	144.345858	1.73865484	39.3314006	5.66734637	182.043703
PM18AJ275	D19AU12a065.csv	68.73333	1.32312258	489.810558	0.19939075	7.11542393	<96.650	2.26314972	56.7349551	<0.547	85.8356248	464922.5658	<0.010	<0.005	<5.567	0.2575931	<0.685	0.59594433	15.4713243	0.0211972	43.0333334
PM18AJ275	D19AU12a387.csv	5.84245478	6564.41767	155.277976	<0.004	0.3817266	8642.57024	0.21607833	56.894524	<0.234	8.18355155	444280.9334	0.10389012	<0.002	92.5595218	7.04711946	121.069844	0.41817901	<7.562	<0.002	17.0171196
PM18AJ275	D19AU12a390.csv	0.13523242	1131.84439	162.674294	<0.004	0.43046562	1821.62567	<0.034	48.9004888	<0.214	2.84430595	461365.8154	0.12568685	0.00175628	<2.400	0.61988374	6.67306294	3.0793137	<6.918	<0.002	29.9939363
PM18AJ275	D19AU12a393.csv	2.89377662	358.52704	334.401001	<0.003	3.11984763	697.598838	0.10094649	57.5628828	<0.194	10.3555746	463797.4984	0.06185143	0.00485695	4.65211645	1.27432346	15.4451698	1.02550929	<6.247	<0.002	8.62271496
PM18AJ275	D19AU12a396.csv	0.63949813	239.579989	360.991224	<0.003	1.8982897	165.047907	<0.031	153.440376	<0.198	6.12980598	464295.1617	0.04469581	<0.001	<2.212	67.4176927	8.00420722	0.20385145	<6.378	<0.002	52.5836462

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ275	D19AU12a397.csv	6.68755807	9614.09715	285.644902	0.04189584	4.67740531	13295.3124	0.08208328	88.6989259	0.29306671	41.6595996	432162.4256	0.29697747	<0.002	4.78318959	21.0189625	274.173734	9.094827	130.57722	<0.002	43.0945569
PM18AJ275	D19AU12a398.csv	0.1722557	601.421794	233.653667	0.00542252	0.15748831	975.404323	0.04855518	202.064724	<0.190	12.4143339	462916.4336	0.11877055	0.00563885	<2.119	17.7578758	9.49600536	1.46863412	<6.069	0.00327073	75.0793117
PM18AJ275	D19AU12a399.csv	3.50271477	61.113703	3819.32931	0.01361571	7.73239713	367.166006	0.03112746	73.2134737	0.2387483	10.4886205	462796.1469	0.01786084	0.00160582	4.35587458	348.313614	18.9859779	0.13055347	8.3070744	<0.002	27.1154747
PM18AJ281	D19AU12a007.csv	0.04234812	1.81117683	292.939947	<0.006	0.03547868	<98.038	0.15246106	92.9105018	0.93691139	0.49205734	465277.6877	<0.010	<0.005	<5.572	<0.081	<0.744	<0.032	<13.966	<0.003	11.3816769
PM18AJ281	D19AU12a218.csv	<0.010	<0.374	155.233145	<0.004	0.0373392	<42.176	0.08531571	124.796802	<0.275	1.16864354	465143.0946	<0.004	0.01014698	<3.113	0.82515766	0.36313864	<0.012	<8.682	<0.002	150.006374
PM18AJ281	D19AU12a227.csv	17.0144995	1.65081434	3756.11221	0.21587949	85.1644275	45.7839154	<0.043	74.2943887	<0.203	30.7168241	463756.908	<0.003	0.00388399	<2.293	17.7431876	3.3777402	<0.009	<6.413	0.00230274	17.9412059
PM18AJ281	D19AU12a008.csv	14.1572144	432.581383	384.681604	0.40700065	36.3484172	<403.269	<0.580	166.407913	<2.204	287.196164	462839.2649	<0.040	<0.020	<22.954	29.2534392	35.3526545	4.08923158	214.722629	0.09323465	25.3825889
PM18AJ281	D19AU12a010.csv	0.35876342	13.9132657	1004.38717	<0.006	11.440196	<106.956	<0.163	200.03912	<0.580	4.44501105	464848.7868	<0.011	<0.006	<6.101	8.81159291	<0.797	<0.036	<15.361	0.00990906	46.5590441
PM18AJ281	D19AU12a011.csv	2.09143604	56.7949392	5351.77182	0.10735076	47.3861585	<156.668	<0.233	17.1270532	<0.846	26.1337893	463602.6906	<0.016	0.14887382	<8.947	60.0789485	4.34940697	<0.052	<22.566	0.12363358	6.41283951
PM18AJ281	D19AU12a012.csv	0.30461204	85.5101613	381.286944	0.03772221	2.6192558	<98.043	<0.144	81.1129753	<0.528	3.65938577	464764.7379	0.03584077	0.05386073	<5.603	0.24274259	<0.722	<0.032	71.2909506	0.01042096	13.4035514
PM18AJ281	D19AU12a013.csv	6.94705236	1326.50234	5918.7105	0.53214727	61.1860918	14062.1546	<0.650	190.365822	11.0325896	64.8429316	434907.4229	0.56625852	1.86612629	<25.500	9.0304355	11.6007594	<0.146	<64.478	30.6885	61.2980478
PM18AJ281	D19AU12a014.csv	6.02021494	3.69235746	1917.74758	6.30609323	23.655754	<89.973	<0.135	441.453	<0.482	110.650362	464021.3885	<0.009	<0.005	<5.149	<0.076	<0.657	0.09050219	<13.038	<0.003	68.7790101
PM18AJ281	D19AU12a015.csv	4.3928536	21309.6911	514.506205	0.22968339	43.3962778	665.722242	<0.304	12.915851	5.68460879	323.064551	371513.098	0.03027271	0.27007405	1346.89838	5886.39652	740.977272	16.9819573	9709.72277	<0.006	10.1166153
PM18AJ281	D19AU12a016.csv	1.16902029	191.873201	2911.86458	0.09865574	36.7100445	<178.839	0.32612488	308.372027	<0.954	17.2612745	462013.5628	0.18473028	2.61183769	22.8366256	242.017264	7.34801881	<0.059	69.6199868	0.01020502	116.043191
PM18AJ281	D19AU12a017.csv	0.40788063	3719.92957	175.135193	0.00724625	2.41156344	166.546933	<0.172	382.042924	<0.616	66.2984161	448408.8176	0.0175359	0.04364819	37.4169662	232.207432	34.7348108	<0.039	2454.61449	0.02948316	33.2422815
PM18AJ281	D19AU12a018.csv	5.95075706	32.9466655	1178.20488	0.15759993	19.1613155	854.11346	0.19484655	239.080842	0.9789101	4974.8832	457940.0262	0.07074689	2.06748762	<6.793	242.643064	70.7269856	0.09219381	<17.220	0.00474822	48.0565491
PM18AJ281	D19AU12a019.csv	3.37046643	13.0756491	1339.63388	1.68839425	3.76022045	<97.944	0.18908568	415.751099	<0.521	28.3529344	464097.308	<0.010	<0.005	<5.616	166.764877	17.762548	0.45156958	<14.294	<0.003	9.26580175
PM18AJ281	D19AU12a020.csv	0.99050694	1138.16768	2132.25283	0.04912225	4.39805601	2050.30136	<0.174	75.477686	3.9783288	238.612744	459576.0529	0.434459	0.05834743	77.5505206	25.6886572	52.3794718	0.14290686	20.2741933	0.91434646	7.21343061
PM18AJ281	D19AU12a021.csv	3.20187729	15249.8548	173.221434	0.20521727	19.2162461	34918.5012	<0.216	36.4150593	4.45215911	3431.28398	394996.3929	2.73468614	<0.008	4625.85579	463.483521	583.862082	3.44903612	268.811938	0.01625893	10.2818646
PM18AJ281	D19AU12a225.csv	0.54100569	675.475507	403.984914	0.03793289	398.729505	1009.20519	0.09878558	1434.69945	0.45687766	79.0295899	460009.7356	0.22297678	9.18521793	<4.604	5.0149385	11.0901144	0.08192577	<12.868	0.01509444	13.5874424
PM18AJ281	D19AU12a226.csv	1.05180067	12.1813616	615.237995	0.03225005	16.6103409	<33.334	<0.047	21.8667252	0.36606856	3.59559147	465067.307	<0.003	<0.002	<2.486	24.5356815	1.6008238	<0.009	<6.952	<0.001	3.80752157
PM18AJ282	D19AU12a143.csv	1.49259387	23.2070816	19.00713	0.58962	0.01177949	424.361676	<0.051	517.280745	<0.210	3.3893379	462119.6193	<0.004	<0.002	3.44271946	508.809061	658.55751	0.03645155	<6.370	<0.001	209.117548
PM18AJ282	D19AU12a152.csv	0.16318697	0.95989629	56.9971268	0.23494345	0.01628513	<29.555	0.04815066	1079.02568	<0.178	2.47139984	461723.9202	<0.003	<0.002	<1.956	12.1921629	2114.58647	1.41202663	<5.473	<0.001	533.884443
PM18AJ282	D19AU12a153.csv	1.26683517	0.30293288	41.6580397	0.31271076	0.0435796	<35.057	<0.050	338.184482	<0.212	8.43967222	464068.4466	<0.003	0.00394477	<2.325	1.82443427	843.378981	0.01561952	<6.503	<0.001	172.292992
PM18AJ282	D19AU12a157.csv	0.51786306	17.7672712	3.98377272	0.4786723	0.00284995	397.565138	<0.046	329.144943	<0.194	3.16795726	461480.7718	0.01644899	0.03238704	<2.134	368.663129	590.564122	0.15253172	<5.964	0.00442731	162.722383
PM18AJ282	D19AU12a159.csv	0.63686615	0.37381949	7.77527288	0.58065151	<0.002	49.9708624	<0.044	277.993425	<0.193	0.4834308	464594.4533	<0.003	0.09559235	<2.128	1.06533916	399.54841	0.02076057	<5.943	0.06643419	150.414599
PM18AJ282	D19AU12a161.csv	2.82791417	59.258916	72.6916836	0.24653198	0.01974823	7617.82054	<0.047	653.837568	<0.203	15.2168661	454050.9069	<0.003	0.01049007	3.05812642	1437.70605	1539.34323	0.05004854	22.9917567	0.00149851	271.276373
PM18AJ282	D19AU12a145.csv	1.70113067	10.7623467	5.3045489	0.27727942	0.00970174	75.7633327	<0.044	375.194696	<0.185	2.1500336	463495.6641	0.01140182	0.00793416	<2.006	54.1169048	239.117497	4.66308497	<5.616	0.09923713	136.351654
PM18AJ282	D19AU12a146.csv	8.91398662	2357.36466	68.2290122	0.17711217	0.03596869	3439.42014	0.09993166	123.477645	0.75222211	29.1617971	455696.6479	0.0854896	0.10156567	<2.145	549.758775	590.52286	0.13477236	9.17834997	0.00338479	117.209447
PM18AJ282	D19AU12a147.csv	1.84143662	46.4019069	44.5639343	0.48770336	0.1587736	737.945734	<0.048	572.309085	<0.204	8.38166051	457900.9928	0.05598699	0.00947431	<2.219	680.720662	2871.12163	0.0374236	34.8263897	0.00365111	257.123266
PM18AJ282	D19AU12a148.csv	1.56204089	34.2637041	44.9975838	0.22671174	0.04473488	2898.56564	<0.050	630.711381	0.32146321	4.38486184	450088.5713	0.09821797	0.17558679	<2.330	373.92677	251.321771	1.0609395	<6.517	<0.001	222.790836
PM18AJ282	D19AU12a149.csv	0.74377576	14.4808832	8.4665427	0.24030539	0.00253586	1138.18056	<0.049	394.078568	<0.210	1.42203978	462631.2049	0.36577206	0.01547263	<2.290	326.569389	529.218896	0.72587607	<6.406	<0.001	200.337638
PM18AJ282	D19AU12a150.csv	2.1559904	3759.83434	50.4256822	0.37422068	0.03223384	5094.12168	<0.052	345.476439	0.46839398	3.80545102	449511.66	0.34758387	0.25752934	<2.483	454.632837	231.911373	0.86523746	<6.943	0.10962664	217.9046
PM18AJ282	D19AU12a151.csv	1.53756591	310.360675	14.9983266	0.42567874	0.00609292	2512.31828	0.05073449	496.445566	0.32188221	4.11669094	452495.7118	0.00552595	0.03666627	10.1612427	3214.68815	547.36399	3.68810091	30.3729748	0.14023406	364.082694
PM18AJ282	D19AU12a154.csv	7.96109903	6823.27516	225.527663	0.28436316	0.04206191	9927.70625	<0.056	48.1005527	0.30395283	4.08873911	441597.3081	0.01560002	0.00655716	<2.629	28.8735082	151.502361	<0.012	<7.349	0.00419614	63.8850323
PM18AJ282	D19AU12a155.csv	0.6833807	12.4249653	14.2087156	0.11664466	0.01212949	884.327925	<0.045	149.697549	<0.193	1.82285393	458863.1507	0.07462677	0.00836169	<2.140	48.1213741	116.785777	0.47350733	<5.981	0.00223653	69.9010931
PM18AJ282	D19AU12a156.csv	0.8714426	75.1617015	10.7866995	0.38507625	0.00333792	86.0064023	0.09898842	185.490982	<0.198	2.17347927	464233.1596	<0.003	0.003965	<2.191	83.1121386	370.931041	0.30694068	<6.125	<0.001	112.972367
PM18AJ282	D19AU12a160.csv	2.1080117	243.603668	135.197209	0.19564495	0.04396408	15859.6719	<0.058	151.841771	0.26513263	11.9809764	439522.5042	0.59120285	0.36267849	8.73011422	1721.3276	664.015827	0.19385857	41.9847195	2.93662586	118.305803
PM18AJ282	D19AU12a162.csv	4.0861777	1044.69675	151.536882	0.44193909	0.04499498	27230.5021	0.0796676	554.840827	1.20598162	11.3230323	421364.413	4.03159607	5.35008356	9.2060906	1103.65758	1718.20875	0.48343735	32.1231047	26.7494069	192.851846
PM18AJ282	D19AU12a163.csv	0.46907384	1191.00571	13.3568627	0.47638729	0.02156392	2140.15228	<0.051	272.824041	<0.221	2.53425063	456748.986	0.06618693	0.00629298	<2.450	599.131875	677.631182	0.04826141	<6.840	<0.001	125.743235
PM18AJ282	D19AU12a164.csv	1.0724542	267.642507	34.8941289	0.27953811	0.00909966	8943.90969	<0.048	337.914866	<0.202	8.03250715	443756.16	0.54192457	0.71087954	6.07810033	954.57316	1518.96094	0.2454487	16.7734814	6.3564758	178.990631
PM18AJ282	D19AU12a165.csv	3.47299806	6564.33812	96.0674674	0.25509796	0.03142677	10703.138	0.12690227	254.13881	<0.258	12.3414957	433761.3179	0.20053401	0.1771688	7.97893424	2131.48338	1251.2401	0.10227131	43.5050006	0.44777531	124.406333
PM18AJ284	D19AU12a108.csv	4.75541136	3.02210876	2676.032	<0.008	52.9320388	<113.461	<0.166	896.655859	<0.671	6.72231633	453379.1589	<0.011	<0.006	<6.904	4.92144954	<0.829	0.04378699	<19.225	0.00763175	10373.3489
PM18AJ284	D19AU12a109.csv	2.65654617	5.14442026	1826.27963	0.01303577	42.1683655	<118.283	<0.172	4227.97255	<0.701	12.7946033	447579.9716	<0.012	<0.006	<7.210	12.3667742	<0.866	<0.037	<20.470	<0.004	13199.2966
PM18AJ284	D19AU12a116.csv	8.59955347	<0.872	3154.24699	0.01398984	78.4702393	<117.206	0.2460261	6007.53903	<0.699	6.06790248	452373.197	<0.012	0.05085405	<7.233	0.33611662	<0.866	<0.037	<20.190	<0.004	5243.33629
PM18AJ284	D19AU12a095.csv	2.54057551	241.670458	7564.64009	0.06796104	40.8114867	277.577013	0.28870803	1632.69282	3.85347585	16.1022679	447938.2446	0.02905074	<0.006	18.2747005	34.8081701	2.82113837	0.06100061	28.670574	<0.004	12687.9201
PM18AJ284	D19AU12a096.csv	7.29994151	610.217745	1146.57891	0.01657771	50.4175538	903.478516	0.213644	2006.84517	<0.509	1.94230004	454044.0389	<0.008	0.01515348	166.822456	0.8164614	<0.629	<0.028	16.8933225	<0.003	6185.33165
PM18AJ284	D19AU12a097.csv	2.04650858	2457.36904	4302.12995	<0.008	19.2600337	3000.9744	<0.163	3258.50239	<0.651	2.12894958	440164.7968	<0.011	<0.006	22.6197269	24.375459	12.2435175	<0.035	<18.230	<0.004	11559.0037
PM18AJ284	D19AU12a098.csv	0.26249614	154.401182	1143.4132	0.00758517	19.7959427	174.17596	<0.129	804.41584	<0.517	2.95938089	451876.4271	0.08443176	1.37171644	10.8323489	64.6407518	2.05530208	<0.028	80.1048064	0.18352242	11448.2695
PM18AJ284	D19AU12a099.csv	6.16470625	65.605649	7820.26435	<0.007	47.62344	3725.16434	<0.148	3019.13423	<0.597	14.2625804	443932.7452	0.09912205	<0.005	<6.043	221.807942	7.92992463	<0.032	<16.760	<0.003	12727.0279
PM18AJ284	D19AU12a100.csv	2.29291993	111.843056	1818.17152	0.01332908	36.4156234	<97.016	<0.143	1032.18386	<0.574	7.82878428	453850.4093	<0.010	<0.005	133.536573	282.744416	3.0951309	<0.031	<16.151	<0.003	9098.4493
PM18AJ284	D19AU12a107.csv	2.14754578	7578.09568	3990.12182	<0.009	39.3938514	11006.8534	<0.192	3673.83725	1.44797696	6.48272966	426744.5448	<0.013	<0.007	121.018577	142.782403	25.7967522	<0.041	<22.152	<0.004	8226.98075

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ284	D19AU12a110.csv	0.46788705	147.462166	371.43069	<0.008	14.7225189	237.433189	0.61713222	0.13345774	1.49661513	237.506743	462767.0629	<0.012	1.07351459	28.5863511	117.667222	8.25090273	<0.036	<19.638	<0.004	501.035265
PM18AJ284	D19AU12a111.csv	4.74163633	452.077143	1129.48979	0.02453773	586.527186	462.403186	<0.154	16368.8634	2.71977778	11.9441304	445234.876	<0.011	0.78684388	37.2847761	242.025771	9.62763607	0.04046367	111.998171	0.01247049	521.779336
PM18AJ284	D19AU12a112.csv	5.2732314	2708.90343	1151.60404	0.02371281	906.110311	3693.07162	0.2152997	23496.7509	3.65394361	37.4324246	429590.3657	0.23304598	3.25431276	53.821673	241.882111	25.685407	0.04856547	54.691283	0.04019203	442.277138
PM18AJ290	D19AU12a257.csv	0.00878358	2.18043874	20.4171102	0.00514108	0.0432111	58.6869498	<0.042	84.0275245	<0.210	0.51542936	465271.2261	<0.003	0.08842954	<2.338	0.9228379	0.35627459	<0.008	<6.640	0.01026572	30.1442429
PM18AJ290	D19AU12a025.csv	1.37383709	10467.9613	67.8537305	0.01803849	0.51287373	5692.55542	<0.200	652.749242	3.00008501	16.0932919	423977.4377	0.68675542	1.76826474	65.4690304	5993.36183	343.829548	0.2062599	1172.85268	0.04637646	33.7331981
PM18AJ290	D19AU12a027.csv	0.63169218	10058.8845	67.4001747	<0.008	0.26579913	4504.88486	<0.194	379.602561	<0.690	10.6955106	430095.8477	0.06764947	4.71765854	1141.16298	17.9994646	1.91909396	<0.043	2873.69073	0.03018666	24.1224979
PM18AJ290	D19AU12a029.csv	3.19793025	22238.0732	538.336682	<0.012	0.40347964	7004.06065	0.47014315	2179.8828	<1.031	11.3392173	354260.1069	0.06690474	2.66700052	14254.2493	2582.98394	154.422144	0.2730655	4332.98718	1.30415793	112.714331
PM18AJ290	D19AU12a030.csv	0.1759809	15023.8813	63.9755009	<0.010	0.31044739	9684.12326	<0.237	732.408123	<0.884	5.48497712	413535.2521	<0.016	0.80156312	130.287976	79.1125763	7.14200312	<0.053	3089.74731	0.01025561	94.243985
PM18AJ290	D19AU12a031.csv	0.03183631	246.182376	66.8176907	<0.007	0.09250799	<121.417	<0.180	701.312084	<0.647	1.8346106	463509.9119	<0.012	<0.006	211.090154	243.17693	5.9383249	<0.040	26.1524491	<0.003	31.2644204
PM18AJ290	D19AU12a252.csv	0.23096939	23792.9377	54.0168184	<0.005	0.58284435	12933.5344	<0.075	136.063758	<0.367	7.31521529	391768.948	0.03226846	0.56305456	485.31126	144.335788	21.2222527	0.03784543	5254.33985	<0.003	15.1293094
PM18AJ290	D19AU12a255.csv	0.16115752	1426.90266	74.6919868	<0.003	0.2244131	259.792652	<0.044	90.8137495	<0.220	3.07641913	460043.1018	0.01090998	0.0107469	148.932804	23.0724429	0.98208643	0.03206371	491.311438	<0.002	3.23943977
PM18AJ290	D19AU12a258.csv	0.0299647	3.28153484	4977.81407	0.09800224	0.06797773	<35.657	<0.049	904.21726	<0.247	2.67702032	463240.3568	<0.004	0.0365958	<2.746	5.00990323	0.88792151	<0.010	<7.803	0.00391841	11.8088859
PM18AJ290	D19AU12a259.csv	0.15324387	38.5345949	18.1830788	0.00971921	0.03345198	94.4810615	0.05197497	91.610199	<0.196	6.65172988	464960.5177	0.00964657	<0.001	24.2941507	178.191915	1.8171645	<0.008	<6.200	<0.001	24.8268369
PM18AJ297	D19AU12a266.csv	0.16671628	1471.96838	45.1176297	0.0429277	0.8072097	<40.099	<0.056	231.238872	<0.280	4.9465871	452198.3283	0.08456154	0.03294975	1534.92398	2784.3158	116.607215	6.0896005	37.3829541	4.66416205	1.00831372
PM18AJ297	D19AU12a267.csv	0.07053854	1164.91077	164.979573	0.06643391	0.64274806	8538.27835	<0.045	158.86067	<0.228	167.326697	453225.788	9.32557318	0.16130133	396.802231	1142.50397	178.143392	4.65425224	36.7546379	5.90079448	10.5887605
PM18AJ297	D19AU12a268.csv	0.19079129	204.740584	<0.587	<0.003	<0.002	<29.440	<0.041	<0.006	<0.206	9.49497038	464874.687	<0.003	0.01124985	66.1818092	91.9206599	26.7452408	0.02818808	<6.537	<0.001	0.09922167
PM18AJ297	D19AU12a269.csv	1.19678131	1505.79996	17.9956226	0.13674115	1.75544947	53.3704539	<0.041	100.094556	0.23578423	197.631565	459214.0785	0.51563948	0.0621496	798.418264	509.152647	129.832132	9.63519248	102.549547	6.12457304	44.4609169
PM18AJ297	D19AU12a270.csv	0.02091525	2494.37665	22.7241742	<0.003	0.20291108	6161.06326	<0.040	85.1479407	<0.203	6.35775149	453496.2232	6.32105868	0.98886842	776.550303	1618.55829	79.7019933	0.88047047	23.9300281	0.37621561	41.8603151
PM18AJ297	D19AU12a271.csv	0.43073817	2769.14533	152.131286	0.07792801	2.88758815	69.8871383	0.03949994	408.276206	0.28154439	16.2286029	454292.6423	0.03890106	0.01230637	1777.30599	216.309109	29.3246574	0.14750088	474.191555	0.56198576	14.9249534
PM18AJ297	D19AU12a272.csv	0.06024076	2670.65263	18.6777358	0.0121513	0.63207271	<34.124	<0.047	117.112976	<0.240	4.05127963	457490.3263	0.02008208	0.03266132	1301.97854	352.82092	15.8325112	1.68803474	143.773231	4.90166674	15.1098523
PM18AJ297	D19AU12a273.csv	2.20336538	2714.79718	177.076546	0.1700219	1.66796108	<32.611	0.40532027	501.143476	1.32900972	89.1358096	456234.9114	<0.003	0.01738833	437.909068	1978.00242	209.859545	14.259806	30.7957156	0.77040035	65.8000447
PM18AJ297	D19AU12a274.csv	0.24602899	141.270588	85.8141147	0.02307055	0.23935641	<27.446	<0.038	77.0562182	<0.193	1.75060164	464708.9688	0.00897749	<0.001	64.6162188	41.9546992	8.42795249	0.01203811	<6.143	0.00211579	4.39518721
PM18AJ297	D19AU12a275.csv	0.28305969	1877.15128	38.1048778	0.03140307	0.67008455	76.0544945	<0.044	131.135722	<0.224	72.5986366	457989.9358	0.0152744	0.02249067	374.818596	747.230311	105.1775	1.69590687	499.88918	0.72000891	62.1628305
PM18AJ297	D19AU12a276.csv	1.2767535	4998.3044	185.443478	0.09814203	3.15278299	1650.81276	0.2958391	134.558766	8.25620199	226.010132	441606.1163	25.6067835	2.01279337	469.422701	225.192987	197.002252	1999.05985	2954.27416	10.1570622	44.9508534
PM18AJ297	D19AU12a277.csv	1.08944911	5142.05849	58.7875953	0.0192926	2.6846508	39.840006	0.22346509	211.746418	<0.233	69.941357	448182.5668	0.09832348	0.20853576	2349.53015	988.055207	98.9978483	5.08687653	574.687853	5.90556295	9.41935247
PM18AJ297	D19AU12a278.csv	0.0678901	6259.88768	23.0936447	0.04911459	0.38423904	2132.37939	0.06299407	187.127146	<0.263	19.4441801	441339.4031	0.1745039	0.00534583	523.157454	387.813587	39.5956907	0.21413892	2501.00651	0.1259927	30.7184342
PM18AJ297	D19AU12a279.csv	1.23414564	578.58404	56.7330924	0.08508192	1.35380664	42.3736575	9.74491743	241.278031	<0.234	430.77014	462028.5371	0.00398424	0.01793465	313.91421	349.572754	69.4293854	4.2288709	24.6062039	1.80220258	13.6353478
PM18AJ297	D19AU12a280.csv	0.517282	3217.52238	62.7846656	0.06535441	1.10937524	258.742567	0.08521055	266.487707	<0.230	25.7423529	454051.7646	0.71663259	0.86754825	1071.70783	663.792249	89.9551508	1.36887475	433.086287	3.11600802	38.3353036
PM18AJ297	D19AU12a281.csv	0.10396407	884.782012	47.8351999	0.01712875	0.85574491	80.7864212	<0.038	277.269016	<0.198	14.9056886	459981.0615	0.01720014	<0.001	124.372244	8.94820589	2.65963195	0.13593535	534.773704	0.00172454	41.6827189
PM18AJ297	D19AU12a282.csv	1.60263466	4046.26394	66.8393095	0.04283044	1.03415443	<31.286	1.39075228	169.054235	<0.222	316.128122	453155.373	0.44502658	0.11854797	1944.62696	634.742327	64.4675019	9.51098868	63.425532	2.68358461	42.8408926
PM18AJ297	D19AU12a283.csv	0.50240009	461.655215	17.990392	0.04225533	0.42490094	<26.694	0.31685556	102.528764	<0.189	37.5704466	463522.7284	0.01755869	<0.001	80.1692761	249.151789	17.8540647	22.934959	57.2587385	0.07779318	22.1465772
PM18AJ297	D19AU12a284.csv	0.17035954	593.563498	407.979353	0.04569344	0.59427667	116.218223	0.04617209	42.2494062	<0.207	312.747502	462632.4525	0.13246805	0.01159015	164.56479	126.539625	44.0156338	6.02388229	41.9537543	0.78578718	188.88338
PM18AJ297	D19AU12a285.csv	1.16297703	388.318504	246.985569	0.04629839	0.60456016	<29.349	0.17797975	1877.83688	<0.208	231.606458	461411.4465	0.04847528	0.01648004	134.530775	275.92687	156.399106	4.31347497	9.66076214	1.34310625	4.66338107
PM18AJ297	D19AU12a286.csv	0.33419176	3764.23668	42.92842	0.04014818	0.7294713	179.7185	0.04745818	935.894277	<0.243	17.6738773	444552.96	0.49121859	0.56203101	1344.65727	737.475716	39.0367034	0.14263197	644.015285	0.13909386	53.9852943
PM18AJ304	D19AU12a344.csv	0.23885187	<0.285	2891.36702	0.00352667	0.01907101	<26.555	<0.035	95.6799317	<0.194	1.17098921	464502.5001	<0.003	0.00159048	<2.166	0.07267458	0.26442347	0.27439752	<6.422	<0.002	28.5794341
PM18AJ304	D19AU12a345.csv	0.62808468	<0.312	1486.46946	0.00921768	0.03606349	<29.131	<0.038	173.619075	<0.213	1.13467581	464715.7674	0.00440077	0.01150332	<2.370	<0.046	<0.273	0.0355197	<7.024	<0.002	104.512523
PM18AJ304	D19AU12a348.csv	0.0068626	3.59756654	39.5266319	<0.003	0.06601505	<24.802	<0.032	1529.40843	<0.178	2.02202899	463951.3617	<0.002	0.0030759	<2.025	0.13116537	<0.229	<0.006	<5.997	<0.001	10.4153169
PM18AJ304	D19AU12a369.csv	0.00823561	1.79426896	184.918468	<0.003	0.15699577	<23.346	<0.030	38.6941274	<0.176	0.51358679	465364.9596	<0.002	<0.001	<1.976	<0.039	<0.225	0.00805135	<5.795	<0.001	5.41757912
PM18AJ304	D19AU12a370.csv	0.08425342	0.80264746	576.703124	<0.003	0.0019074	<23.264	<0.030	14.1434068	<0.176	0.6083498	465238.5834	<0.002	<0.001	<1.973	<0.039	0.24429902	0.03803602	<5.787	0.00645868	4.28401193
PM18AJ304	D19AU12a346.csv	0.15596079	4.68678152	1305.40231	<0.003	0.0216564	1753.21908	<0.035	124.607699	<0.201	2.43549325	463760.2614	1.35891158	<0.001	<2.205	4.0004384	2.79246343	<0.006	<6.540	<0.002	24.151799
PM18AJ304	D19AU12a347.csv	7.17279276	473.549565	327.684813	0.0327591	0.42980707	<26.978	<0.035	81.1581014	<0.198	111.642222	459772.0678	0.01226787	<0.001	13.2444101	451.516251	43.4124595	1.98300163	6.66440699	<0.002	28.8707003
PM18AJ304	D19AU12a349.csv	0.24251537	3.13824265	207.486005	<0.003	0.06478171	<27.070	<0.035	143.229213	<0.199	11.6113354	465129.4751	0.0140913	<0.001	<2.213	<0.043	<0.255	0.1763757	<6.554	<0.002	25.3309175
PM18AJ304	D19AU12a350.csv	1.66805103	37.9479359	250.220311	0.01544574	0.79486514	32.8306451	17.8799015	195.784933	<0.193	29.7986666	464144.8509	0.00588069	0.00232614	<2.152	0.99452702	1.98191631	0.80161082	6.99346518	<0.002	24.1670414
PM18AJ304	D19AU12a352.csv	1.69878726	4154.00288	324.588533	0.01831077	0.36137131	4410.68359	<0.037	88.2405797	89.5369761	12.0254033	446685.9256	3.12801252	0.19435841	21.8001537	4029.1248	579.160142	4.93594559	32.8927977	3.6639299	26.3770023
PM18AJ304	D19AU12a353.csv	0.56443743	21.0272514	117.976571	<0.003	0.16780501	29.5832389	<0.036	159.001977	<0.206	2.75085246	465136.6045	<0.003	<0.001	<2.296	<0.045	<0.265	0.0459714	<6.793	<0.002	26.2299381
PM18AJ304	D19AU12a354.csv	1.76586013	1975.15907	1028.35788	<0.004	0.34985031	57.8301827	0.05055776	67.0553475	<0.222	10.2500832	459570.6856	<0.003	0.00181866	842.051501	163.234665	3.70029828	0.04496289	25.3154448	<0.002	19.7802489
PM18AJ304	D19AU12a355.csv	1.35346275	511.206949	1223.56375	0.00406295	0.13083975	4224.2726	0.08922988	89.2452923	0.77212488	19.0145336	445262.8589	1.24983291	0.29710299	103.561366	4897.61597	237.125344	0.09942236	267.652302	0.26879475	19.5032475
PM18AJ304	D19AU12a356.csv	0.20206468	2707.44928	27.2274009	<0.004	0.15350392	1134.26186	<0.040	82.4431738	<0.228	4.2176675	455313.9987	0.16332206	0.01272782	27.9677904	236.985407	25.6217901	0.11308509	860.772017	<0.002	21.7020127
PM18AJ304	D19AU12a357.csv	0.04663263	10.692363	27.2775675	<0.003	0.1561262	<25.869	<0.033	1.4738981	0.19237225	0.36877091	465362.5255	<0.003	0.04250784	7.97962448	<0.042	<0.246	0.23938654	<6.320	0.04549645	1.25943142
PM18AJ304	D19AU12a358.csv	0.0384191	330.856436	1613.50047	0.0044083	0.00304485	1241.26029	<0.030	377.032584	<0.174	1.09741418	461845.2261	0.16105203	0.13214668	<1.937	2.39538062	1.22922729	0.02625651	8.91838479	3.03026558	95.3325558
PM18AJ304	D19AU12a359.csv	2.30317742	1530.76341	823.020608	0.01663953	0.16352028	6164.7762	0.05756488	141.537635	13.8685753	17.9284934	454123.2111	0.03024555	0.0236332	6.35641943	2164.58563	178.359322	0.02022493	36.4022833	<0.002	26.570844
PM18AJ304	D19AU12a360.csv	0.29822836	15.3239271	86.0957678	<0.003	0.0028358	64.7018767	0.03804661	36.9000219	<0.178	0.54229041	465046.0918	0.00713675	0.01097682	<1.983	18.8239319	3.03601407	0.01044066	<5.847	0.13803906	27.5143449

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	Ag107	Al27	As75	Au197	209Bi	Ca43	Cd111	Co59	Cr53	Cu65	Fe57	Gd157	Hf178	K39	Mg24	Mn55	Mo95	Na23	Nb93	Ni60
PM18AJ304	D19AU12a362.csv	1.14714573	2023.19111	330.159623	<0.003	0.05693885	3283.68162	<0.036	59.5066854	<0.214	6.53991145	457718.2977	1.44977685	0.01166777	27.3538136	19.0390969	26.0046917	0.31614116	190.154671	0.00729021	13.1274816
PM18AJ304	D19AU12a371.csv	0.39975457	690.134708	156.795042	<0.003	0.43463885	761.560562	<0.034	87.294535	<0.201	4.54357741	460182.5605	1.00494604	0.00715597	546.260198	23.0447706	1.84099372	0.4040566	85.8902524	<0.002	4.67538896
PM18AJ304	D19AU12a372.csv	0.48053435	880.631331	202.08128	<0.004	0.07754547	976.854428	0.04287505	206.59767	<0.212	3.29585536	455459.148	0.72863149	0.01785466	29.559961	4.36477194	3.63593631	0.87848792	356.796771	0.0211025	29.4381749
PM18AJ304	D19AU12a373.csv	0.5134724	630.885466	223.918101	0.00807477	0.25119828	395.921923	0.1247277	111.969691	0.18573766	8.90968564	463071.6587	<0.002	<0.001	9.07447114	1.01413595	0.28170476	0.02214146	148.768007	0.00184355	19.8219769
PM18AJ307	D19AU12a322.csv	<0.006	9.09949496	5.10447577	0.00375517	<0.001	<27.812	<0.037	406.843592	<0.200	0.6201473	465043.9198	0.00421083	0.04529866	<2.218	0.13694784	<0.253	<0.007	<6.566	0.00781809	20.1824902
PM18AJ307	D19AU12a333.csv	<0.006	1.05211577	95.0888074	<0.003	<0.001	32.4628201	<0.036	13.8646207	<0.200	0.45508617	465403.2111	<0.003	<0.001	<2.220	0.08491114	<0.255	<0.007	<6.586	<0.002	5.17522872
PM18AJ307	D19AU12a338.csv	0.00745268	<0.305	2.84339751	<0.003	<0.002	<28.633	<0.037	23.7916094	0.25455141	0.41133241	465416.3749	<0.003	<0.002	<2.312	<0.045	<0.266	<0.007	<6.858	<0.002	29.8116826
PM18AJ307	D19AU12a317.csv	0.02180398	179.580184	24.3027335	<0.003	0.00608954	1210.4167	0.10562269	102.693587	<0.214	8.47615172	463885.517	1.31563867	1.52390922	<2.364	63.6073923	17.5771451	<0.007	10.0228281	0.0985297	13.373349
PM18AJ307	D19AU12a318.csv	0.06746411	1286.03861	64.8148733	<0.003	0.00870182	1228.56516	0.21032147	38.89526	0.41342807	25.8561053	461031.2239	1.1837872	0.83696998	8.67612847	378.165357	96.9340251	<0.007	107.657778	0.42094394	5.2088305
PM18AJ307	D19AU12a320.csv	0.03891722	392.157334	44.3285912	<0.003	0.01990879	1650.96061	0.15311599	186.260634	0.42404691	16.3119652	462899.2413	2.02953367	1.59281027	<2.286	184.548173	38.1499486	0.04383438	<6.761	0.15266447	12.4426941
PM18AJ307	D19AU12a321.csv	0.09825192	1141.99957	45.7852249	0.00364131	0.03882872	2488.34046	0.2444946	61.5068671	0.47425032	21.7978326	458856.221	1.24313754	0.85993067	7.49036119	241.901238	60.4929496	<0.008	92.6113154	2.13025419	7.61223496
PM18AJ307	D19AU12a323.csv	<0.006	30.0369591	106.702005	0.00316981	0.17115933	42.201377	0.09639794	118.30258	<0.181	10.3343881	465234.5644	0.07020859	0.0513933	<2.004	10.7837646	2.87008607	<0.006	<5.934	<0.001	3.89812879
PM18AJ307	D19AU12a324.csv	0.01214106	1451.51863	15.5944614	<0.004	<0.002	15918.6387	0.08506987	15.3775521	14.9411908	9.37701868	450707.8991	0.2683447	0.68989799	<2.625	797.456458	428.386966	<0.008	<7.772	<0.002	12.452347
PM18AJ307	D19AU12a326.csv	0.00980772	815.898601	17.6779795	<0.003	0.00803804	<29.060	<0.038	35.0345839	3.92465579	6.37248812	463158.8165	0.00373347	0.26589646	<2.324	360.806355	103.557177	<0.007	<6.885	<0.002	17.2004208
PM18AJ307	D19AU12a334.csv	0.03573941	1944.28174	27.0403615	<0.003	0.00213978	2692.97349	<0.036	47.219644	0.51292434	8.34143352	457769.578	2.01664101	1.31913424	13.273482	275.704644	63.7420521	<0.007	225.185179	0.92377757	9.85554372
PM18AJ307	D19AU12a336.csv	0.01585696	7228.47605	14.675297	<0.004	0.03476648	4353.86619	<0.042	92.5126308	0.30920714	5.21102773	442625.7791	0.12043668	0.3211605	104.798495	147.646321	38.1142433	0.01181892	1405.78908	<0.002	17.5666117
PM18AJ307	D19AU12a337.csv	0.01827028	176.95089	19.3030014	0.00407147	0.03972826	567.295027	0.10114769	223.544341	2.49838627	6.74568811	464225.9928	0.1021225	0.16778116	<2.150	82.7691987	29.7358039	<0.006	<6.381	0.01155421	59.5173187
PM18AJ307	D19AU12a339.csv	0.0429448	1078.74046	21.3562528	<0.003	0.01495741	7796.47101	0.45302843	144.147151	6.89668393	18.9500886	456976.8908	0.08922328	0.25610053	<2.451	593.096667	251.359792	0.0171818	<7.272	0.02064463	18.7385682
PM18AJ307	D19AU12a340.csv	0.00749306	616.150319	16.3300684	<0.003	0.00740184	<27.473	0.05597949	47.8563842	3.22493253	35.2892264	463547.0909	0.01777756	0.39454963	<2.223	300.533661	83.290716	0.01537713	<6.595	0.04082806	20.248734
PM18AJ307	D19AU12a341.csv	0.03038358	969.249522	47.6269376	<0.004	0.027037	33329.0468	0.05262912	11.0064729	0.4638946	5.03912188	440142.7569	0.36332869	<0.002	109.964884	67.4289753	600.902553	0.02559545	196.933602	0.01303158	9.01019192
PM18AJ307	D19AU12a342.csv	0.49767488	584.779373	31.1044652	0.00345324	1.17042645	12115.2449	0.34457818	485.194311	4.37261108	22.6155107	455052.3963	0.84968233	0.16925673	3.51635275	250.003133	255.691448	<0.007	<6.855	0.00885009	37.5862505
PM18AJ309	D19AU12a124.csv	17.3116142	11.6360171	16.4997488	0.02069616	0.00825137	<87.604	0.13964497	56.9634632	<0.524	111.194904	465173.0552	<0.009	<0.005	<5.489	21.825915	33.926789	24.7234531	<15.350	0.01760585	26.5471255
PM18AJ309	D19AU12a117.csv	7.8673719	2996.63805	263.930524	<0.007	0.0216234	5590.96461	1.23429342	192.198558	2.341974	12.3764268	450837.591	0.02968204	0.07706179	<5.724	407.760315	395.044063	7.61302569	<15.975	0.60429647	88.2810884
PM18AJ309	D19AU12a118.csv	4.4028242	130.585123	5982.83747	0.08580259	1.95888297	<310.122	<0.438	3163.76548	<1.799	63.0582469	459296.0632	<0.030	<0.015	<19.225	195.097402	24.7294626	<0.094	<52.847	<0.010	107.370511
PM18AJ309	D19AU12a119.csv	2.51748099	11.8822184	102.866579	<0.008	1.17934228	<111.024	0.3987401	1638.11906	<0.659	13.3074258	463267.4415	<0.011	<0.006	<6.893	81.1433567	8.38395479	0.04068311	<19.268	<0.004	26.6276447
PM18AJ309	D19AU12a120.csv	0.65325319	4.82301226	64.4480168	<0.007	0.73107644	18211.0959	0.56593618	1578.04617	<0.597	39.2393529	451672.8601	0.1587565	<0.005	<6.204	14.2944817	18.8839094	<0.031	27.8231317	<0.003	166.117599
PM18AJ309	D19AU12a123.csv	26.186271	16.3835908	<1.238	0.02827738	<0.004	<80.321	<0.117	113.500624	<0.480	293.610365	464350.9341	0.02736793	<0.004	<5.023	31.1717534	126.461086	631.818735	<14.054	<0.003	49.3254884
PM18AJ309	D19AU12a125.csv	6.07574005	219.133556	3538.51744	0.01706828	0.0153028	396.449847	1.1270744	263.679249	4.78366637	28.2209367	447071.2976	<0.011	<0.006	7.60962958	249.064115	112.304917	1.02381749	<19.773	0.11115438	214.75571
PM18AJ309	D19AU12a126.csv	37.3373233	181.192154	129.408826	0.04907717	0.02094143	<87.240	0.4048126	278.141939	1.30334511	15.9896093	458752.772	<0.009	<0.004	<5.488	269.894646	4459.5234	693.95706	<15.358	<0.003	140.559613
PM18AJ309	D19AU12a127.csv	19.0883715	2031.48313	639.48557	<0.008	0.07086872	3235.58208	1.4832462	555.562743	5.67678505	43.957225	446263.958	<0.010	0.00834837	<6.405	1125.21024	1732.04561	26.1356998	23.3028803	<0.004	217.361889
PM18AJ309	D19AU12a129.csv	7.94641325	630.823326	1649.90164	0.09228776	0.12937987	219.37822	5.21593506	343.717991	<0.651	196.803462	449461.1772	<0.010	<0.005	<6.842	292.617428	51.8411929	1.15391879	<19.071	<0.004	27.2711526
PM18AJ309	D19AU12a130.csv	49.6875929	20.2718904	1243.51401	0.012762	1.87657303	11465.0648	6.18892302	810.778201	<0.510	2199.5036	446175.9477	<0.009	<0.004	20.1347975	364.916236	5201.48907	1101.49911	35.5161986	<0.003	371.77802
PM18AJ309	D19AU12a131.csv	14.5964539	879.891373	451.44831	<0.008	0.13482814	243.626522	0.68683489	283.77502	<0.639	151.120811	445748.9801	<0.011	<0.006	8.83040855	1706.15698	4919.1848	522.41869	23.3833045	<0.004	134.431937
PM18AJ309	D19AU12a132.csv	33.4996184	1216.57324	375.576075	<0.008	0.15607691	8329.4081	0.2629868	472.558865	30.3466153	294.547863	437293.7838	1.13933765	0.28416216	8.21684039	2133.61536	7601.47922	411.451527	36.4880057	1.8641297	235.851333
PM18AJ309	D19AU12a133.csv	38.7496795	405.47373	1045.96718	0.02149897	0.53213406	1976.01716	1.89750503	307.354291	5.55544717	282.070933	437697.9518	<0.010	<0.005	13.5917638	1585.7685	1234.19481	16.3294445	29.5833341	<0.004	171.711492
PM18AJ309	D19AU12a134.csv	150.654398	102.897378	1210.36792	0.06640593	0.24464946	2098.60777	6.16288554	516.433957	1.7447385	542.798027	438755.5797	0.15971864	0.16095488	12.956537	911.259613	11518.6177	254.427775	62.9562331	0.21228537	389.937937

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ027	D19AU19a262.csv	2.55056885	2.32273156	2.28634456	<0.003	<0.002	533646.478	<0.064	21.1400672	657.938351	<0.041	<0.000	0.40734483	0.1628032	1.27359326	<0.013	0.03514638	0.10425629	<0.003	0.56588123	12.0326578
PM18AJ027	D19AU19a267.csv	0.40008456	0.41102671	0.37857939	0.00382965	0.00285998	534423.613	<0.059	12.1368081	<58.638	<0.040	0.00092628	0.46327952	<0.001	1.06008848	<0.013	0.00068777	<0.011	<0.002	0.83632298	<0.001
PM18AJ027	D19AU19a272.csv	0.24488158	0.22401074	0.26601768	0.00745139	<0.002	534288.096	<0.053	11.217856	81.8695854	<0.039	<0.000	1.27484545	0.01596639	7.77773487	<0.012	0.03254381	0.34359669	<0.002	0.44290904	4.27240838
PM18AJ027	D19AU19a273.csv	3.75668783	3.68169209	3.59776873	0.01178379	<0.002	533827.88	0.35395111	13.6071813	463.246722	<0.046	0.00193853	3.01505249	0.14456773	6.11982796	<0.014	0.03160823	<0.011	<0.003	2.69851339	6.02647823
PM18AJ027	D19AU19a274.csv	0.04690103	0.07466066	0.07252854	<0.003	<0.002	534451.387	<0.060	11.3668452	<62.007	0.0677825	0.00182006	<0.198	<0.001	2.86727576	<0.014	<0.001	0.04802571	<0.003	0.5948295	0.00289442
PM18AJ027	D19AU19a255.csv	4.90557217	4.61796375	4.71258014	<0.004	0.00583958	501325.475	0.55612885	56.32613	15173.6391	<0.057	0.02107107	2.81914676	0.0264504	692.745729	<0.017	0.02401749	5.35868546	0.02305168	1.59120667	3.91078682
PM18AJ027	D19AU19a256.csv	4.69775353	4.87561178	4.64508529	<0.003	<0.002	530622.618	1.40642838	18.0956316	1990.12195	<0.042	<0.000	11.8075207	0.20884268	2.16868279	<0.013	0.06923096	0.0262752	<0.002	<0.465	8.64446685
PM18AJ027	D19AU19a257.csv	28.1785468	26.6576324	26.897773	<0.003	<0.002	531976.058	0.33678932	7.29068824	1418.63472	<0.041	0.00212672	0.49942539	0.00793534	2.37147783	0.04944498	0.01782486	0.66823019	<0.002	46.1739464	0.48089736
PM18AJ027	D19AU19a258.csv	7.28818707	7.01564084	6.93892774	<0.003	<0.003	507785.601	0.39689647	13.1109165	17148.4407	<0.050	0.00079941	0.84215107	0.46973589	17.6376302	<0.016	0.15132262	0.32486415	<0.003	0.86517005	22.9479495
PM18AJ027	D19AU19a259.csv	13.2381559	11.7078553	12.68968	<0.003	<0.002	531968.144	0.12536816	8.04327588	1736.41292	<0.039	<0.000	0.57125253	0.28378334	3.1762943	<0.013	0.05979955	0.99230405	<0.002	1.88869841	10.9538214
PM18AJ027	D19AU19a260.csv	11.7230255	10.9514765	10.690226	0.00337456	<0.003	494738.966	1.69472505	22.729372	27477.5662	0.0588934	0.03696606	6.51002597	1.48682232	33.3148642	<0.017	0.64730348	2.5874664	<0.003	3.31443343	85.1972848
PM18AJ027	D19AU19a261.csv	11.214061	10.00753	10.9093301	<0.003	<0.002	513291.205	2.16653812	23.7801214	8473.67383	0.18081859	0.01188629	3.65590391	3.41954886	795.396077	<0.014	0.27295579	87.5311825	0.01525984	1.52898231	14.1587485
PM18AJ027	D19AU19a264.csv	14.1629306	12.5343039	12.8788442	<0.003	<0.003	532554.33	0.57902558	10.1841988	1628.30518	<0.048	<0.000	3.62483014	0.064562	3.64688819	<0.016	0.00938876	0.06494408	<0.003	0.62229117	2.99808085
PM18AJ027	D19AU19a265.csv	0.22730138	0.25075304	0.26115091	<0.002	<0.002	534338.122	<0.058	9.47240869	125.568211	<0.038	<0.000	<0.179	<0.001	2.83254031	<0.013	<0.001	<0.011	<0.002	0.49948186	<0.001
PM18AJ027	D19AU19a266.csv	23.4005544	21.4456092	22.186585	<0.003	<0.002	523387.152	2.98326576	60.3647821	3226.68598	0.54420213	0.18099485	18.2051667	0.0877535	3880.60642	<0.014	0.20420636	41.5122039	0.12932216	1.22320547	13.5651975
PM18AJ027	D19AU19a268.csv	5.11656609	4.92422347	4.71704475	<0.002	<0.002	532534.222	0.41402194	84.4275373	872.002253	0.04478733	<0.000	3.453844	<0.001	2.03177266	<0.013	<0.001	0.08188463	<0.002	0.44218542	<0.001
PM18AJ027	D19AU19a269.csv	9.26826423	8.77781543	8.79356953	<0.003	<0.002	513871.391	0.15853567	7.56157503	11252.4498	<0.046	0.0030985	0.33436328	0.16238118	60.9474702	<0.015	0.0478114	0.86027034	0.00464888	1.46921315	7.37672181
PM18AJ027	D19AU19a270.csv	10.2622431	8.98095962	9.13309117	<0.003	0.00251101	519854.722	1.33017035	52.075137	4403.77963	0.49164432	0.21611642	8.70085034	1.58999579	2609.43581	<0.014	0.80017874	25.2291138	0.07090836	1.95926867	115.998116
PM18AJ027	D19AU19a271.csv	2.35496204	2.34838893	2.5003506	<0.003	<0.002	526225.29	0.34302849	26.0360128	5133.052	<0.045	<0.000	3.95594108	<0.001	8.88995489	<0.014	<0.001	0.14854974	<0.003	1.21254422	0.25765115
PM18AJ027	D19AU19a275.csv	1.39660953	1.08482239	1.24130779	<0.003	<0.003	533669.35	0.4919038	23.6341742	462.862926	<0.052	<0.000	6.86516276	0.02699209	4.33440344	<0.015	0.00291621	0.05290755	<0.003	0.55064244	0.4600501
PM18AJ031	D19AU12a167.csv	13.9330979	12.9059454	12.9552813	0.00803343	<0.001	533618.094	3.11581127	8.87745391	<52.545	<0.031	<0.000	11.9259521	0.00225713	2.1234896	<0.014	<0.000	<0.012	<0.002	1.69794145	<0.002
PM18AJ031	D19AU12a175.csv	<0.021	<0.022	0.03756543	<0.003	<0.002	534240.244	<0.018	146.676816	<68.700	<0.041	<0.001	0.23667987	<0.001	1.82961864	<0.019	<0.001	<0.015	<0.003	<1.039	<0.002
PM18AJ031	D19AU12a189.csv	37.3413371	32.0808564	35.8848959	<0.003	<0.002	532858.415	7.11614211	13.379757	198.445133	<0.038	<0.001	6.17440052	<0.001	2.3117328	<0.017	<0.000	0.17278912	<0.002	504.404231	0.01168622
PM18AJ031	D19AU12a190.csv	52.6757776	49.4543531	50.9662791	<0.002	<0.001	533767.146	3.53277906	5.60403428	<54.946	<0.034	<0.000	0.71310978	<0.000	2.7562624	<0.015	<0.000	<0.012	<0.002	2.20508942	<0.002
PM18AJ031	D19AU12a193.csv	11.5321363	11.0056422	10.9253409	<0.003	<0.002	533270.801	1.92339809	4.88206862	59.1256299	<0.037	0.00061513	10.2295718	0.00062756	2.4020863	<0.016	<0.000	0.11127141	<0.002	2.13943106	<0.002
PM18AJ031	D19AU12a166.csv	7.39631345	6.56156127	6.96008524	0.00504675	<0.002	529661.644	0.24188728	7.85528432	2315.62534	<0.037	<0.001	13.6080727	0.00150295	21.5111314	0.04146153	0.00471787	1.21259465	<0.002	2.68329135	0.22060519
PM18AJ031	D19AU12a170.csv	5.97719258	5.85188698	5.71990239	0.00861695	<0.001	521892.672	1.67259446	23.0792951	3718.19337	0.4057114	0.60667424	20.7680645	2.32812395	4247.96472	<0.016	0.88009982	26.6962472	0.30044081	3.39120754	86.7398135
PM18AJ031	D19AU12a171.csv	9.81639966	8.81682546	8.83647912	<0.003	<0.002	529553.612	4.38752704	9.29350775	2007.55817	0.04674508	0.02113397	17.6449092	1.08144079	50.0010995	<0.018	0.53712106	1.27539321	<0.003	<1.030	49.8536627
PM18AJ031	D19AU12a172.csv	10.7253779	9.84093522	9.78349406	<0.003	<0.002	528101.699	1.40678767	5.46756647	1916.23233	0.65895647	0.31088367	1.9534236	1.09301107	2321.95523	<0.017	0.90075763	22.9614773	0.12993839	<0.938	66.6765954
PM18AJ031	D19AU12a173.csv	32.6934085	32.8602148	32.0747334	<0.003	<0.002	530524.108	15.040263	9.36101536	1457.78793	<0.039	<0.001	21.6372386	<0.001	48.8087907	<0.018	0.00049976	4.03882629	<0.003	22.4539864	0.01204981
PM18AJ031	D19AU12a174.csv	1.54286805	1.71740557	1.56915631	0.00305651	<0.002	533210.71	0.45911563	7.91823196	319.682536	<0.038	<0.001	9.45263829	0.00286319	6.5850938	<0.017	0.00068698	0.81156679	0.00488752	0.96365897	0.92886295
PM18AJ031	D19AU12a177.csv	6.59179365	6.10675622	6.15047417	<0.002	<0.001	531305.733	1.83394558	73.9368243	1235.5333	0.11499554	0.06452578	16.7468639	0.54014535	777.362793	0.03967764	0.3122193	3.61032014	0.06742281	1.43299049	26.4725899
PM18AJ031	D19AU12a178.csv	8.97652747	8.25320855	7.99894561	<0.003	<0.002	530753.8	1.12016493	7.50354894	1486.8986	0.07587203	<0.001	4.66475304	0.11935317	143.16391	<0.017	0.02911202	3.96794745	<0.002	1.23821178	8.26122776
PM18AJ031	D19AU12a179.csv	24.0357701	24.0319274	23.3678633	0.00706987	<0.002	531650.66	3.30326098	6.87276862	536.387769	0.11760613	0.0355297	8.09865083	0.64245762	581.388774	<0.018	0.35052494	5.97372426	0.0333411	<0.971	33.118562
PM18AJ031	D19AU12a180.csv	9.09999548	8.76164698	8.60912386	<0.003	<0.002	528513.6	1.46651387	5.00476662	1835.34448	0.50005729	0.26925195	6.67580701	0.93604663	1655.66109	<0.018	0.62984713	17.9474998	0.07607021	<1.006	50.2811254
PM18AJ031	D19AU12a181.csv	12.5216211	10.7884619	10.8716573	<0.006	<0.003	531378.558	1.43702909	81.616317	1345.08121	<0.081	0.01010463	21.2853024	0.468085	12.5875623	0.04814359	0.2922307	1.24816771	<0.005	<1.981	31.0300924
PM18AJ031	D19AU12a182.csv	15.8389846	15.9992323	14.9957694	<0.003	<0.002	531260.423	4.24973596	8.26745799	1362.19501	<0.038	<0.001	73.3205154	<0.001	9.81489893	0.08086129	<0.000	0.24413166	0.12227685	168.039438	0.00462324
PM18AJ031	D19AU12a191.csv	17.6528764	15.1118773	15.4108765	<0.004	<0.002	515183.251	4.75834114	7.01676274	8084.03816	0.05075405	0.00167228	11.4070391	<0.001	96.0519694	0.02686333	<0.001	16.1852268	0.00463665	1167.46257	0.05500352
PM18AJ031	D19AU12a192.csv	9.70790046	9.64557886	9.45773531	<0.003	<0.002	530144.221	4.51189763	8.45769178	1829.67854	<0.039	0.10783447	15.2951977	0.90723208	72.5203399	<0.017	0.43396436	0.83083268	0.01769008	<0.895	42.1012859
PM18AJ031	D19AU12a194.csv	6.73108336	6.52445566	6.30787368	<0.003	<0.001	532074.213	1.27020232	52.4912047	1004.05118	0.04563714	0.00537896	15.2425954	1.03962803	58.1934378	0.02463921	0.39288181	1.93176292	0.00571297	1.3299465	42.6901252
PM18AJ201	D19AU19a057.csv	24.9546833	22.3434395	23.7275379	<0.009	0.05843211	534265.081	<0.627	336.668503	<182.651	<0.144	<0.002	11.0294259	<0.002	<1.005	<0.069	<0.002	0.08778994	0.02721553	<2.005	<0.007
PM18AJ201	D19AU19a058.csv	4.84697869	4.2723673	4.24748045	0.04225542	0.10522223	534180.375	<0.683	341.554941	<196.527	<0.157	<0.003	18.4350198	<0.002	2.59956091	<0.074	<0.002	<0.043	<0.007	<2.157	<0.008
PM18AJ201	D19AU19a059.csv	0.10751945	<0.058	0.20733439	<0.008	0.04587654	534153.238	<0.616	482.420331	<179.381	<0.144	<0.002	8.56524745	0.00821323	5.43165646	<0.067	<0.002	<0.039	0.00838764	<1.966	<0.007
PM18AJ201	D19AU19a223.csv	0.2171632	0.20851838	0.18047532	<0.003	0.03359681	534115.123	<0.077	482.700875	<63.644	<0.058	0.00285086	3.99238605	<0.001	3.66570623	<0.013	<0.001	<0.013	<0.003	1.5031362	0.00256266
PM18AJ201	D19AU19a225.csv	<0.015	0.0796205	0.0132448	<0.003	0.0910169	534228.731	<0.073	269.577932	<60.337	<0.055	0.00364649	5.16203234	<0.001	2.49802932	<0.012	0.00156807	<0.012	<0.003	0.72095878	<0.002
PM18AJ201	D19AU19a226.csv	<0.020	<0.021	<0.017	<0.004	0.07399152	534177.381	<0.096	455.078682	<77.635	<0.072	0.00317696	9.21076779	0.00292772	3.05959714	<0.016	<0.001	<0.016	0.00492112	<0.651	0.005389
PM18AJ201	D19AU19a227.csv	0.91838238	0.72561348	0.87325288	0.06695419	0.02110633	534107.721	<0.080	335.29793	<65.993	<0.060	<0.000	3.20909884	<0.001	2.61835632	<0.013	<0.001	<0.014	<0.003	108.124925	0.00260974
PM18AJ201	D19AU19a228.csv	0.39933591	0.31246372	0.38007616	0.0082358	0.06873057	534154.58	<0.079	462.385802	<65.524	<0.059	0.0006156	13.5421572	<0.001	2.57049045	<0.013	<0.001	<0.013	<0.003	1.27415931	<0.002
PM18AJ201	D19AU19a229.csv	0.32547365	0.28018141	0.3050028	<0.002	0.03017834	534400.67	<0.065	153.498958	<53.269	<0.048	<0.000	3.68593574	<0.001	3.91184818	<0.011	<0.001	<0.011	<0.002	0.66072619	0.00483072
PM18AJ201	D19AU19a230.csv	<0.016	<0.017	0.01942072	0.01666895	0.08242663	534255.433	<0.073	347.785169	<61.152	<0.055	<0.000	5.19659505	<0.001	1.77739301	<0.013	<0.001	0.07664316	<0.003	<0.514	<0.001
PM18AJ201	D19AU19a233.csv	0.05519221	0.04064227	0.03275765	<0.003	0.08278635	534233.293	<0.081	381.588981	<66.611	<0.060	<0.000	6.10161317	<0.001	2.43699602	<0.014	<0.001	<0.014	<0.003	<0.558	0.00279216
PM18AJ201	D19AU19a234.csv	<0.016	<0.017	<0.013	<0.003	0.08326083	534078.443	<0.075	518.558596	<61.548	<0.055	0.00171099	23.1234171	<0.001	3.41893896	<0.013	0.00150659	<0.013	<0.003	<0.515	0.00667429

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ201	D19AU19a235.csv	0.33302857	0.31924272	0.30327196	0.01020164	0.05091334	534228.195	<0.076	386.41065	<62.741	<0.055	<0.000	12.1824843	<0.001	1.68780725	<0.013	<0.001	<0.013	<0.003	<0.525	0.00342406
PM18AJ201	D19AU19a236.csv	0.1050817	0.0815009	0.06535669	<0.003	0.04232077	534220.136	<0.072	379.838381	<59.563	<0.052	0.00091557	7.1387277	<0.001	1.67136631	<0.012	<0.001	<0.012	0.00325311	0.97582851	0.00370543
PM18AJ201	D19AU19a237.csv	<0.018	0.02222362	<0.014	<0.003	0.09494227	534175.278	<0.082	431.146549	<68.171	<0.058	<0.000	18.6847461	<0.001	2.94578137	<0.014	<0.001	<0.014	<0.003	<0.562	<0.002
PM18AJ201	D19AU19a239.csv	0.7086271	0.61164624	0.58147552	<0.003	0.06243747	534273.125	<0.071	309.717523	<58.855	<0.051	<0.000	8.53705241	0.0030416	3.11034955	<0.012	<0.001	0.02666739	<0.003	<0.490	0.00789219
PM18AJ201	D19AU19a240.csv	0.0259679	0.05614633	0.03072836	<0.003	0.05143899	534213.494	<0.066	350.798927	<54.476	<0.047	0.0010778	16.2829297	<0.001	2.95034483	<0.011	0.00525193	<0.011	<0.002	<0.454	0.00424618
PM18AJ201	D19AU19a241.csv	1.00803848	0.90214372	1.02160449	0.01794669	0.08025209	534279.359	<0.078	311.157889	<65.539	<0.055	0.00307379	9.91232712	<0.001	1.85551025	<0.014	0.00166195	<0.013	<0.003	0.84876454	<0.002
PM18AJ201	D19AU19a242.csv	0.09072827	<0.015	<0.011	<0.003	0.10820895	534380.784	<0.066	191.686127	<54.805	<0.046	<0.000	0.27066845	<0.001	1.59756772	<0.011	<0.001	0.01224797	<0.002	0.82018343	<0.001
PM18AJ201	D19AU19a243.csv	0.7199626	0.81417628	0.72432585	<0.003	0.08256668	534328.917	<0.082	248.657127	<67.877	<0.056	0.00153772	0.46816156	<0.001	4.04185426	<0.014	<0.001	<0.014	<0.003	0.59061023	<0.002
PM18AJ201	D19AU19a244.csv	0.05820715	0.04512233	0.03941719	<0.003	0.06366837	534339.647	<0.068	234.714045	<56.764	<0.047	<0.000	<0.190	<0.001	1.25498129	<0.012	0.00081379	<0.011	<0.002	0.69628185	0.00400067
PM18AJ201	D19AU19a246.csv	0.208881	0.24859967	0.2024711	<0.003	0.09824253	534248.449	<0.081	324.511109	<68.606	<0.055	0.00074966	12.6794042	<0.001	1.32869881	<0.015	<0.001	<0.014	<0.003	<0.556	<0.002
PM18AJ201	D19AU19a254.csv	0.17404054	0.14418554	0.11575578	<0.003	0.04749083	534292.384	<0.065	299.075137	<57.226	<0.042	0.00530349	2.21722421	<0.001	<0.605	<0.012	0.00141395	<0.011	<0.002	0.50095149	<0.001
PM18AJ201	D19AU19a060.csv	0.27525318	0.23515079	0.47539884	0.09864892	0.61937254	534053.037	<0.846	247.200016	<248.347	<0.198	<0.003	8.53503439	<0.003	2.92230363	<0.093	<0.003	0.15101943	<0.009	2.84585538	<0.009
PM18AJ201	D19AU19a224.csv	0.021295	0.02036182	0.01791334	0.00545025	0.03556381	534140.941	<0.077	448.996979	<65.206	<0.059	<0.000	6.04491551	0.00155647	2.19495963	<0.013	<0.001	0.34418736	0.00445033	<0.546	<0.002
PM18AJ201	D19AU19a231.csv	2.23167269	2.3103236	2.21504745	<0.003	0.11093277	534114.579	<0.078	354.223123	<63.843	<0.058	0.00176442	14.8878634	0.00268016	5.37974621	<0.013	0.00385827	20.6614009	<0.003	62.935847	<0.002
PM18AJ201	D19AU19a232.csv	0.09596317	0.07483001	0.07515244	0.01502401	0.06666433	534164.784	<0.078	444.10958	<66.011	<0.058	0.00069475	18.6245944	0.00167789	2.91776239	<0.013	<0.001	1.56027046	0.00479209	0.78962508	<0.002
PM18AJ201	D19AU19a245.csv	0.61084627	0.25346996	0.34238628	<0.003	0.07560245	534121.705	<0.075	300.342996	90.924377	<0.051	<0.000	8.78916313	0.00290391	2.81305688	<0.014	0.00293512	0.09764879	0.00547867	<0.530	<0.001
PM18AJ201	D19AU19a247.csv	1.16631101	0.85113625	1.04043931	<0.004	0.23455167	534280.539	<0.107	209.2153	<86.201	<0.071	<0.001	6.39052161	<0.001	2.02579214	<0.018	<0.001	0.12534206	<0.004	<0.736	<0.002
PM18AJ209	D19AU12a406.csv	2.67146781	2.3651277	2.69766152	<0.002	0.03097143	531907.59	0.10235591	91.2779997	1071.02625	<0.043	<0.000	3.05898038	0.03213261	2.08200582	<0.015	0.01965294	3.72913952	<0.002	11.7829816	9.93291672
PM18AJ209	D19AU12a407.csv	3.78217076	3.38330583	3.46972156	<0.002	<0.002	528853.633	0.37239368	112.596969	3313.39292	<0.043	<0.000	8.99864483	0.03037778	2.646856	<0.014	0.0500485	1.24767455	0.00715054	1.73085624	11.5310686
PM18AJ209	D19AU12a408.csv	0.77642671	0.6566778	0.73521214	<0.002	0.07854418	534038.054	0.01797751	66.1185732	235.039262	<0.046	<0.000	3.67805107	0.00620327	2.08526811	<0.015	0.00292783	0.14092324	<0.003	<0.532	0.51483759
PM18AJ209	D19AU12a409.csv	8.33460975	7.58797948	7.6992758	0.01402658	0.03728965	516040.686	0.59812576	97.5123705	3106.19241	0.08810268	0.01882914	5.22420328	0.40426056	235.826665	<0.015	0.93133252	10.8003339	0.22449228	5.0960605	2.06790584
PM18AJ209	D19AU12a410.csv	6.49464233	5.70138731	5.90280276	<0.002	<0.002	528946.065	0.59992175	200.428525	2567.73514	<0.043	<0.000	82.9543968	0.01681139	2.41955159	<0.014	0.02416795	0.08368062	0.00573506	1.11994891	7.08682025
PM18AJ209	D19AU12a411.csv	4.31293246	4.18571697	4.10937945	<0.002	<0.002	529971.856	0.16365841	129.210939	2102.35293	<0.044	<0.000	13.1515526	0.00856245	1.5952615	<0.014	<0.000	2.22065184	<0.002	3.54758728	0.02713626
PM18AJ209	D19AU12a413.csv	6.58961715	6.25819654	6.11877063	<0.002	0.04126503	523095.976	0.44694629	156.570502	3391.51285	0.26146477	0.1265798	23.0065751	0.42274481	4339.64665	<0.016	0.49874692	38.4534634	0.10170058	11.0563705	80.1428002
PM18AJ209	D19AU12a415.csv	5.81004077	5.15476451	5.26805195	<0.002	0.03337367	532808.873	0.19846082	81.1370095	665.751227	<0.044	0.00056099	4.28033641	0.53291366	4.10774663	<0.014	0.08896807	7.57783243	0.00392486	1.75739582	18.673931
PM18AJ209	D19AU12a416.csv	6.91672497	6.22150036	5.8862036	0.00335391	0.03365309	529055.626	0.36298769	47.3561901	2701.24398	<0.040	<0.000	3.68916829	0.04594731	3.87816875	0.0163703	0.02456084	3.7907176	<0.002	20.9871135	12.3552183
PM18AJ209	D19AU12a419.csv	34.9279163	32.7687215	32.2111929	<0.002	0.0896516	530090.97	1.15264396	91.7711055	1559.62868	0.0583872	0.03658645	30.7016209	0.06131238	1082.05317	<0.015	0.05328887	10.1584329	0.01248612	70.4719203	8.30331428
PM18AJ209	D19AU12a420.csv	21.0293303	19.7991306	19.3439958	<0.002	<0.002	528612.052	16.9299652	11.1715868	2203.30814	<0.044	0.00061999	0.5863145	0.0026991	3.6385299	2.24995693	<0.000	7.9387819	0.0042983	14.1917705	<0.002
PM18AJ209	D19AU12a421.csv	14.8230321	13.7404099	14.0366175	0.00336548	0.09629394	529625.804	0.86095711	42.4345645	2430.10999	<0.042	<0.000	3.5721068	0.0578528	5.21618626	<0.014	0.05420088	4.53147838	<0.002	5.01224153	15.3681086
PM18AJ209	D19AU12a422.csv	17.5310239	16.0210955	16.3700497	0.00635771	0.0244614	517461.555	0.81770609	76.8739312	11086.9575	<0.048	<0.000	20.2065102	0.00053263	4.94466212	0.10542526	<0.000	13.5287734	<0.003	19.4312029	0.00938139
PM18AJ209	D19AU12a423.csv	42.7463598	39.7847495	40.4003987	0.00864282	0.01175764	519579.3	9.95566438	48.1126531	4464.09944	0.08265455	0.00857918	3.78729233	0.22072047	177.174584	1.17170199	0.14181842	10.1913526	0.6176418	177.261322	38.5381709
PM18AJ209	D19AU12a425.csv	50.7206061	46.3615527	46.9997066	<0.002	<0.002	519899.589	3.93443431	49.160203	6337.27924	0.0542465	0.02046948	2.4858365	0.18274226	130.380948	0.03705648	2.29627937	24.4023562	0.07399946	32.0339195	0.5221574
PM18AJ209	D19AU12a428.csv	17.7171795	16.4893922	16.4986091	<0.002	0.07068571	532099.098	1.10592246	42.2306684	1100.52351	<0.037	0.00178906	6.54265239	0.08927179	9.34059524	0.03102039	0.03043028	4.86755458	<0.002	3.95494775	11.8646753
PM18AJ209	D19AU12a429.csv	17.4375523	16.8173674	17.054475	0.00639583	0.01578985	527930.227	2.45987837	80.1426079	3188.86514	<0.046	0.00478207	14.6849492	0.07126834	12.3527721	<0.016	0.03081763	3.6148448	<0.003	6.30805263	7.5499979
PM18AJ215	D19AU12a043.csv	2.71490293	3.83768168	3.30119174	<0.007	<0.003	533802.453	0.08794429	67.9154767	<139.407	<0.084	<0.001	1.78908464	0.15225193	4.64699012	<0.025	0.04763474	<0.031	0.00734812	<2.525	8.24468851
PM18AJ215	D19AU12a052.csv	4.50632479	4.23927137	4.07178915	0.01532037	<0.004	534201.514	0.06216358	71.9262284	180.078428	<0.102	<0.002	4.61629014	<0.002	3.390806	<0.032	0.00329698	0.04286807	<0.006	6.43668323	0.05958863
PM18AJ215	D19AU12a054.csv	1.07154288	0.93367237	1.05480097	<0.007	<0.003	534176.876	<0.048	79.0931441	<149.819	<0.088	0.0039754	2.13399969	0.09043358	4.90506331	<0.029	0.10145982	0.04622709	<0.006	<2.694	5.88177173
PM18AJ215	D19AU12a038.csv	10377.4628	11671.2345	12206.9038	<0.010	0.00697391	522289.079	1.97654853	438.460761	3807.2435	<0.117	0.04167363	107.887475	0.71019969	281.151195	<0.035	0.14258844	7.86473308	<0.007	<3.567	44.7305844
PM18AJ215	D19AU12a039.csv	107.187821	99.7322099	101.739798	<0.012	<0.005	483660.626	1.0116236	119.782571	29416.25	<0.147	0.01924505	41.2226768	0.3963839	217.767634	0.04901443	0.10014262	5.07046557	0.0101737	<4.497	22.5906561
PM18AJ215	D19AU12a040.csv	138.640732	132.028801	136.569858	<0.016	0.01621544	408342.432	2.10885964	88.0691515	47604.1026	5.17784007	2.15625079	31.6939595	1.0086059	30808.2924	<0.055	1.74028975	302.099917	0.4664975	6.32133584	188.579303
PM18AJ215	D19AU12a041.csv	116.245234	112.009241	115.029729	<0.012	0.02353214	503354.072	1.70753136	67.9729894	14040.3779	0.82613791	0.273514	11.2704841	0.98775929	3679.32626	0.05672979	0.41229744	41.6050758	0.06309103	<4.220	71.7727854
PM18AJ215	D19AU12a042.csv	24.1504998	30.5654651	23.4041478	<0.008	<0.004	530644.954	0.47115464	47.7401416	1922.74148	<0.102	0.00480097	4.05072179	2.12467084	31.5305844	<0.030	0.78404631	0.43301064	0.00872555	9.00187413	139.86609
PM18AJ215	D19AU12a045.csv	7.96827187	7.46098338	7.35584693	<0.009	<0.004	529219.153	0.37294327	84.4513387	3075.09253	<0.101	<0.002	5.08287642	0.86776968	4.39216538	<0.031	0.27628757	1.21349073	0.00903525	<3.037	56.2066518
PM18AJ215	D19AU12a046.csv	39.12237	36.0631267	36.6570728	<0.011	<0.005	508391.095	0.4091785	47.537001	14399.2168	<0.123	<0.002	12.2936227	1.33761652	21.5808271	<0.038	0.48964494	2.507065	<0.008	<3.682	93.6113658
PM18AJ215	D19AU12a047.csv	49.8103955	45.6669484	47.0043892	<0.008	0.0145409	528899.148	0.63723803	78.00218	1432.38586	<0.100	<0.002	7.38774402	1.14964331	6.51393315	<0.031	0.11740749	2.87247161	0.12910399	<2.988	11.4665088
PM18AJ215	D19AU12a048.csv	29.6738819	34.2876101	36.1772993	<0.013	0.00613059	509712.42	0.6638084	67.0671203	6558.31415	1.36625401	0.70134646	22.6105011	1.37288181	7155.17947	<0.048	0.34960822	110.607146	0.21528252	7.32222195	80.4691258
PM18AJ215	D19AU12a049.csv	173.267256	163.051478	173.510114	<0.039	<0.018	473689.03	2.5698826	117.077604	28650.1162	0.59162886	0.18225096	41.0492004	0.62711443	3454.76001	<0.144	0.1653822	42.1717145	0.16155561	<13.373	48.3362643
PM18AJ215	D19AU12a050.csv	21.8190628	20.2538561	21.9576937	<0.009	0.00632303	528273.404	0.19945406	42.4607495	3207.8478	<0.111	<0.002	5.15145381	0.55668879	31.7754662	<0.035	0.11112149	1.97099914	<0.007	<3.329	31.5497432
PM18AJ215	D19AU12a051.csv	6.89062031	6.45398731	6.52730485	0.02300194	<0.003	533389.741	<0.049	49.0207964	591.859075	<0.090	<0.001	4.6053647	1.46316734	10.8865063	<0.029	0.4021957	0.2114769	<0.006	<2.742	88.3764112
PM18AJ215	D19AU12a053.csv	16.680866	17.1642947	16.2193622	<0.011	<0.005	523646.332	0.30335832	48.5984521	6060.09396	<0.125	<0.002	11.3720923	0.19702553	56.1585071	<0.041	0.04858232	1.90086771	<0.008	<3.713	12.1461898
PM18AJ215	D19AU12a374.csv	34.4304476	31.1952178	32.9482245	0.00354192	<0.002	524487.574	0.84933365	88.2042914	5494.89886	<0.040	<0.000	6.09680087	0.39600959	4.8986492	0.01663565	0.05956529	2.23753672	0.02437278	3.40931865	16.3640483
PM18AJ215	D19AU12a375.csv	1.77280166	1.42939958	1.45893392	0.0102879	<0.002	534158.813	0.01877399	90.5966438	147.387911	<0.041	0.0004973	2.74444867	0.79319841	1.73530269	<0.016	0.31313022	0.157216	<0.002	0.95469312	58.6520194

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ215	D19AU12a376.csv	5.66124158	4.8266117	5.08885988	0.00555681	<0.002	533944.281	0.09770868	41.364613	209.728224	<0.041	0.0038012	10.4825239	0.76055693	6.02817089	<0.017	0.20929172	0.5308918	<0.002	0.83741799	68.9602883
PM18AJ215	D19AU12a377.csv	0.67850058	0.63490168	0.56783501	<0.002	<0.002	533624.638	0.012271	58.7420435	250.610684	0.07466637	0.01394129	1.96989811	0.19243242	193.471766	<0.015	0.05791576	2.15226312	0.01236944	1.37214664	14.4209856
PM18AJ215	D19AU12a378.csv	12.466034	11.1334879	11.8323235	0.00392733	<0.002	527927.103	0.17296799	112.422047	3399.20034	<0.044	0.00529636	38.5447391	0.0545455	192.369095	<0.017	0.01719101	2.18151313	<0.003	<0.581	3.92640659
PM18AJ215	D19AU12a379.csv	13.1131791	12.5850207	12.0999998	0.00370547	<0.003	507558.77	0.10438549	38.1201204	13414.2378	0.4451221	0.15725311	14.4269226	0.31485867	2217.45664	<0.021	0.11782697	25.0009675	0.03214264	4.67988774	24.9993361
PM18AJ215	D19AU12a380.csv	151.367678	139.923944	142.63724	<0.004	<0.003	457133.713	1.41044533	129.536132	40245.2727	0.08603536	0.01588341	76.9906719	0.47007502	178.215919	0.04555019	0.05226548	18.633016	0.00654442	13.522699	16.6519937
PM18AJ215	D19AU12a381.csv	34.9730297	31.7151983	32.2921152	<0.002	<0.002	509359.346	0.54244896	49.8044351	10194.9907	0.90973135	0.23440509	8.81596343	0.57043331	4337.94606	<0.018	0.29814882	46.0560477	0.04508391	2.43439273	47.4497832
PM18AJ215	D19AU12a382.csv	58.5687048	59.0272763	55.1922771	<0.003	0.00737363	494555.198	0.99764089	70.3131997	15017.8706	1.33626205	0.71263276	33.3290764	0.9386199	8933.07197	<0.021	0.61521146	92.4580238	0.23449756	7.94226001	90.2500515
PM18AJ215	D19AU12a384.csv	25.4086921	22.1923977	23.71679	<0.002	0.00353077	520173.158	0.2002776	49.6343082	8309.42605	<0.051	0.00510073	12.4672561	0.1614606	78.4624679	<0.020	0.03974169	1.95453075	0.00431312	1.09036163	8.25636
PM18AJ215	D19AU12a385.csv	95.4357936	87.6377687	88.6257557	<0.003	<0.003	497251.141	0.66529268	43.9325129	15738.4985	1.27470494	0.32955031	18.4005001	0.87088274	5530.28037	<0.021	0.59011739	60.3230541	0.07716064	4.76389831	67.4695385
PM18AJ219	D19AU19a192.csv	0.40744975	0.31069906	0.36238567	<0.003	0.00736837	532661.181	<0.101	26.2033425	910.038946	<0.064	<0.001	1.11694913	0.00291892	3.30624556	<0.018	0.00643305	4.26663989	<0.003	<0.662	<0.002
PM18AJ219	D19AU19a193.csv	27.6779504	25.4763074	25.9192692	<0.003	<0.002	531585.946	0.16161656	32.7561399	1499.35072	0.06764164	0.00167193	50.5024916	<0.001	4.03857974	<0.016	0.01192418	4.03990493	<0.003	1.78244551	2.36849151
PM18AJ219	D19AU19a194.csv	2.03354038	1.79321597	1.91551967	<0.003	0.00219659	531673.458	0.08625429	38.7116067	1376.90569	<0.048	<0.000	0.34544772	<0.001	4.41586823	<0.013	<0.001	1.54901412	<0.002	2.19007414	0.03288673
PM18AJ219	D19AU19a195.csv	29.0461198	27.3437943	27.2071568	<0.003	0.00548692	523537.083	0.76655951	25.8471987	4165.44115	0.12095652	0.04537952	16.2656438	0.23545759	1663.61622	0.03301566	0.10311849	56.8289231	0.01386337	9.46284201	19.3253937
PM18AJ219	D19AU19a197.csv	11.1600421	10.2258201	10.6827603	<0.004	<0.003	450841.233	1.32901835	35.8010611	32510.0919	0.53581498	<0.001	4.23929188	3.02456814	70.8678854	<0.021	0.94837994	240.065832	<0.004	7.42168041	0.92626225
PM18AJ219	D19AU19a198.csv	54.6858715	51.1751406	50.8271296	<0.004	<0.003	499328.591	0.51886747	38.3722945	16766.2366	0.16953944	0.02111964	62.4551829	0.20729175	619.649151	0.14038424	0.11324816	38.1941507	0.05787451	90.4015579	45.7203327
PM18AJ219	D19AU19a199.csv	23.7148542	22.2622062	22.3567219	<0.003	<0.003	491949.073	1.93490684	33.7398775	18606.9696	0.18501566	<0.001	19.9677005	0.1329806	27.3977491	<0.017	0.05106387	63.2509402	0.02031619	9.92591765	6.37029143
PM18AJ219	D19AU19a200.csv	30.719892	28.5275929	28.7771991	0.00794709	<0.002	516326.056	0.78530027	25.3224707	7577.03249	0.08604117	<0.001	24.0229186	0.18800063	27.5326833	0.02517818	0.04734892	33.0953625	<0.003	42.3232042	15.5049635
PM18AJ219	D19AU19a202.csv	44.5091991	39.6968899	41.7273358	<0.003	0.00279592	526916.015	0.38169319	28.0401489	3975.82367	<0.058	<0.001	32.7497531	<0.001	2.35264417	<0.014	<0.001	1.07568371	<0.003	0.72180437	<0.002
PM18AJ219	D19AU19a204.csv	40.8766709	38.8850637	38.7904498	<0.003	<0.002	525688.378	0.45940888	34.9594797	4522.31352	<0.056	0.00593136	21.8870431	0.01654059	274.687868	<0.014	0.00148459	7.81569877	0.00891109	7.99631215	1.76101254
PM18AJ219	D19AU19a205.csv	103.435865	99.2995588	96.3307135	<0.003	<0.002	523679.428	0.65487617	42.084977	3906.59656	0.06104479	0.00184431	11.6842654	1.42652489	21.4611284	<0.014	0.09516762	34.7475188	<0.003	0.61543334	0.4642131
PM18AJ219	D19AU19a206.csv	12.714194	11.8217037	11.9072165	<0.003	<0.002	528725.033	0.82747936	22.0604977	2001.30965	0.22221898	0.03540056	11.4820571	0.04541583	1788.95313	0.02482956	0.05683631	62.0379103	0.01714845	28.7363732	3.47062871
PM18AJ219	D19AU19a207.csv	94.6521405	91.5116368	90.9367956	<0.003	0.00243215	532730.023	1.1221781	38.1191127	703.853057	<0.051	<0.000	34.1110924	0.00901003	5.1369033	0.02500243	0.00109544	3.71105305	<0.002	4.52197134	0.05984277
PM18AJ219	D19AU19a208.csv	260.955547	249.189144	245.115543	<0.003	<0.002	531663.718	0.85834661	46.0624347	1148.13929	<0.055	0.00157286	54.2120552	0.02848437	123.268207	0.02709417	0.00779906	9.83765426	<0.003	28.6892037	1.5148411
PM18AJ219	D19AU19a209.csv	362.446809	381.385574	373.299353	<0.003	0.00212964	532656.095	0.90256239	57.6744387	729.686927	<0.049	0.00404833	79.4803972	0.00537292	2.57192638	0.03022762	0.00247718	3.40628267	0.00437645	6.59930596	1.15970504
PM18AJ219	D19AU19a210.csv	6.60346846	6.55848542	6.11739863	0.00492852	<0.002	532143.958	0.1381786	28.7321347	1238.91555	<0.051	<0.000	6.35895702	0.01226935	1.93801876	<0.012	0.00526168	0.89920764	<0.002	2.16898516	2.41851429
PM18AJ219	D19AU19a212.csv	21.9523906	21.090185	21.2828538	<0.003	<0.002	527894.128	0.45378074	26.9873185	3633.3919	<0.051	<0.000	7.11926351	0.07067926	9.3798001	0.01395862	0.00271045	9.42655104	<0.002	3.27117975	0.15132552
PM18AJ219	D19AU19a219.csv	4.52943068	3.76485901	4.14777159	<0.003	<0.002	533475.819	0.09404028	36.0822406	487.007247	<0.056	<0.000	1.32151769	0.0155172	4.73680812	<0.012	0.0040499	2.33984332	<0.003	1.9720302	0.00734844
PM18AJ219	D19AU19a220.csv	2.42659545	2.28270571	2.613227	<0.002	<0.002	533696.284	0.08735169	14.1669108	347.343044	<0.049	<0.000	0.90967569	0.02500826	6.07918009	0.03841826	0.00391337	4.30273284	<0.002	4.79661761	2.4195304
PM18AJ219	D19AU19a221.csv	16.1661456	15.9211	15.8816233	<0.003	<0.002	531522.172	0.1720702	43.5797153	1190.35721	<0.055	<0.000	7.9062222	0.1777297	18.5096103	0.01566586	0.02722318	11.5751412	<0.002	3.93004036	<0.002
PM18AJ219	D19AU19a222.csv	14.3779027	13.4581151	13.6709751	0.00716048	<0.002	523096.889	0.54963353	31.1034471	5209.58167	0.11202838	0.00346994	9.12500408	0.02657744	30.6828674	0.02808191	0.02119171	23.1224645	<0.003	22.7477824	1.96093233
PM18AJ222	D19AU12a288.csv	25.489023	23.6786507	23.8700854	<0.003	<0.002	519382.829	1.45146462	76.9198891	7706.42897	<0.046	0.001548	117.654891	<0.001	20.6498755	0.02425112	0.01037749	10.6602893	0.0041254	8.72453603	2.56292667
PM18AJ222	D19AU12a299.csv	9.15973163	8.32119685	8.45715192	0.00402638	<0.002	534321.404	0.23312009	15.0080712	66.5428408	<0.037	0.00072894	0.60330623	0.00188562	12.287264	<0.017	0.00079533	0.37664523	0.00542503	<0.583	0.01946313
PM18AJ222	D19AU12a305.csv	20.5516627	18.8245531	20.1930122	<0.003	0.00542565	499262.973	2.00907901	67.6896495	18923.9889	0.06590774	<0.001	57.1282789	0.02308363	48.4187335	0.11245412	0.00184335	32.1176773	0.00965742	19.987618	1.13802426
PM18AJ222	D19AU12a308.csv	7.68825805	7.5256061	7.79063907	<0.005	<0.004	345344.573	0.82119144	68.1238684	76145.1802	0.15225794	<0.001	42.2844734	0.08664631	111.477562	<0.043	0.07792193	131.355734	0.09729984	5.6544967	13.1355747
PM18AJ222	D19AU12a309.csv	52.7353518	49.1249635	51.0314897	<0.003	<0.002	514383.586	3.45353932	81.1922642	10347.4636	0.07496618	0.00290542	121.044759	0.03193999	30.0888019	0.20697161	<0.000	16.327556	0.01759876	13.4534914	0.73827685
PM18AJ222	D19AU12a310.csv	12.7056317	12.2561332	11.8533529	<0.002	0.00324345	526563.012	0.16597886	78.5632081	3912.51818	0.06928136	0.01123409	21.2815365	0.03987897	170.72372	<0.019	0.01823124	6.79027454	<0.003	3.79959955	8.91200113
PM18AJ222	D19AU12a287.csv	18.751306	17.7616836	18.2334279	<0.003	<0.002	523640.303	1.23830931	42.4075293	5750.53975	<0.042	<0.000	14.7169946	0.0053704	8.02414775	<0.019	0.00052495	3.57463179	0.01017383	5.07567522	0.42107626
PM18AJ222	D19AU12a289.csv	12.7619716	11.5890394	12.5037008	<0.003	<0.002	516856.566	0.92069786	69.6380977	7351.99455	<0.044	0.00662198	71.0826241	0.00203749	276.493416	0.08759364	0.00208969	17.7234597	0.01899847	3.91192621	0.38175094
PM18AJ222	D19AU12a290.csv	2.68863226	2.47707449	2.41382695	0.01058641	<0.002	530348.519	0.1149487	78.536394	2151.09101	<0.044	<0.000	6.37730645	0.12167797	9.11248861	<0.020	0.01469628	4.6370115	<0.003	14.3486037	7.43480897
PM18AJ222	D19AU12a297.csv	19.1985113	18.5073187	18.5979183	<0.003	<0.002	522193.863	1.17499922	60.741385	6235.02581	0.04291912	0.00248793	8.72501715	0.04586831	30.5689095	<0.020	0.02519193	7.6602578	<0.003	7.16060691	16.2957036
PM18AJ222	D19AU12a298.csv	2.67550138	2.62761661	2.42828143	0.06030781	<0.002	530881.92	0.03479048	77.1390828	1578.37388	<0.043	0.00817017	23.8914805	0.00543303	277.460892	<0.020	0.00649901	7.12193124	0.02096322	2.81782901	0.99544296
PM18AJ222	D19AU12a300.csv	11.4224287	10.4929071	10.8855815	<0.003	0.00384853	515519.442	0.18611317	69.6500675	6181.22441	0.58509993	0.14370227	34.8575979	0.08759543	5932.7781	<0.023	0.27131036	117.702987	0.05356911	8.65072237	11.8904276
PM18AJ222	D19AU12a301.csv	73.0075646	70.5158519	69.5115998	<0.003	<0.002	516104.308	1.25216626	43.4667773	8841.92429	<0.045	0.0015268	13.3195262	0.41624695	13.6672408	0.05121696	0.09209153	8.4761282	<0.003	2.9309824	43.4083869
PM18AJ222	D19AU12a302.csv	37.9527986	35.3643259	35.257124	<0.002	<0.002	530297.866	0.92183216	45.2116921	2099.00325	<0.040	<0.000	8.4857927	0.07848596	55.4167862	<0.019	0.0204144	2.35635465	0.00559276	<0.635	6.84045426
PM18AJ222	D19AU12a303.csv	20.8384998	19.3733088	20.2618649	<0.003	<0.002	521179.724	1.42221978	36.9593088	6808.56265	<0.045	<0.001	11.0795152	<0.001	12.3850236	<0.021	0.00265691	2.29649233	<0.003	5.44349191	0.21836269
PM18AJ222	D19AU12a304.csv	25.7384461	23.7211861	24.349511	0.00317504	<0.002	488707.341	0.86969757	64.9137518	22775.7965	0.16408026	0.16365018	64.5181929	0.265584	2134.11254	0.02561709	0.09403427	98.8941599	0.05624857	25.8522234	47.248308
PM18AJ222	D19AU12a306.csv	26.6316957	26.1929235	23.8917316	0.00752789	<0.005	511402.618	1.25929764	52.0825016	11974.2222	<0.113	<0.001	17.9903863	<0.001	21.7895434	<0.052	0.00379987	7.95294013	<0.007	11.9238534	0.24422639
PM18AJ222	D19AU12a307.csv	17.0361927	16.1154991	16.1287023	0.00550894	<0.002	526567.453	1.18020729	45.559878	4006.43065	<0.043	<0.000	12.3571908	<0.001	9.07353869	<0.020	<0.000	4.99329849	<0.003	1.86660913	0.10752981
PM18AJ222	D19AU12a312.csv	8.28647754	7.40724785	7.65473224	0.00276537	<0.002	525753.671	0.29879117	79.4171398	4077.047	0.10737134	0.01059008	7.1592424	0.14160277	130.51277	<0.020	0.05132438	6.08577848	0.01969976	5.62166017	31.4265564
PM18AJ222	D19AU12a314.csv	4.03473909	3.49056259	3.57087122	0.00804611	<0.002	525957.51	0.18699771	85.028623	4332.33139	0.04865627	<0.000	46.2263223	0.14991494	5.22769901	<0.020	0.00562554	3.55325423	<0.003	2.92070408	3.99089559
PM18AJ222	D19AU12a315.csv	18.7611935	17.6229797	17.8415786	0.01361284	<0.002	521813.92	1.36136091	43.2744254	6072.62119	<0.044	<0.000	6.80823525	0.1298826	10.0958312	<0.021	0.01869105	9.70504408	<0.003	11.50796	8.93492191
PM18AJ222	D19AU12a316.csv	37.5292957	35.7312538	38.5006343	<0.002	<0.002	525347.501	2.57154809	33.8693977	4623.93922	0.05790432	<0.000	18.8941854	0.06183195	9.98593283	<0.016	0.00625457	6.51391932	<0.002	3.22646177	7.69247337

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ249	D19AU12a201.csv	0.03551462	<0.018	0.04202514	<0.003	<0.002	534276.581	<0.015	157.882156	<56.894	<0.037	<0.000	1.4979814	<0.000	2.56787476	<0.016	0.00425072	0.02086106	<0.002	<0.813	0.00380103
PM18AJ249	D19AU12a203.csv	<0.018	<0.019	<0.014	<0.003	0.09591048	534305.403	<0.016	131.92021	<61.968	<0.040	<0.001	0.60206202	<0.001	1.5329017	<0.018	0.0004512	<0.014	0.00545244	<0.881	<0.002
PM18AJ249	D19AU12a206.csv	0.51319861	0.48135032	0.59346376	<0.003	<0.002	534311.74	<0.016	208.596673	<61.497	<0.040	<0.001	0.3835523	<0.001	2.94946175	<0.017	0.00426695	<0.013	<0.002	<0.862	<0.002
PM18AJ249	D19AU12a207.csv	0.06818902	0.06140349	0.07253332	<0.002	0.00291784	534332.609	<0.015	219.294756	<56.072	<0.037	<0.000	0.640039	<0.000	1.76639603	<0.016	<0.000	<0.012	<0.002	<0.794	<0.002
PM18AJ249	D19AU12a209.csv	14.6572769	14.9333192	13.883478	<0.003	<0.002	534507.872	0.0957609	6.86823714	<61.029	<0.040	<0.001	3.11194338	<0.001	1.2485607	<0.018	<0.000	<0.013	0.01286303	<0.853	<0.002
PM18AJ249	D19AU12a212.csv	0.25184331	0.26288603	0.35593485	<0.005	<0.003	534465.64	<0.027	8.90006246	<105.038	<0.070	<0.001	<0.246	0.00144397	2.37145291	<0.030	<0.001	<0.023	<0.004	<1.459	<0.004
PM18AJ249	D19AU12a216.csv	0.09362745	0.18095424	0.17664667	<0.007	<0.004	534283.214	<0.039	276.062888	<153.476	<0.104	<0.001	3.27785256	<0.001	4.0270823	<0.046	<0.001	<0.033	<0.006	<2.113	<0.006
PM18AJ249	D19AU12a195.csv	9.64906124	8.77267216	9.21250651	<0.003	<0.002	534271.234	0.04133265	4.63615306	113.777907	<0.037	<0.000	<0.130	<0.001	2.52579972	<0.016	0.00059907	0.2790661	0.00434941	<0.847	<0.002
PM18AJ249	D19AU12a197.csv	13.3078444	12.3167819	11.906056	<0.003	0.00200682	534060.524	0.10071382	4.06655497	181.696624	<0.042	0.00138502	1.41728221	0.04190127	2.29133095	<0.018	0.02578312	1.53670449	<0.003	1.58318891	0.03815195
PM18AJ249	D19AU12a198.csv	78.4679141	74.6895426	73.5965634	<0.003	<0.002	533829.131	0.37369928	7.34695628	248.122292	<0.041	<0.001	5.11755562	<0.001	2.12273054	<0.018	<0.000	0.3383753	<0.003	4.45152865	<0.002
PM18AJ249	D19AU12a199.csv	173.771261	163.548217	158.801969	0.00534939	0.00225503	520947.338	1.76492516	42.2131408	7736.88994	0.0811426	<0.001	42.9565859	0.00158478	3.49090426	0.05169579	0.00281764	0.20154053	<0.003	1.76359907	<0.003
PM18AJ249	D19AU12a200.csv	106.011155	101.155265	101.989496	<0.003	<0.002	530667.076	0.67240462	7.12974376	1990.86895	<0.040	<0.001	0.45690006	0.00134319	2.75549535	0.03594335	0.00047822	1.11612207	<0.002	36.5236	<0.002
PM18AJ249	D19AU12a202.csv	85.3326287	79.757744	80.9979989	<0.003	<0.002	531018.615	0.37343521	8.1529987	1772.69857	<0.040	<0.001	2.23015876	<0.001	5.58378692	0.0180243	0.00047776	1.52563319	<0.002	3.79349423	0.16475038
PM18AJ249	D19AU12a205.csv	30.1684703	27.8934159	28.395622	<0.002	<0.001	534352.094	0.20413703	7.00537326	67.3329075	<0.036	<0.000	0.41350235	<0.000	2.10532827	<0.016	<0.000	0.08556855	<0.002	<0.783	<0.002
PM18AJ249	D19AU12a210.csv	15.2039412	14.3975689	14.2157328	<0.003	0.00309275	531431.648	0.08718785	4.89296001	1817.56892	0.04322476	<0.001	2.89805215	<0.001	4.24021212	<0.018	<0.000	1.33520662	<0.003	3.931316	0.04334746
PM18AJ249	D19AU12a211.csv	57.0702241	52.5979429	54.1117887	<0.003	0.00808867	533588.699	0.23179388	19.4812854	394.460676	<0.048	<0.001	20.0523016	0.00094941	1.88468402	<0.021	<0.001	1.11091353	<0.003	3.97486334	0.06393596
PM18AJ249	D19AU12a213.csv	332.356181	317.19616	308.042567	<0.002	0.0092026	533919.302	0.1356357	25.1066962	167.850959	<0.035	<0.000	15.7812014	0.0009869	1.63006563	<0.015	0.00104819	0.06539707	<0.002	1.08690566	<0.002
PM18AJ249	D19AU12a217.csv	24.0903892	21.6420526	22.5733338	<0.003	<0.002	520795.231	0.10533618	12.9778602	7167.29079	0.08927855	0.02149755	8.56164723	0.11354188	446.487932	0.06469012	0.17777736	5.85050466	0.27196874	155.90704	0.77358064
PM18AJ251	D19AU19a175.csv	0.61660827	0.64549105	0.66487434	<0.003	<0.002	534413.827	<0.089	12.7508071	<63.847	<0.049	<0.001	6.35731949	<0.001	2.69449396	<0.016	<0.001	0.04355159	<0.003	0.58304309	0.10719352
PM18AJ251	D19AU19a161.csv	33.8345322	32.0419942	31.6770426	<0.003	<0.002	516714.954	4.67976502	58.1318476	7370.41311	0.26500904	0.29424691	4.00477336	0.67110056	2475.89906	0.69970789	0.20780974	14.9043653	0.16490482	4.15489635	63.1171152
PM18AJ251	D19AU19a162.csv	46.1763301	42.7755144	42.6454584	<0.003	<0.002	526929.213	1.40129373	21.4769067	4083.92316	<0.053	<0.001	19.1438132	0.15334883	5.75629515	0.27669467	0.03935064	2.0014502	0.00507081	1.50643364	5.32192312
PM18AJ251	D19AU19a163.csv	20.2424298	18.9981331	19.3055721	<0.004	<0.003	485245.821	2.53440401	30.8140868	18539.4465	0.69755196	0.60684899	32.6427355	0.7954918	10904.9085	0.11113079	0.32775841	92.945293	0.30215662	7.52994278	65.8996036
PM18AJ251	D19AU19a164.csv	4.0722582	4.01986094	4.05416973	0.01040329	<0.002	520313.705	2.40004738	17.1473823	6760.69856	<0.056	<0.001	1.91682311	0.21626983	19.9377275	0.0954646	0.04803518	7.25510465	0.00335628	3.26029821	4.83342279
PM18AJ251	D19AU19a165.csv	3.14057036	3.14889528	2.97591017	0.00545132	<0.002	529956.15	0.18252759	63.8598213	1426.4207	<0.053	0.00273416	11.5816012	0.05710413	10.8405036	<0.018	0.01085378	2.74652625	<0.003	<0.637	0.13008548
PM18AJ251	D19AU19a166.csv	21.6077471	20.1700855	20.0727066	<0.003	0.00418877	524726.925	2.3676898	40.8130306	3155.07761	0.23168886	0.20464453	19.001693	0.80493199	2010.88366	0.1798908	0.23734785	20.115982	0.04515869	2.12628551	52.8280137
PM18AJ251	D19AU19a167.csv	11.1537397	9.96956695	10.4701714	<0.003	<0.002	506451.197	4.32499895	19.4864416	8545.3054	0.11588616	<0.001	15.3595982	0.20550828	18.5901561	0.06791598	0.08250644	17.8045533	0.00580816	3.24448043	1.12402564
PM18AJ251	D19AU19a168.csv	25.7528792	24.7066599	24.7203938	<0.003	0.00355321	528239.725	1.60596239	10.4837607	1921.70647	<0.053	<0.001	9.1578656	0.04929484	4.24838544	<0.018	0.01486972	2.45790333	0.00921882	11.983594	0.10856218
PM18AJ251	D19AU19a169.csv	34.7189117	32.0122013	31.0064332	<0.003	0.00532408	522017.637	4.32580544	9.22964714	5693.93855	0.19025311	<0.001	38.711418	0.02644359	6.98874455	0.15173632	0.0012083	4.19197656	0.00551817	457.612708	0.03307192
PM18AJ251	D19AU19a170.csv	4.69462278	4.51665866	5.40339281	0.00469464	<0.002	534221.641	<0.090	23.635429	96.1892474	<0.048	<0.001	15.5973733	0.10417798	2.93299114	<0.016	0.01535417	0.10815998	<0.002	1.04604589	5.74534855
PM18AJ251	D19AU19a171.csv	23.6132145	21.2988789	21.6662733	<0.003	<0.002	521823.714	4.66729376	13.536766	7795.85495	<0.056	<0.001	13.3615126	0.00802499	6.14814085	0.13253522	0.01665383	5.01172422	<0.003	1.60434125	0.48248412
PM18AJ251	D19AU19a172.csv	3.43703165	3.51493198	3.30038734	0.00644777	<0.002	532349.359	0.59596248	37.1605543	458.046049	0.05331885	<0.001	9.25146197	0.00302814	3.93075454	0.02098028	<0.001	0.48844855	<0.003	1.23668749	0.18650883
PM18AJ251	D19AU19a173.csv	28.4236432	26.0336948	26.6605555	0.00636895	<0.003	530888.746	10.0326893	18.2513635	1771.1408	<0.060	0.00449386	37.9662008	<0.001	3.43931298	0.10569299	<0.001	0.98760231	0.01109865	1.22902129	<0.002
PM18AJ251	D19AU19a174.csv	31.8284039	29.25474	30.0267902	<0.004	0.00574407	508411.942	1.35748887	19.2279781	10803.5885	0.22073488	0.0244394	18.3230216	1.30211516	175.825566	0.0391821	0.2883007	24.1892381	0.05464976	1.75341661	52.0769367
PM18AJ251	D19AU19a176.csv	51.0868774	48.5846402	48.7526544	<0.003	<0.002	532766.91	1.99480061	20.4862738	117.968114	<0.055	<0.001	54.8346286	0.00844456	6.05280231	<0.017	<0.001	0.14193031	<0.003	0.89493272	0.01104103
PM18AJ251	D19AU19a177.csv	14.0512042	13.0422022	13.7107013	<0.003	<0.002	532409.853	0.64270549	26.9027634	770.638436	<0.051	<0.001	3.72706235	0.04683974	5.6148999	0.05430857	0.06800007	0.92713634	<0.003	1.29768166	0.04464571
PM18AJ251	D19AU19a184.csv	2.01203441	1.80112641	1.77405831	<0.003	<0.002	534044.389	0.33888624	37.5893334	85.1611695	<0.051	<0.001	9.77042014	<0.001	3.22410588	0.01637102	0.00248145	0.06697409	<0.003	0.69065161	0.00208841
PM18AJ251	D19AU19a185.csv	31.70549	29.1072045	30.5630189	<0.003	<0.002	524144.73	5.48611893	12.8531216	4079.11374	0.10007836	0.00521975	45.6043969	1.5765065	6.0983585	0.07717402	0.27953801	3.90499385	0.01448439	5.21246774	110.680662
PM18AJ251	D19AU19a186.csv	8.26185732	7.49746501	8.47636395	<0.003	0.00237353	527261.646	4.34424819	18.2793007	3333.41881	<0.055	<0.001	3.01992732	0.00833599	16.3789838	0.05340871	0.00250245	2.85164706	<0.003	7.17236698	0.02189652
PM18AJ251	D19AU19a187.csv	14.991058	13.8368511	14.0189377	<0.003	<0.002	519278.785	4.59808637	24.1940701	6057.34138	0.30279947	0.31025649	6.11382606	0.73635931	3037.86448	0.1118471	0.22314667	19.4067595	0.36766165	4.06530973	66.2766515
PM18AJ251	D19AU19a188.csv	15.9843641	14.1766997	14.7347015	<0.003	<0.002	493226.783	4.51260768	13.1483785	11545.2532	0.91779499	0.14908392	13.7306849	0.19169386	14445.7429	0.06808616	0.27833835	88.2444255	0.6018871	12.6032107	30.2273856
PM18AJ251	D19AU19a189.csv	38.2003046	35.396608	36.2941573	<0.003	<0.002	524019.817	0.69609436	28.6963068	5773.4429	0.05950752	0.01081041	2.27059093	0.02919907	254.413443	0.29065868	0.00739025	2.15967461	0.00944344	1.15873562	1.21698931
PM18AJ251	D19AU19a190.csv	18.3636904	17.6549922	17.5367271	0.00862497	<0.002	519464.069	0.48886268	46.9244882	8134.39236	<0.058	0.00998457	42.1865456	0.77405543	147.987427	0.03675263	0.14589754	2.14192771	0.01751685	1.56132272	7.33375454
PM18AJ251	D19AU19a191.csv	44.9376036	42.3621356	43.0716974	0.00341588	<0.002	525518.398	4.06166605	18.2720977	4375.41177	0.07720396	0.00069849	42.7451065	0.03012605	6.03839556	0.42157766	0.00807366	4.3888117	<0.003	2.02368912	0.26456846
PM18AJ252	D19AU12a072.csv	5.70399099	6.3179182	5.99461416	0.01643487	<0.004	521781.06	0.50755921	<4.902	9394.76786	0.29458129	<0.002	3.6484401	0.00755878	91.7838002	0.1026322	0.00773845	10.3712888	<0.007	9.67713583	2.36488002
PM18AJ252	D19AU12a073.csv	8.23944777	7.6098178	6.45621417	<0.018	<0.008	508536.97	0.67833111	<9.379	12528.0753	0.45917411	<0.003	<0.588	0.01411148	42.4507682	0.08023803	<0.003	72.8266908	<0.013	54.6777278	2.09520195
PM18AJ252	D19AU12a074.csv	6.59826223	5.47666444	6.03766351	<0.011	0.03333052	505939.516	1.23918764	<5.882	11135.2621	9.52381545	<0.002	<0.370	0.47002657	6063.94855	0.25585876	0.14297028	1018.07606	0.08995425	516.338685	10.7891853
PM18AJ252	D19AU12a075.csv	6.03050387	5.88462921	5.8781588	<0.011	0.03177965	482589.571	0.68221122	<5.696	31099.0475	6.08927112	0.00611019	1.08823429	1.58923809	6432.17599	0.16000091	0.48475542	405.887131	0.36651385	236.720908	12.4404946
PM18AJ252	D19AU12a076.csv	8.11449937	8.2753858	8.27263688	<0.012	<0.006	481603.655	0.90269576	<6.859	39905.0479	0.87471162	<0.002	<0.430	0.65985583	426.25112	0.13751312	0.05951604	74.7067262	0.01487387	41.9744243	10.4797636
PM18AJ252	D19AU12a079.csv	31.8673117	30.7664661	38.7613588	<0.008	0.02022894	526484.474	0.98340272	11.0633342	4043.32262	<0.096	<0.001	2.36698514	0.60016198	4.12659685	0.13123039	0.500619	22.1047258	<0.006	8.48331928	4.05857794
PM18AJ252	D19AU12a080.csv	145.662393	134.330658	137.596932	<0.012	0.01571534	486022.477	7.69441815	68.1699372	21511.1348	5.66451362	0.00434388	29.5697658	1.40508439	8636.51476	1.03793148	0.54152118	308.18529	0.28516277	70.4084222	7.84381026
PM18AJ252	D19AU12a081.csv	93.7913722	92.6961803	99.9249249	0.01385337	0.02832244	522394.016	6.34701368	122.711777	5689.61179	1.03484671	0.00263069	25.2193346	0.00706036	6.85321602	0.23825444	0.01584867	12.7430468	<0.007	354.370535	0.43539554
PM18AJ252	D19AU12a082.csv	51.1136289	43.8654093	46.5256363	<0.008	<0.004	520417.661	2.75842625	6.45657112	7808.42618	0.34251337	0.00279812	<0.268	0.0360532	38.733852	0.19907396	0.01967895	15.9100708	0.01275314	33.0087851	1.91737039

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ252	D19AU12a083.csv	65.0277075	55.2475534	48.9375772	<0.021	<0.010	500481.121	3.2245346	324.176378	18529.0485	0.73067879	<0.004	79.5084519	0.02411877	6.27085993	<0.100	0.01108186	37.075282	0.11130256	34.6129139	<0.016
PM18AJ252	D19AU12a084.csv	46.9240737	44.2728572	47.3853311	<0.009	<0.004	505485.011	2.81089843	41.9309896	23869.5476	0.59588733	<0.002	9.3368427	<0.002	0.97677116	0.98082948	<0.001	5.51754638	<0.007	6.76452402	0.0501167
PM18AJ252	D19AU12a085.csv	65.7284896	59.8300123	62.7517902	<0.010	<0.005	495254.416	2.40891204	12.0816185	21339.0211	0.55557297	<0.002	55.5104645	0.28640362	19.6135297	0.31864779	0.22134798	17.7242026	<0.008	197.642054	64.6047248
PM18AJ252	D19AU12a086.csv	5.28922438	4.70260446	4.7269113	<0.007	<0.003	529016.795	0.43740882	4.89831592	2946.14178	0.1650603	0.00576163	2.52483146	0.0095949	1.748738	<0.034	<0.001	2.1085988	<0.005	2.79291894	0.6398373
PM18AJ252	D19AU12a087.csv	61.1396103	54.990903	59.1943335	<0.010	<0.005	477804.593	4.32635599	67.1699416	18337.4122	2.40766527	0.20193325	33.9382195	0.57295541	14049.7873	0.12940791	0.14410597	316.216469	0.15250835	272.075326	6.10797201
PM18AJ252	D19AU12a088.csv	0.11743428	<0.051	0.09288919	0.01764939	<0.004	532938.956	<0.052	<4.660	653.301643	0.12605466	0.00174528	<0.286	0.01508175	211.152514	0.34973481	0.00209553	4.48738692	<0.006	<2.813	0.33648428
PM18AJ252	D19AU12a089.csv	8.13691797	7.38078713	8.28640658	<0.010	<0.004	518867.406	0.57888082	68.5914581	9015.01514	0.16934349	0.00752626	16.3473647	0.03373644	583.22803	<0.047	0.02430747	13.4895561	<0.007	3.71434389	1.05881916
PM18AJ252	D19AU12a090.csv	46.7648837	42.4905031	42.3744933	<0.008	<0.004	527650.03	1.45955666	33.4867238	2757.62191	0.20114648	0.00605236	54.5873076	0.01385545	665.257603	0.14208361	0.05352535	22.3227254	0.01105395	627.379822	75.9056957
PM18AJ252	D19AU12a091.csv	14.0186989	12.6748745	13.5784169	<0.008	<0.004	508852.621	0.88655934	31.1891047	9822.02931	0.21908338	<0.002	6.17122431	<0.002	22.6548548	0.06108017	0.00646105	49.661582	<0.006	65.6429702	0.0801798
PM18AJ252	D19AU12a092.csv	144.931292	135.118106	133.301825	<0.009	<0.004	514140.661	9.93368922	29.4778318	14781.8709	0.51493956	0.01155567	15.7902817	0.00312998	9.34692298	0.63711465	<0.001	11.6775711	0.01353103	9.22731622	0.10612068
PM18AJ252	D19AU12a093.csv	44.7339337	45.0498481	41.3407564	<0.008	<0.004	524333.387	3.58832833	80.9540853	5221.62079	0.11660064	<0.001	9.11554146	0.0154976	2.52922888	0.06057291	<0.001	1.68791133	0.02155342	287.107683	0.37810475
PM18AJ260	D19AU12a229.csv	1.37657736	1.355397	1.88050432	<0.003	0.00614998	534247.613	0.05960009	42.8470152	65.7619485	<0.043	<0.001	2.88834582	0.07940195	15.5296786	<0.019	0.05336784	0.12826544	<0.003	<0.810	3.57551172
PM18AJ260	D19AU12a022.csv	131.756974	119.783523	120.921027	0.02547992	0.0092244	480863.818	11.1940025	20.5814383	24412.2905	0.34833391	0.00498958	5.54812596	0.26761638	72.5577295	<0.046	0.10202494	50.5814438	0.03957409	7.52185895	23.087994
PM18AJ260	D19AU12a023.csv	34.6191328	35.4404105	32.3329402	0.03077117	0.00998521	522567.937	1.42161453	18.8805891	5397.7724	<0.103	<0.002	42.0256253	0.20456099	10.5097349	<0.031	0.11700975	19.190069	<0.006	<3.232	26.3027921
PM18AJ260	D19AU12a024.csv	10.6541515	9.15365453	9.60614924	0.02510674	0.01350597	506243.666	1.4541538	59.5693022	11382.0846	0.26781256	<0.002	28.3725993	1.15875702	33.0344478	<0.035	0.14592695	40.238959	0.03565599	<3.607	6.02261702
PM18AJ260	D19AU12a228.csv	8.33064365	7.8668374	8.16766524	0.00897274	<0.002	532127.752	0.43325433	19.4690666	1053.27247	<0.039	0.00059729	9.83007548	0.43283477	4.29259069	<0.017	0.19919897	0.70960773	0.00247107	1.73412775	29.8707452
PM18AJ260	D19AU12a232.csv	10.0151234	8.66393282	8.95341271	<0.003	<0.002	530078.872	0.28375781	40.7180345	1408.66444	0.12042179	0.07989381	10.2769148	0.56860354	1061.40227	<0.019	0.29177827	11.6565173	0.0855109	<0.839	57.3724187
PM18AJ260	D19AU12a233.csv	16.8484617	15.2810193	15.400635	<0.002	<0.002	529865.296	0.79355558	28.6873213	1925.19238	<0.040	0.00654758	18.4620507	0.77750814	35.6889646	0.0179851	0.33482199	0.94351927	0.02695933	1.77617432	33.9546663
PM18AJ260	D19AU12a234.csv	68.9650868	62.5010006	62.5742504	<0.003	0.00581105	503714.584	4.09310454	10.9365318	14675.9795	<0.051	<0.001	3.37616127	0.37816362	18.7793363	<0.022	0.07385468	1.01891475	0.00367427	1.37921923	12.3536103
PM18AJ260	D19AU12a235.csv	3.95687739	3.58016859	3.7908256	0.0096891	0.00169901	533761.807	0.12001544	34.3702103	307.026716	<0.041	<0.000	4.70038009	0.00402435	2.37930989	<0.017	0.00405009	0.0141502	<0.002	<0.759	0.63013973
PM18AJ260	D19AU12a236.csv	77.7606834	75.8640846	73.9936107	<0.009	<0.006	482091.838	4.25917425	22.8595973	26582.7535	<0.143	<0.002	2.0931876	0.79681483	133.659652	<0.061	0.09312032	3.86465947	0.02869346	3.56268549	13.9761986
PM18AJ260	D19AU12a237.csv	10.2423163	9.78933787	9.81053549	<0.003	<0.002	525183.078	0.28245142	29.7566828	4563.39556	<0.045	0.00743982	13.1953126	0.40427127	50.3585677	<0.019	0.07661054	1.63728347	0.00392894	2.06282249	18.2948351
PM18AJ260	D19AU12a238.csv	11.1207395	10.1929158	10.8584516	0.00298189	<0.002	521720.45	0.57564632	27.2709809	5234.13552	0.17783448	0.11399786	17.3824637	0.36798813	2126.18078	<0.018	0.18924014	22.0281246	0.15439683	5.3035402	21.7573919
PM18AJ260	D19AU12a239.csv	15.8710526	13.7129379	15.2565056	<0.003	<0.002	525914.057	0.96180505	31.149232	3471.84075	0.09414696	0.01969429	14.6020364	0.7811605	463.802824	0.02752398	0.16727498	10.6623855	0.0262185	4.52790581	27.1810217
PM18AJ260	D19AU12a241.csv	12.1518269	11.0588873	10.9140635	<0.003	0.00229734	533468.708	0.55455135	23.2943118	235.376775	<0.042	0.00457348	10.9852473	0.71785826	17.7258685	<0.018	0.15407155	0.67871052	<0.002	<0.767	38.3693208
PM18AJ260	D19AU12a242.csv	10.2182823	8.86266455	9.08654557	0.0043019	<0.002	519276.892	0.5315454	51.2228417	5542.30101	0.20033723	0.00338816	36.0807059	0.64022339	102.178053	<0.020	0.16032847	20.7312483	0.02375063	1.42796654	37.1846158
PM18AJ260	D19AU12a243.csv	15.0905358	13.6510745	14.340396	0.00622621	0.00245733	490391.03	1.13108004	70.9477971	17754.2078	0.35664641	0.0634833	50.7569395	1.14932401	429.19519	<0.024	0.47412571	70.6775284	0.05107337	2.299213	86.9527222
PM18AJ260	D19AU12a244.csv	21.2388203	20.1541468	20.2642199	<0.003	<0.002	490129.123	1.1940292	61.0424975	17915.0949	0.26839007	0.00204428	33.6353228	1.00970701	53.8425778	<0.024	0.40777479	67.1127046	0.03305678	1.71839201	43.319719
PM18AJ260	D19AU12a245.csv	3.19125354	2.78029407	2.93801887	<0.004	0.0031527	465748.341	0.45681307	24.9333828	58022.6617	0.0834341	0.01092063	18.2200312	0.01446397	56.3553637	<0.027	0.0114432	3.53630321	<0.004	<1.129	5.26188604
PM18AJ260	D19AU12a246.csv	19.311903	17.1950764	18.371902	<0.003	<0.002	506987.495	1.44576786	101.217188	17026.518	0.11517559	0.00260452	27.3316064	0.46679921	15.7888917	<0.020	0.20144734	28.9760617	0.01145128	1.6748628	52.4781767
PM18AJ260	D19AU12a248.csv	121.344141	113.058623	111.528449	<0.003	0.0022187	503280.384	6.8728471	20.8371918	14183.2264	0.14320677	0.00385595	2.18080962	0.17251997	57.1981746	0.02551619	0.07709812	36.2922411	0.02963445	5.61200116	13.7875215
PM18AJ260	D19AU12a250.csv	2.79804437	2.95332597	3.10876121	<0.009	<0.006	533385.09	0.09111671	64.5970427	468.960955	<0.143	<0.002	19.1407667	0.06472167	12.9245513	<0.059	0.0569664	0.71404316	0.02902385	<2.567	10.4855076
PM18AJ260	D19AU12a251.csv	5.95232879	5.98283904	6.39837278	<0.003	<0.002	529081.901	0.2625226	39.9632153	4456.42321	<0.053	0.00066316	10.8611095	0.02856266	20.7790167	<0.023	0.00471487	0.5298533	<0.003	<0.943	3.02280932
PM18AJ275	D19AU12a055.csv	52.1838578	45.8420834	48.102366	<0.009	<0.004	533696.558	0.1566904	51.8190352	<173.507	<0.105	<0.002	42.1560371	<0.002	3.14974789	<0.035	0.00458875	0.27590234	<0.007	4.60486924	<0.006
PM18AJ275	D19AU12a056.csv	<0.059	0.26216831	<0.052	0.01022888	<0.004	534517.394	0.85745128	3.74401823	<157.450	0.31545608	<0.001	<0.251	<0.001	0.84320085	<0.032	<0.001	0.95005308	<0.006	3.88244026	<0.006
PM18AJ275	D19AU12a059.csv	4.82459688	3.74244119	4.07360937	<0.008	0.00389361	533381.496	0.17262217	66.0528498	<157.465	<0.095	<0.001	59.4073605	<0.001	1.55557337	<0.032	0.00766178	<0.035	<0.006	<2.804	<0.006
PM18AJ275	D19AU12a060.csv	1.91104134	1.9334815	2.25689953	<0.008	<0.003	534372.731	0.30094373	<3.477	<146.069	0.14431164	0.00571006	0.55998892	<0.001	87.3000113	<0.031	0.02556344	21.5011046	<0.006	22.9993587	<0.005
PM18AJ275	D19AU12a386.csv	95.4677116	90.3499699	91.5790776	0.01112146	<0.002	533632.568	1.14074425	23.7436867	380.348361	<0.042	0.00056325	61.2347072	0.0025354	1.63716024	<0.016	0.01876504	0.54569463	<0.002	6.13046252	0.05027717
PM18AJ275	D19AU12a388.csv	0.09540097	0.17024923	0.09519631	<0.003	0.01131704	534345.711	0.01318094	28.9169839	<80.668	<0.058	<0.001	63.369083	<0.001	1.59050676	<0.022	<0.001	<0.017	<0.003	<0.735	<0.003
PM18AJ275	D19AU12a389.csv	0.20622682	0.21469595	0.24568557	0.00550343	<0.002	534429.748	<0.010	23.7576691	<60.255	<0.044	0.000516	28.459962	<0.000	0.93773367	<0.016	0.00251841	<0.013	<0.003	0.71159556	<0.002
PM18AJ275	D19AU12a391.csv	78.3083313	74.3406557	71.492096	<0.002	<0.002	532402.725	0.91284011	58.7383755	<56.213	<0.041	0.0006305	234.309201	<0.000	2.52425989	<0.015	0.00067982	0.02168368	<0.002	<0.507	<0.002
PM18AJ275	D19AU12a392.csv	4.4355266	3.9710677	4.2321217	<0.002	<0.002	534133.712	0.04020905	31.2471058	<58.285	<0.043	<0.000	29.1138712	<0.000	1.12956686	<0.015	<0.000	0.04472291	<0.002	<0.526	<0.002
PM18AJ275	D19AU12a394.csv	8.08543316	7.77540767	7.70953566	<0.002	<0.002	534346.778	0.14615163	28.8667694	<56.228	<0.041	<0.000	11.2029637	<0.000	2.20422184	<0.015	<0.000	<0.012	<0.002	<0.503	0.00630726
PM18AJ275	D19AU12a395.csv	12.7440892	12.0039367	12.1209927	<0.002	0.00468304	532263.718	0.34203957	27.1862708	180.31457	<0.046	0.00261972	61.2693804	<0.001	4.1596597	<0.017	0.00060882	0.29128174	<0.003	<0.560	<0.002
PM18AJ275	D19AU12a057.csv	0.65520234	0.50148746	0.72757497	<0.007	<0.003	533548.991	1.59278122	<3.124	500.001368	0.13665242	<0.001	<0.218	0.01087955	19.0707217	0.48092707	0.02281485	5.0338099	<0.005	12.9996535	<0.005
PM18AJ275	D19AU12a058.csv	22.999419	21.1739596	20.5500616	0.0123392	<0.004	528341.301	0.91764741	4.87146567	2455.50479	1.99903149	<0.002	2.58502682	<0.002	2.66358276	0.20617339	0.02701599	3.20824606	0.05795407	13.6772308	0.07380137
PM18AJ275	D19AU12a062.csv	64.1570135	55.6821438	59.0481492	0.01931063	0.00988668	464128.462	1.07660007	103.760995	20027.2884	6.10968304	0.3473962	95.5097742	0.00952569	21559.114	<0.044	0.47314568	434.498262	1.3795383	14.2009739	2.83136576
PM18AJ275	D19AU12a065.csv	137.679326	131.946266	153.182248	<0.008	<0.004	534023.984	0.64724705	29.8545535	<156.332	<0.092	<0.001	61.2661898	<0.001	5.95427428	<0.033	<0.001	0.1624413	<0.006	81.4588226	<0.006
PM18AJ275	D19AU12a387.csv	11.4548032	10.7595352	11.0236638	<0.002	<0.002	510376.002	0.8046499	21.8087161	9466.5971	<0.050	0.00165122	28.1441124	<0.001	7.96070582	0.03306894	0.08398219	25.1283304	<0.003	22.1406596	0.09808204
PM18AJ275	D19AU12a390.csv	2.97814367	2.56902096	2.55495382	<0.002	0.00322081	529834.325	0.17230881	26.7122627	1778.49402	<0.046	<0.000	47.5508422	<0.001	3.39514673	<0.017	0.04539337	9.73015301	<0.003	2.27798806	<0.002
PM18AJ275	D19AU12a393.csv	25.5379421	24.6225652	24.1286017	<0.002	0.00319644	532572.814	0.59720925	30.9289928	679.272006	0.06728011	0.00151369	48.1073839	<0.000	3.7389373	0.05824773	0.0461444	5.15388484	<0.002	12.0334577	0.02705607
PM18AJ275	D19AU12a396.csv	17.3113757	16.294147	16.5470413	<0.002	0.0037226	533255.696	0.33344838	35.0845991	468.291011	<0.044	<0.000	46.8019454	<0.000	7.11737287	<0.016	0.00177516	1.90987937	<0.002	1.29759125	0.00589801

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ275	D19AU12a397.csv	39.1402316	35.9795324	37.5107708	<0.003	0.00470283	496699.382	1.25862516	24.9152421	15452.7002	0.29116314	0.00126671	79.9320562	<0.001	91.8634887	0.03519289	0.0613829	64.9892771	0.00480902	26.7547521	0.26219241
PM18AJ275	D19AU12a398.csv	2.35593899	2.25823617	2.06905377	0.00424127	<0.002	531813.695	0.13776393	38.1572493	999.850214	<0.042	<0.000	52.7846495	<0.000	4.13899441	<0.015	0.00401732	6.51758538	<0.002	8.58526855	0.06763434
PM18AJ275	D19AU12a399.csv	62.8055478	58.9414021	59.4974553	<0.002	<0.002	529975.532	2.05152853	31.8946028	905.105131	0.05456771	<0.000	93.5041656	<0.000	6.52249659	<0.015	0.00054633	1.59724929	0.01389922	1.04943202	0.02219945
PM18AJ281	D19AU12a007.csv	0.24720545	0.27050295	0.26627901	0.00779858	<0.003	534278.755	<0.051	37.0352932	<167.031	<0.093	0.0040895	5.98855113	<0.001	2.08475548	<0.037	<0.001	<0.035	0.01866267	<3.200	<0.005
PM18AJ281	D19AU12a218.csv	0.27669028	0.16897468	0.24090966	<0.004	<0.002	534361.886	0.06755605	57.9506847	<79.598	<0.054	<0.001	9.83752026	<0.001	2.18825492	<0.023	<0.001	0.02578978	<0.003	<1.089	<0.003
PM18AJ281	D19AU12a227.csv	723.281489	656.747288	684.43474	0.00433542	<0.002	531306.149	25.0815303	141.753644	<58.384	<0.040	<0.000	315.199206	<0.001	1.69734071	<0.017	<0.000	<0.013	<0.002	1.36512526	0.01734459
PM18AJ281	D19AU12a008.csv	197.660271	199.000919	190.906682	<0.031	<0.014	531785.934	2.81294807	443.474972	1195.25557	<0.378	<0.006	272.134067	0.04548998	19.328066	<0.147	<0.005	20.6105646	1.34454422	<12.361	5.28215927
PM18AJ281	D19AU12a010.csv	61.3200129	55.3581219	61.6149915	<0.009	0.00525548	533620.212	1.77190716	150.722953	<180.749	<0.106	<0.002	75.7937942	0.00491999	4.75452601	<0.039	<0.001	0.10768252	0.00851305	<3.433	0.47496109
PM18AJ281	D19AU12a011.csv	333.612226	283.100832	289.545653	<0.012	<0.005	530191.299	18.5454819	205.6668	<263.978	<0.151	<0.002	106.136753	0.19546477	9.83247791	<0.054	0.02807396	<0.055	<0.009	<4.972	9.56531603
PM18AJ281	D19AU12a012.csv	14.3194199	13.6455579	13.6644222	<0.008	<0.003	533630.076	0.44143203	86.4325858	343.04823	<0.094	<0.001	69.7591173	0.00492967	3.00718423	<0.033	0.04277311	0.0419525	0.0080222	<3.066	18.506338
PM18AJ281	D19AU12a013.csv	968.783499	925.567379	988.189224	<0.035	<0.015	497523.985	19.2909458	191.473366	8355.31576	1.10194558	1.64339729	213.339026	0.05849726	11908.1021	<0.147	0.42100659	14.1941118	0.95786673	<14.105	18.6217965
PM18AJ281	D19AU12a014.csv	40.7516721	36.0245486	38.8385564	<0.007	0.00384926	532692.383	0.57306456	104.774777	261.89184	<0.088	<0.001	261.113432	<0.001	<0.661	<0.029	<0.001	0.05594745	0.00623326	<2.854	<0.005
PM18AJ281	D19AU12a015.csv	284.412254	265.841452	268.808592	<0.017	<0.007	427832.85	65.5873982	7.80905481	62116.3102	0.54781579	<0.003	226.067617	0.22867481	4.67405256	1.6073003	0.55795474	13.2840549	<0.012	43.2143974	6.99064226
PM18AJ281	D19AU12a016.csv	311.877454	303.217047	309.382572	<0.014	<0.006	529875.652	14.061351	116.652953	1517.03377	<0.172	<0.003	53.4724714	1.44498278	6.07561185	<0.057	0.55386674	0.20243618	0.02067222	<5.572	92.3857481
PM18AJ281	D19AU12a017.csv	40.8343875	40.3214413	40.3093316	<0.009	<0.004	515418.05	3.06933335	49.4511409	11391.4692	<0.112	<0.002	33.8377387	0.08012318	5.83139591	0.04160375	0.00999038	0.51796523	0.01049876	4.08175082	0.34013935
PM18AJ281	D19AU12a018.csv	123.939702	112.378228	119.470145	0.00996393	<0.004	530751.965	4.44607352	220.58059	1254.11265	<0.114	0.00565667	82.0153865	0.33457484	2.63366774	<0.037	0.08929332	0.31605802	<0.007	<3.678	55.537415
PM18AJ281	D19AU12a019.csv	9.7864637	8.00039808	8.02052203	<0.008	<0.003	532855.098	0.25422999	95.9826838	383.132759	<0.095	<0.001	146.911775	<0.001	1.22069592	<0.029	0.00862783	<0.035	0.00862155	<3.027	0.11682638
PM18AJ281	D19AU12a020.csv	62.0180427	56.0002325	59.3773641	<0.009	<0.004	527287.774	44.5207648	13.6685878	2168.00824	0.38123046	0.02101125	7.31404462	0.75660902	393.834769	1.65027885	1.0409247	11.1483291	0.43382941	<3.614	1.65715966
PM18AJ281	D19AU12a021.csv	468.406494	397.686081	395.164193	<0.012	<0.005	457924.537	98.9240078	17.3887347	27015.9308	1.25132299	<0.002	6.43825906	0.29271376	32.554244	12.2232842	0.50738855	45.9619105	0.35648231	<4.739	0.49458694
PM18AJ281	D19AU12a225.csv	858.43466	776.098177	804.976996	<0.005	0.00398592	529960.557	1.68795058	554.698184	1388.11867	0.08232212	0.00433844	248.804597	2.94063887	8.11536024	0.05821325	1.37360185	8.38801235	<0.005	<1.573	457.125147
PM18AJ281	D19AU12a226.csv	219.298803	189.716842	201.532074	<0.003	0.00321477	533844.513	2.2443403	150.400283	<63.340	<0.043	<0.001	110.591801	<0.001	3.55911958	<0.019	<0.000	0.01579443	<0.003	<0.847	<0.002
PM18AJ282	D19AU12a143.csv	28.7951002	27.1298655	27.1923805	<0.003	0.00209103	532249.255	6.456311	4.42599241	1255.18648	<0.036	<0.001	0.35522933	0.00196902	3.38896591	1.27462527	<0.000	2.40340979	<0.002	3.28325711	0.23446008
PM18AJ282	D19AU12a152.csv	13.4344903	12.1287979	12.5668099	<0.002	<0.001	534438.68	1.63639924	2.92313124	<52.044	<0.030	<0.000	2.00857751	<0.000	2.01866676	0.07134973	<0.000	0.15659897	<0.002	5.80346889	<0.002
PM18AJ282	D19AU12a153.csv	43.0583933	40.4307421	40.6350711	<0.003	<0.002	534466.079	5.83694908	3.81704037	<61.808	<0.035	<0.001	2.18491669	<0.001	1.66269648	0.41831666	<0.000	0.61229256	<0.002	2.30937454	0.00440746
PM18AJ282	D19AU12a157.csv	12.3797716	13.2896153	12.5877667	<0.003	0.00208238	531178.043	3.05809715	7.57114286	2345.21649	<0.033	<0.000	0.933416	<0.001	2.33156294	0.17069363	<0.000	0.8139991	0.00671738	2.98790678	0.51156446
PM18AJ282	D19AU12a159.csv	7.6850045	7.16645957	7.72786232	<0.003	<0.001	534453.569	1.88366107	7.25477756	<56.311	<0.032	<0.000	<0.113	0.00292317	11.5908703	0.36121368	0.00961277	1.58780064	<0.002	1.63316617	1.28472459
PM18AJ282	D19AU12a161.csv	51.9173337	47.902008	49.938997	0.00404605	<0.001	524235.294	16.3173475	4.29119929	2745.11885	0.03600551	<0.001	2.26892214	0.00079205	8.96373388	4.79859979	<0.000	2.33609742	0.00612691	6.24029029	0.48532798
PM18AJ282	D19AU12a145.csv	12.3422435	10.9410234	11.4275279	0.00535172	<0.001	533105.445	4.86148282	4.52517859	1069.92208	<0.030	0.00341608	1.12467035	0.00255407	57.3208354	1.81870384	<0.000	7.27221783	<0.002	1.45070981	0.2481506
PM18AJ282	D19AU12a146.csv	57.4925369	49.1490165	51.42442	<0.003	<0.001	524299.595	29.8684937	3.15875817	4089.89329	0.04185564	0.00162175	3.00016029	0.24558381	13.3964243	29.183334	0.03229368	6.18326963	0.00720846	4.09880597	2.82231097
PM18AJ282	D19AU12a147.csv	85.5382816	77.2021858	79.4617565	0.00641041	0.00151598	530125.489	19.6458718	5.50936907	2706.8291	0.05723937	<0.001	0.75199425	0.01124248	9.14802703	2.29157702	<0.000	0.98668954	0.00539387	8.55311999	0.48100968
PM18AJ282	D19AU12a148.csv	45.3603236	42.2585123	42.9976659	<0.003	<0.001	518094.058	10.6802603	6.09623721	12070.1333	<0.035	<0.001	0.4706192	0.05553613	3.83596168	1.25804581	0.00167132	5.69723658	0.01982346	2.90720773	14.3359433
PM18AJ282	D19AU12a149.csv	11.2825543	10.9500379	10.9375901	<0.003	<0.001	532537.127	5.04320867	5.78508239	696.23242	<0.035	<0.001	0.31643116	0.23312883	6.73257912	0.83318588	0.01233084	2.50038267	0.00340654	2.28692354	4.30687565
PM18AJ282	D19AU12a150.csv	27.2088622	24.7717834	25.8190483	<0.003	<0.002	517084.165	8.12358012	2.84195278	8121.88781	0.07365727	0.00867508	0.24309649	1.33985885	61.2773518	2.74267656	0.06634492	23.7675417	<0.002	2.73048479	7.49350438
PM18AJ282	D19AU12a151.csv	28.1540352	25.9551838	26.2625141	<0.003	<0.001	521225.006	9.20430825	4.11274248	7144.21866	<0.034	<0.001	0.30897751	0.01036066	12.7975786	0.64974824	0.0007945	4.50738763	<0.002	7.0240015	1.24155807
PM18AJ282	D19AU12a154.csv	23.6464067	22.4239871	22.2792676	0.00381073	0.01008773	507463.225	158.051003	7.48076835	10922.7289	0.13227641	<0.001	0.80903487	<0.001	14.6461527	1.72434079	0.01573015	7.66806936	0.00319182	14.1544727	0.92450588
PM18AJ282	D19AU12a155.csv	14.0383077	12.6996895	12.7631336	0.00578753	0.00269034	527315.298	2.70078481	3.57315576	5655.39226	<0.032	<0.000	<0.113	0.06088583	3.06247228	0.45714087	0.00427509	1.44350043	0.02800407	<0.873	1.45118168
PM18AJ282	D19AU12a156.csv	8.82304974	8.76928304	8.66794595	<0.003	<0.001	533865.288	2.33425119	5.58612839	371.871636	<0.034	<0.000	<0.118	0.02480488	1.44140308	1.04309244	0.0013675	0.98617645	0.00350495	1.18187794	0.09698996
PM18AJ282	D19AU12a160.csv	73.2041392	67.4613812	71.1145488	<0.003	<0.002	505797.902	26.5423364	5.53255286	11676.6589	0.13256049	0.20573785	1.97686267	0.2792536	1732.91609	11.971354	0.09564912	14.7610743	0.06241682	3.68357555	11.9342744
PM18AJ282	D19AU12a162.csv	51.6488987	51.9828711	50.1612556	0.00721921	<0.002	486677.416	15.6894477	6.97096744	11409.1002	0.89302724	1.31238949	0.14925974	2.1070716	13285.488	6.09384137	1.14316064	177.096247	0.40465216	6.44938814	290.69843
PM18AJ282	D19AU12a163.csv	9.69245107	8.50611552	8.81769705	<0.003	<0.002	525739.887	2.82465776	4.45636148	4737.92309	<0.037	<0.001	0.41276523	0.05202179	10.4730311	0.60473565	0.00207565	3.89590955	<0.002	3.49633861	0.49266531
PM18AJ282	D19AU12a164.csv	30.3992315	28.6704774	28.827115	<0.003	<0.001	511940.763	9.14157926	5.44781127	10137.7288	0.15660966	0.42359063	0.1440023	0.31692066	3460.37401	2.0291254	0.16315699	29.8290323	0.03606751	6.21975547	16.8632116
PM18AJ282	D19AU12a165.csv	39.564183	38.2042338	38.1924249	0.01409706	<0.002	499993.421	17.2205563	<2.750	15459.3928	0.1253693	0.04605395	<0.159	0.05201454	211.133548	4.84143912	0.06322785	16.2198008	0.00707519	9.57703588	4.35535116
PM18AJ284	D19AU12a108.csv	221.915429	262.306391	221.3504	0.01202304	0.01990707	531590.587	0.3133795	779.589163	<190.074	<0.109	<0.002	85.4070255	0.00385831	2.76142236	<0.050	0.00416223	<0.042	<0.007	<3.212	<0.007
PM18AJ284	D19AU12a109.csv	323.172671	304.868755	304.478008	<0.010	0.00657675	532065.282	0.97187462	703.230202	<198.410	<0.113	<0.002	119.901181	<0.002	2.73982013	<0.052	0.00152393	0.05734533	<0.008	<3.349	<0.007
PM18AJ284	D19AU12a116.csv	1450.24115	1262.50357	1366.2778	<0.010	<0.005	530272.582	0.33154063	1472.16291	<197.966	<0.114	<0.002	100.588093	0.01664612	5.22330488	<0.053	0.03864547	<0.044	<0.008	<3.337	5.57754459
PM18AJ284	D19AU12a095.csv	359.943439	341.799201	336.687317	<0.009	<0.004	526606.308	0.58028781	820.115098	641.041674	<0.108	<0.002	80.2011168	<0.002	5.16184327	<0.047	0.00706536	0.65320566	0.01080209	<3.204	0.04431072
PM18AJ284	D19AU12a096.csv	498.879814	452.173688	443.274492	<0.007	0.0050301	529705.405	0.32056504	777.083112	1394.83216	<0.079	<0.001	58.356469	<0.001	2.24933539	<0.035	<0.001	0.73893727	<0.005	<2.473	0.10498633
PM18AJ284	D19AU12a097.csv	49.8320807	48.5033981	50.3106928	<0.009	<0.004	519455.182	0.19272497	953.424099	5277.30125	0.10945093	0.00376188	33.9001084	<0.002	8.51810507	<0.046	0.01005495	4.47126083	0.0110734	<3.142	0.1265946
PM18AJ284	D19AU12a098.csv	34.9199986	32.6862104	32.8532994	<0.007	<0.003	531476.88	0.89269637	883.414193	628.852629	<0.084	0.01629273	79.1030824	0.64464654	33.7026477	<0.037	1.00025513	0.52580056	<0.006	<2.493	102.527907
PM18AJ284	D19AU12a099.csv	921.70754	849.012575	861.355094	<0.008	<0.004	523586.379	0.29698317	900.106475	636.592	<0.097	0.00331766	69.1122175	0.00348387	5.77281305	0.1014653	<0.001	0.63400718	0.00955963	<2.873	0.05755161
PM18AJ284	D19AU12a100.csv	498.083457	438.252399	464.580484	<0.008	0.00678879	531271.944	1.15853785	911.948488	300.964945	<0.094	<0.001	80.1925061	0.00428795	9.7041364	<0.041	<0.001	0.26984574	<0.006	<2.765	<0.006
PM18AJ284	D19AU12a107.csv	218.447157	206.6524	193.667735	<0.011	<0.005	501152.919	0.732865	732.282141	11708.4284	0.16373168	<0.002	61.9212009	<0.002	19.9248212	0.21909872	0.01528867	17.1522972	<0.009	<3.717	0.07697515

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ284	D19AU12a110.csv	17.0585147	16.5849532	15.713453	0.01201575	<0.005	531828.225	0.07577805	635.824548	1254.44531	<0.111	<0.002	<0.358	0.43734011	7.53253049	0.06398361	0.41967145	0.35159029	<0.007	14.7410783	46.3336311
PM18AJ284	D19AU12a111.csv	535.331556	549.333866	507.02427	<0.009	<0.004	529201.381	0.41325891	1079.73618	1454.58551	<0.102	0.00595447	779.336792	0.7297823	31.2278945	0.06577816	0.40614312	1.61254847	<0.007	<3.005	53.7319298
PM18AJ284	D19AU12a112.csv	918.254654	826.901123	856.325405	<0.010	<0.005	519185.167	0.38321492	1117.32664	5635.19427	<0.116	<0.002	808.472913	1.69011534	39.654435	0.12434052	0.98977016	4.61029978	0.01836886	4.41084069	158.505372
PM18AJ290	D19AU12a257.csv	1.23713088	0.99253291	1.1866177	<0.003	<0.002	534409.134	0.06042818	13.2512624	<58.858	<0.042	0.0022066	0.53077833	0.05016546	46.1592526	<0.018	0.01814374	0.14017744	0.01164625	<0.725	3.27582236
PM18AJ290	D19AU12a025.csv	11.1473421	9.88791868	10.6882746	<0.011	<0.005	488031.296	1.12220456	11.401323	22093.8867	0.3528106	0.00756271	25.8540619	11.5448875	39.8159672	<0.040	0.36635088	23.5422431	<0.008	17.8895276	76.1537927
PM18AJ290	D19AU12a027.csv	10.3075534	8.62899612	8.85783305	<0.011	<0.005	494322.946	0.15146127	18.3449536	20686.9708	<0.127	<0.002	8.81336865	1.8889138	5.26775384	0.06897624	1.02981616	0.04960924	<0.008	<3.940	153.738486
PM18AJ290	D19AU12a029.csv	1.67239512	1.50680068	1.45185539	<0.017	<0.007	409289.054	0.2011525	<4.572	71230.8061	<0.193	0.10228133	50.3875288	1.19021418	1021.22195	1.18212043	0.7987879	18.4457536	0.1562556	13.3440733	145.548266
PM18AJ290	D19AU12a030.csv	12.479277	12.4321143	11.6334829	<0.013	<0.006	475771.174	0.30916031	13.4233946	29594.8984	<0.154	0.00457946	14.2352675	0.5267495	6.08386333	<0.046	0.24757197	0.17976758	<0.010	<4.788	35.9726876
PM18AJ290	D19AU12a031.csv	3.43664341	3.25324938	3.64672537	<0.010	<0.004	533039.935	0.10625621	33.7635106	661.797563	<0.117	<0.002	14.3880767	<0.002	17.9422882	<0.035	<0.002	1.12926813	<0.007	<3.621	<0.007
PM18AJ290	D19AU12a252.csv	15.2833587	13.5634243	14.3773181	<0.004	<0.003	450065.144	0.64364005	16.0124186	40609.7219	<0.074	0.00257571	19.5265977	0.21951591	14.2386267	<0.031	0.18583648	0.95885348	<0.004	2.09831936	25.7502744
PM18AJ290	D19AU12a255.csv	3.71849603	3.628196	3.50595087	<0.003	<0.002	528360.65	0.09376621	24.2032621	3481.17411	<0.044	<0.000	6.93193011	<0.001	4.43187602	<0.019	0.00252808	0.05781129	<0.003	0.77205254	0.01588918
PM18AJ290	D19AU12a258.csv	0.12259743	0.10108099	0.0797618	<0.003	<0.002	530831.264	0.03355422	10.7423116	<69.112	<0.049	<0.001	39.253266	0.00963019	2.07982177	<0.021	0.01458314	0.02424593	<0.003	<0.831	1.356695
PM18AJ290	D19AU12a259.csv	1.47978582	1.40681176	1.60897053	<0.002	<0.002	534062.722	0.12028957	16.0638258	129.94478	<0.039	<0.000	1.56348491	0.00295998	4.53902155	<0.017	0.00464733	0.18817531	<0.002	<0.670	<0.002
PM18AJ297	D19AU12a266.csv	3.98583411	4.12814913	3.80350889	<0.003	0.19604268	519419.693	0.03395991	618.736647	7305.70022	0.76282555	0.12822914	0.74838994	0.12312936	1430.93345	0.06333048	0.14832723	15.9485089	0.19070058	5.13338246	1.44092263
PM18AJ297	D19AU12a267.csv	1.93046678	1.50981417	1.62670363	<0.003	0.08185667	520745.76	0.23109656	556.681353	2637.31022	1.13395171	0.21633819	1.54345712	0.6712357	1501.9676	<0.020	1.03323616	15.4178506	0.20969564	11.4825281	6.94678961
PM18AJ297	D19AU12a268.csv	10.6504074	9.25801514	9.32600929	0.00559215	<0.002	533887.679	1.22564914	<4.710	262.43615	0.04615095	<0.000	<0.157	0.02960303	5.13165305	0.81553401	<0.000	0.34823316	<0.002	0.69437628	0.15924274
PM18AJ297	D19AU12a269.csv	40.1626697	37.264805	37.8814239	0.01784177	0.21548225	527691.744	1.1312071	478.859312	2753.53572	0.77084153	0.21714386	0.30102074	0.61807539	757.282456	0.06093832	0.17129655	12.0745357	0.3813063	23.1862711	1.54990551
PM18AJ297	D19AU12a270.csv	5.1217246	5.12562635	4.46381765	0.00960409	0.05483122	520901.901	1.2882295	287.6786	3661.17272	0.20959765	0.02954135	0.63070581	1.78800444	110.912502	0.02525857	0.94126004	4.83826748	0.70300081	11.5405819	27.3618503
PM18AJ297	D19AU12a271.csv	56.4563039	51.8897716	53.530157	0.03621183	0.11303207	521957.052	3.8585782	516.444021	6503.54074	0.9973442	0.03043992	3.2062742	1.20944417	88.2131591	0.07762175	0.05357991	6.36499275	0.99285901	8.23045037	0.26711265
PM18AJ297	D19AU12a272.csv	10.7220908	9.66848228	9.6828829	<0.003	0.08843503	525450.287	0.47296185	216.032382	4072.46347	0.42147154	0.24947164	1.75359434	0.02626828	312.827847	0.040291	0.07272742	7.32745118	0.24062021	12.274538	0.85015429
PM18AJ297	D19AU12a273.csv	50.5168628	47.7861493	50.2671143	<0.003	0.88050804	524603.029	5.72892553	580.614664	3674.58397	0.38457054	0.09316293	0.8738355	0.09300531	357.796072	0.03331078	0.05075988	7.62606164	0.26381843	10.3630457	1.03652404
PM18AJ297	D19AU12a274.csv	5.29551584	5.07758194	5.29984179	<0.002	<0.002	533387	0.10543343	813.303654	228.515004	<0.039	<0.000	0.70567208	0.00119081	2.4378241	<0.017	0.00124656	0.04330664	<0.002	<0.633	0.00397754
PM18AJ297	D19AU12a275.csv	9.76758269	8.92549365	9.28731893	0.00759123	0.15965488	526098.791	0.17911762	614.439066	4003.67141	0.44986751	0.00824123	1.26305152	0.01628971	147.267021	<0.020	0.04187947	18.624695	0.11234118	17.4450911	0.25808775
PM18AJ297	D19AU12a276.csv	56.1846477	50.0219593	51.2155454	<0.003	22.4209181	508925.252	3.38083726	390.731469	12788.1495	1.2751931	0.55435064	1.69129266	15.1294482	1188.55915	0.14205902	3.11540905	15.371899	0.81608237	30.7426563	59.0274828
PM18AJ297	D19AU12a277.csv	12.976418	12.8433108	12.6053156	<0.003	0.25814878	514917.143	1.53472799	444.659568	9340.28154	0.72964641	0.25687746	1.497788	0.11210404	567.238112	0.12513544	0.33444	6.46684628	0.48334691	11.6913076	6.03596452
PM18AJ297	D19AU12a278.csv	3.25019969	3.00360387	3.40927428	0.00919933	0.07455321	506975.523	0.07055104	345.709287	14710.2989	0.22891184	0.00628141	1.70133522	0.01373354	57.6284786	0.02678545	0.02921646	3.98173986	0.07173379	5.98474545	0.04477352
PM18AJ297	D19AU12a279.csv	8.98261667	8.33786112	8.5710967	<0.003	0.08704044	531272.045	1.26899628	458.717983	1214.05778	0.51237362	0.04442417	0.97630783	0.01948768	327.101525	0.03628063	0.06870437	5.12739666	0.5755312	103.924453	0.37532509
PM18AJ297	D19AU12a280.csv	30.3511518	28.5766341	29.7523858	0.00911616	0.13545814	521706.325	1.24045564	567.753063	6071.22919	0.91370007	0.25148303	1.27491846	1.28182483	369.186053	0.05253006	0.62871	8.80567831	0.46464002	76.1665337	26.7163559
PM18AJ297	D19AU12a281.csv	11.5450925	10.6456513	12.1663138	<0.002	0.00937679	528422.116	0.72645836	370.046552	3811.35005	0.16750369	<0.000	0.25281324	0.02587911	2.33017049	0.06181209	0.00788548	0.13552665	0.00392295	<0.639	0.01887857
PM18AJ297	D19AU12a282.csv	18.5893117	17.6697511	18.1460781	0.00882742	0.34634675	520873.359	1.7483855	429.480762	6177.21523	0.71979057	0.24625751	0.80556218	0.75747087	259.571716	0.11001289	0.24253888	9.01220667	0.65046092	52.193721	1.58326919
PM18AJ297	D19AU12a283.csv	5.82099057	5.14879208	6.22869577	<0.002	0.26228403	532355.87	0.56278766	357.174307	939.882938	0.14864118	0.01171591	0.76816526	0.00656468	32.2409017	0.0212604	0.01761891	3.23482397	0.08241238	6.23891487	0.00340004
PM18AJ297	D19AU12a284.csv	4.64892198	4.20622883	3.7700862	<0.002	0.08977283	531618.875	0.24653795	353.225641	856.815673	0.49707701	0.03005478	0.69792479	0.0331424	448.509115	<0.018	0.07990962	7.21311143	0.39700544	44.8984892	0.52421104
PM18AJ297	D19AU12a285.csv	3.01442702	2.71910264	2.8397846	0.10347569	0.41790629	532051.778	0.08147877	556.680405	459.087193	1.52201946	0.05769964	0.20286913	0.06630467	624.843508	0.02216264	0.03850711	6.15101245	0.18095741	49.0326909	0.19068451
PM18AJ297	D19AU12a286.csv	12.7594309	11.9312828	11.8621596	0.0062419	0.02094758	511480.046	1.23497658	393.39962	14632.5342	0.1459915	0.01529889	0.9284869	0.53968473	33.7972815	0.11413918	0.24540728	2.69179481	0.00715307	6.66229661	15.9824862
PM18AJ304	D19AU12a344.csv	3.71656575	4.01613387	3.48602393	<0.002	<0.002	532208.514	0.31488447	263.950726	<55.684	<0.038	0.0023727	192.870818	0.00237258	2.03178654	0.03679066	0.06891843	0.02767784	<0.002	<0.564	<0.002
PM18AJ304	D19AU12a345.csv	14.5061483	13.7864662	14.1492481	0.0028895	<0.002	533219.441	0.81505456	279.571062	<60.978	<0.042	<0.000	142.781928	<0.001	2.27109991	<0.019	0.00057677	<0.013	<0.003	<0.619	<0.002
PM18AJ304	D19AU12a348.csv	0.9803908	0.89657071	0.90709023	0.00515361	0.00195322	534434.878	0.02351132	19.8353941	<52.232	<0.035	<0.000	9.20153443	<0.000	2.69201856	<0.016	<0.000	0.02310817	<0.002	<0.516	<0.002
PM18AJ304	D19AU12a369.csv	4.3729844	4.97498578	4.90547593	0.00895127	<0.002	534363.254	0.17313185	32.1208241	<51.952	0.03774829	<0.000	3.26761858	0.00163523	0.85785308	<0.015	<0.000	<0.011	<0.002	<0.497	<0.002
PM18AJ304	D19AU12a370.csv	0.51379256	0.5179697	0.43368666	<0.002	0.00351857	533949.659	0.02727378	208.60432	<51.951	<0.036	<0.000	72.5886945	<0.000	2.76082054	<0.015	0.00334653	<0.011	<0.002	<0.486	0.33227702
PM18AJ304	D19AU12a346.csv	15.3512808	13.6404253	13.0782046	0.0091458	<0.002	532095.387	0.71565993	198.652864	<56.810	<0.039	<0.000	79.5659308	0.05465891	1.13441149	<0.018	0.03655591	0.10904262	<0.002	<0.584	<0.002
PM18AJ304	D19AU12a347.csv	128.578234	117.780066	121.304997	<0.002	0.00378729	528117.372	5.64513532	149.924985	4461.93552	0.09898077	<0.000	73.4690125	0.00753138	1.01157377	0.86839826	1.12933809	4.69375521	<0.002	7.20924039	0.06370873
PM18AJ304	D19AU12a349.csv	6.12208495	5.23662916	5.61921187	<0.002	<0.002	534212.145	0.14316138	203.902169	<57.145	<0.039	0.00180439	57.8496465	0.00179258	1.12282265	<0.018	<0.000	0.01931581	0.0024989	52.7193117	<0.002
PM18AJ304	D19AU12a350.csv	79.4512062	75.2211313	74.4081272	<0.002	0.00427985	533883.906	2.4650797	203.146584	121.128101	<0.038	<0.000	37.3695546	0.01926136	2.44413674	0.01926395	0.00078359	0.04113267	<0.002	776.006996	0.06266099
PM18AJ304	D19AU12a352.csv	47.605919	43.0108199	45.3223075	<0.002	0.00501326	513623.094	0.96710621	136.400398	6564.27845	0.61190702	0.26093869	41.903629	0.22289823	2039.4621	<0.019	0.22078825	51.2606106	0.12676245	30.8346185	3.56554097
PM18AJ304	D19AU12a353.csv	25.9149259	24.6504257	24.6851318	<0.002	<0.002	534208.881	0.41192828	236.96964	<59.520	<0.041	<0.000	111.613516	<0.001	2.74516391	<0.018	<0.000	<0.013	<0.003	<0.593	0.00495756
PM18AJ304	D19AU12a354.csv	21.0842157	19.4855709	20.2567605	<0.002	<0.002	527358.1	0.62870151	174.325159	3087.37611	<0.044	0.00163653	50.45187	0.00492504	2.96798303	0.03096135	0.00383263	1.07602682	<0.003	1.03122766	0.05474913
PM18AJ304	D19AU12a355.csv	65.0764273	60.7897723	63.453127	<0.003	<0.002	511213.188	2.59458348	157.334282	12127.4362	0.6333985	0.00829974	46.2717534	72.4038836	80.4890235	0.05443045	0.17916496	6.6444199	0.01164587	43.8018334	5.69526012
PM18AJ304	D19AU12a356.csv	14.0548848	12.7792237	13.051502	0.00325312	<0.002	522967	0.27785732	96.8554396	6142.15664	<0.046	<0.000	15.6959593	0.12624987	6.4184475	<0.020	0.01658721	1.92944435	0.00434285	2.93658602	0.3535177
PM18AJ304	D19AU12a357.csv	8.8059793	8.01952935	8.61149003	<0.002	0.00477328	534387.795	0.3244469	23.1411424	70.4785919	<0.039	<0.000	0.9254168	0.01844123	2.86871994	<0.017	0.00916841	<0.012	0.00824452	<0.549	0.71457542
PM18AJ304	D19AU12a358.csv	2.96468332	2.91693059	3.01933629	<0.002	0.00191876	530106.391	0.10188855	208.011666	919.412947	0.20557917	0.35335483	106.033082	0.00488891	833.025054	<0.015	0.00630508	3.78474423	0.06022845	<0.498	2.43286714
PM18AJ304	D19AU12a359.csv	94.8707022	85.4615352	87.6464591	0.00655493	<0.002	521536.144	3.25689941	155.078226	3585.6697	0.04428803	<0.000	68.464614	0.00173266	8.39995162	0.07152332	0.00183089	12.2102043	0.007169	16.1848568	0.63123913
PM18AJ304	D19AU12a360.csv	1.60398436	1.55162348	1.52748321	<0.002	<0.002	534040.827	0.04448005	89.199609	162.434685	<0.036	0.00089573	10.2034994	0.20231101	100.877724	<0.015	0.00980177	0.52975337	<0.002	<0.507	0.08503087

All Elements in ppm.

Appendix H:
Pemberton Hills Pyrite Mineral Chemistry (LA-ICP-MS)

Sample ID	Analysis	206Pb	207Pb	208Pb	Pt195	Re185	S34	Sb121	Se77	Si29	Sn118	Ta181	Te125	232Th	Ti49	205Tl	238U	V51	W182	Zn66	Zr90
PM18AJ304	D19AU12a362.csv	32.2108968	29.465082	30.2575992	<0.002	<0.002	525551.89	1.46885565	144.562431	3436.92406	0.14355196	0.00053218	37.5704072	0.04288288	9.23461184	<0.019	0.08682553	4.59212154	0.00620461	0.63118864	0.74143289
PM18AJ304	D19AU12a371.csv	22.9904244	23.4601733	21.6100991	<0.002	<0.002	528480.575	0.69504279	51.4198656	3653.13778	<0.042	<0.000	14.0053938	0.07138213	4.69492534	0.03450734	0.02801562	0.34341195	0.00937606	<0.561	0.18668542
PM18AJ304	D19AU12a372.csv	12.1991396	10.9755457	12.1859001	<0.002	0.00405348	523159.967	0.15567672	130.824731	8050.51226	<0.044	<0.000	52.2857068	0.02993848	6.40757261	<0.018	0.15830061	0.30585603	0.00738413	0.62319873	0.76214299
PM18AJ304	D19AU12a373.csv	22.2340359	20.8237322	21.8519778	<0.002	<0.002	531808.031	0.56524419	71.0851569	1260.45117	<0.037	<0.000	15.1563188	0.00258094	2.5101172	0.02471205	<0.000	0.05502343	<0.002	0.74858231	0.00376237
PM18AJ307	D19AU12a322.csv	0.16064294	0.16892674	0.18778186	<0.002	<0.002	534499.74	<0.012	<5.149	<56.121	<0.039	<0.000	<0.176	0.04580219	2.45445131	<0.018	0.00746607	<0.012	<0.002	<0.597	1.29738738
PM18AJ307	D19AU12a333.csv	1.6141857	1.42825984	1.29733971	<0.002	0.00297263	534429.995	0.02876108	<5.183	<56.577	<0.039	0.00229955	<0.181	<0.000	1.9764419	<0.018	0.00052	0.01958094	0.00352566	<0.589	<0.002
PM18AJ307	D19AU12a338.csv	0.13626522	0.03933186	0.07072125	0.00255428	<0.002	534522.621	<0.012	<5.410	<59.138	<0.041	0.00045456	<0.191	<0.001	1.75105132	<0.019	<0.000	<0.013	<0.003	0.77065377	<0.002
PM18AJ307	D19AU12a317.csv	25.3292021	23.1231957	24.1847902	<0.002	0.00308312	532859.596	0.13413191	<5.477	303.970505	<0.041	0.00523643	<0.184	1.02665464	102.67813	<0.019	0.4792448	1.26658175	0.02493994	0.69063715	61.2423553
PM18AJ307	D19AU12a318.csv	53.9200386	50.6612966	51.8814636	<0.002	<0.002	529606.125	0.57008449	6.158271	1789.92294	0.08562715	0.030782	<0.187	0.9925378	143.764004	<0.020	0.25986676	6.32466084	0.00809782	4.01494289	39.1507398
PM18AJ307	D19AU12a320.csv	44.1790265	42.0812444	42.6694039	<0.002	<0.002	531844.994	0.33770877	6.40881177	626.227694	<0.040	0.01921162	<0.180	1.28874766	72.4944337	<0.018	0.47073535	2.6342248	0.01402737	2.10084821	57.6171891
PM18AJ307	D19AU12a321.csv	44.4349336	41.8495441	42.6641615	<0.003	<0.002	527092.22	1.11524022	9.53947961	2521.52751	0.11071372	0.06785061	<0.202	0.90654899	1287.31505	<0.021	0.53747001	22.4606599	0.07193211	2.71665297	29.662055
PM18AJ307	D19AU12a323.csv	8.8020876	8.13189427	8.53207006	<0.002	0.00422611	534357.905	0.09699518	4.91707368	<50.724	<0.035	<0.000	<0.158	0.05186345	7.42329209	<0.016	0.02719492	0.24284446	0.00267789	0.55526203	3.24964029
PM18AJ307	D19AU12a324.csv	21.9124354	21.5068082	21.3546631	<0.003	<0.002	518119.539	0.06584874	<6.117	1850.52255	0.06997529	<0.001	<0.210	0.05822683	179.192669	<0.022	0.05728226	15.4305968	0.02878972	6.0959801	15.9457215
PM18AJ307	D19AU12a326.csv	31.2109301	28.296789	29.3686868	0.0048669	<0.002	532061.645	0.11985371	<5.379	1064.07664	0.04599425	<0.000	<0.185	0.03053435	74.0447244	<0.019	0.08258629	6.45351975	0.01361204	4.13423654	7.71856746
PM18AJ307	D19AU12a334.csv	29.9695889	28.0392128	28.3161641	0.00253936	<0.002	525826.394	0.09119071	5.42246359	3199.68514	0.07469406	0.08991352	<0.181	1.3573033	632.774972	<0.018	0.56133711	8.61110389	0.06899383	3.39287213	51.9163863
PM18AJ307	D19AU12a336.csv	19.6870594	17.574194	18.0143529	0.00310327	<0.002	508464.163	0.07002715	<6.065	12459.1854	<0.045	<0.001	<0.212	0.06451086	18.5077765	<0.021	0.08515259	1.69762455	<0.003	2.78409467	11.9952335
PM18AJ307	D19AU12a337.csv	26.0380803	26.0531371	25.2714345	<0.002	<0.002	533445.622	0.14851849	6.31102774	204.143888	0.04580518	<0.000	<0.176	0.02794223	140.750797	<0.018	0.02507726	4.2698861	0.03948937	1.39748206	6.59124003
PM18AJ307	D19AU12a339.csv	79.3961572	75.6380008	75.1096146	0.00283769	<0.002	525281.089	0.74137527	7.60880138	1325.05069	<0.043	<0.000	<0.202	0.02987772	238.273816	<0.020	0.03115706	10.2688997	0.06064186	6.77200638	5.94816011
PM18AJ307	D19AU12a340.csv	26.905249	25.1096646	24.3749787	<0.002	<0.002	532531.533	0.15318576	<5.196	845.089734	<0.039	0.00138243	<0.183	0.08050597	112.027226	<0.018	0.04876944	7.07771252	0.06499436	6.26846788	10.50208
PM18AJ307	D19AU12a341.csv	9.9237829	9.37379867	9.40854207	<0.003	0.01073865	506152.343	0.44335142	<5.878	1784.71658	<0.044	0.00086659	<0.209	0.0008406	133.013781	<0.021	0.00094131	3.24652517	0.00326463	<0.659	0.04890269
PM18AJ307	D19AU12a342.csv	71.0243613	65.9306345	66.1376821	<0.002	0.00309869	523461.78	0.94042739	6.28976059	872.138891	<0.041	<0.000	<0.192	0.02707133	128.741726	0.04082884	0.02431777	5.31011015	0.01226596	2.61540748	3.0386954
PM18AJ309	D19AU12a124.csv	6.85718173	6.31464467	7.02970348	<0.007	0.0092426	534449.09	11.2173353	10.4137574	<149.300	<0.085	<0.001	3.00956105	0.00382036	2.14832097	5.10423551	<0.001	<0.033	<0.006	<2.487	0.0482413
PM18AJ309	D19AU12a117.csv	13.8294867	13.1734189	13.6916528	<0.008	<0.004	518449.92	10.566651	<4.717	6328.32501	0.1102111	0.0038846	0.30644979	0.00421159	1173.60963	0.19999017	0.03078391	7.49760114	0.19379121	40.9690106	3.84861745
PM18AJ309	D19AU12a118.csv	480.888209	434.156645	450.786859	<0.025	<0.012	528585.16	43.7166441	293.20524	648.210951	<0.290	<0.005	186.293827	<0.005	13.109509	0.88908564	<0.004	2.70832377	<0.020	<8.542	<0.018
PM18AJ309	D19AU12a119.csv	258.294139	236.957991	250.78335	0.01064722	<0.004	533756.205	3.37291836	278.076154	229.428151	<0.105	<0.002	191.330949	<0.002	1.63555956	0.60943252	<0.001	0.07300931	<0.007	<3.133	<0.007
PM18AJ309	D19AU12a120.csv	83.416289	80.719881	80.5539245	<0.008	<0.004	520547.536	0.95904589	257.798831	<169.245	<0.097	<0.001	61.3454495	0.02216885	4.96274608	<0.044	0.01463131	0.11148736	0.3908742	11.1402331	<0.006
PM18AJ309	D19AU12a123.csv	7.09738966	7.12407189	6.02872855	0.01896592	0.00331783	534291.649	7.42691719	20.2502728	<136.779	<0.078	<0.001	1.43114156	<0.001	<0.804	4.66239172	<0.001	0.05604805	<0.005	<2.276	<0.005
PM18AJ309	D19AU12a125.csv	59.7471065	53.9600002	55.214266	<0.009	<0.005	512610.072	37.8220419	71.8577189	16018.1665	<0.110	<0.002	1.14678541	<0.002	175.202102	7.55979007	0.01332533	2.11447333	0.03008664	25.3591646	0.62031947
PM18AJ309	D19AU12a126.csv	10.2282205	8.48788897	9.21494146	<0.007	<0.004	532965.575	49.8380303	<4.418	773.708876	<0.083	<0.001	<0.280	0.01241976	3.07442859	0.5899852	<0.001	0.89569313	<0.006	13.7018066	<0.005
PM18AJ309	D19AU12a127.csv	42.4764028	36.2826088	38.0629317	<0.008	<0.004	515185.65	16.1336917	<5.312	11651.466	0.17447106	<0.002	1.5734987	<0.002	11.4325078	0.34259846	0.01955485	7.47820836	0.02945046	32.6682339	0.25954832
PM18AJ309	D19AU12a129.csv	34.0051745	26.1475733	27.7091123	<0.008	<0.004	516300.268	15.5296602	67.228337	13858.8842	<0.100	<0.002	3.78888675	<0.002	2.25162574	2.77534604	<0.001	1.08230725	<0.007	205.750961	<0.007
PM18AJ309	D19AU12a130.csv	130.65766	122.778748	131.587939	0.02028366	0.00352741	522473.295	14.3622705	5.22600814	1482.93101	0.14554874	<0.001	6.38144908	<0.001	2.17588336	0.87453527	0.09317533	16.0792147	<0.006	255.634059	0.01360917
PM18AJ309	D19AU12a131.csv	24.5731966	24.6407844	20.9232362	<0.009	0.0177683	518458.645	6.28098886	<5.645	11375.1626	<0.105	<0.002	3.14676447	<0.002	7.6713846	0.29725894	0.00748319	4.29146297	0.03124922	58.0898208	<0.007
PM18AJ309	D19AU12a132.csv	36.0521753	31.033235	33.3103431	0.02331852	<0.004	512303.11	14.311418	<5.244	8186.37064	0.14534527	0.03199052	3.95278982	0.17201839	3444.64469	0.33487444	0.08575243	8.65126182	0.64656543	45.4366537	8.08464577
PM18AJ309	D19AU12a133.csv	105.402238	91.8173033	99.9037089	<0.008	<0.004	504584.561	36.5344826	<5.449	22515.5772	0.14765827	<0.002	4.96156165	<0.002	2.11776998	0.58442133	0.00946797	10.957076	0.02770782	68.8992869	0.0873395
PM18AJ309	D19AU12a134.csv	92.5663723	90.5322077	89.8442507	<0.008	<0.004	518634.945	13.5248016	5.94865199	10051.8234	0.25556849	0.00459627	7.10385754	0.0101925	943.128541	0.32302144	0.08311115	10.0973222	0.09523511	69.7687698	1.41528626

All Elements in ppm.