U-Pb zircon age and Pb isotopic constraints on the age and origin of porphyry and epithermal vein mineralization in the eastern Dawson Range, Yukon

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ABSTRACT

Six dikes that are closely associated with the Klaza epithermal vein system in the Mt. Nansen district yield early Late Cretaceous U-Pb zircon ages (78.2-76.3 Ma); this age is similar to that obtained from the porphyry stock that hosts the Cyprus Cu-Mo-Au porphyry occurrence immediately to the southeast. These results support the interpretation that epithermal veins in the Mt. Nansen district are likely genetically related to subvolcanic magmatism. Granodiorite of the Dawson Range batholith that underlies most of the Klaza property gives a U-Pb zircon age of 107.9 ± 0.3 Ma. These dates overlap with previously reported mid-Cretaceous U-Pb zircon ages for felsic dikes associated with the Brown-McDade and related vein and breccia deposits in the Mt. Nansen mine. The new results, together with regional dating and Pb isotopic data from western Yukon, emphasize the metallogenic importance of the "early Late Cretaceous" magmatic-hydrothermal event in this region.

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INTRODUCTION

The eastern Dawson Range in west-central Yukon hosts a wide variety of porphyry, epithermal and related styles of mineralization, including those in the Sonora Gulch area as well as the Freegold and Mt. Nansen camps (Fig. 1). Much of the mineralization in this region is known to be "early Late" Cretaceous in age and associated with the Casino plutonic suite (~78-72 Ma; Sonora Gulch, Nucleus, Revenue, Casino); however, at least some intrusion-related deposits, such as Antoniuk (Fig. 1), have yielded unambiguous mid-Cretaceous formation ages (Allan *et al.*, 2013). In addition, some occurrences, such as the Bonanza vein swarm in the Prospector Mountain area (Fig. 1) are spatially and temporally associated with the "late Late" Cretaceous (71-67 Ma) Prospector Mountain suite magmatism and deposition of Carmacks Group volcanic rocks (Allan *et al.*, 2013).

The timing of formation of epithermal vein systems in the Mt. Nansen camp, including the main "Brown-McDade cluster" (Brown-McDade, Huestis, Weber, Flex and Dickson veins; Fig. 2), as well as the extensive area of veining in the Klaza deposit area to the north ("Klaza cluster"; Fig. 2), has been problematic. Mortensen *et al.* (2003) report U-Pb zircon ages ranging from 107.9 ± 0.9 Ma to 109.0 ± 0.7 Ma for northwest-trending quartz-feldspar porphyry dikes that are closely associated with the veins in the main Brown-McDade cluster, and, in the absence of any other direct constraints on the timing of mineralization, concluded that the veins formed at approximately the same time. Hart and Langdon (1998) had previously argued that epithermal veins in the Mt. Nansen camp (including both those in the main camp and the Klaza system) could represent parts of a "porphyry-to-epithermal transition" that was centered on the Cyprus porphyry and contained Cu-Mo-Au porphyry-style mineralization (Fig. 2). However, a Re-Os age of 71.1 ± 0.3 Ma reported by Selby and Creaser (2001) for molybdenite from the Cyprus porphyry deposit was incompatible with such a model if the Mt. Nansen veins were indeed middle Cretaceous in age.

A U-Pb dating study of intrusive rock units that either host or are spatially closely associated with mineralization in the Mt. Nansen area was undertaken. This study also evaluates existing and new measured Pb isotopic compositions of igneous feldspar minerals from many of the intrusions as well as sulphides (mainly galena) from the various deposits and occurrences. The aim of the work is to better constrain the timing of mineralization throughout the eastern Dawson Range, and to test models such as the "porphyry-to-epithermal transition" that was proposed for the Mt. Nansen area. New results resolve some of the questions concerning the age(s) of mineralization in much of the area, although some areas of uncertainty still exist.

GEOLOGY OF THE EASTERN DAWSON RANGE

The eastern Dawson Range is mainly underlain by intermediate to felsic intrusive rocks of the Early Cretaceous Dawson Range batholith (Whitehorse plutonic suite; Fig. 1). Eruptive equivalents of the Whitehorse suite are locally preserved as the Mt. Nansen Group volcanic rocks in the vicinity of Mt. Nansen (Figs. 1 and 2). The batholith was intruded into metamorphic rocks of the Yukon-Tanana terrane, as well as large bodies of Late Triassic and Early Jurassic plutonic rock of the Minto plutonic suite that underlie much of the easternmost end of the Dawson Range (Fig. 1). Small bodies of hypabyssal felsic porphyry of early Late Cretaceous age are widespread in the region; some of these host, or are spatially closely associated with, some of the main mineral deposits and occurrences in the area (*e.g.*, Casino, Nucleus, Revenue). The slightly younger late Late Cretaceous Carmacks Group mafic volcanic rocks cover extensive areas in the eastern Dawson Range (Fig. 1). Paleocene and Eocene felsic intrusive and extrusive rocks are increasingly abundant along the southwestern flank of the Dawson Range.

MINERALIZATION IN THE MT. NANSEN DISTRICT

The Mt. Nansen district (Fig. 2) includes two main concentrations of mineralized veins: the "Brown-McDade cluster", centered approximately 11 km southeast of the top of Mt. Nansen and includes the Brown-McDade vein system that was mined by BYG Resources in 1995-98; and the "Klaza cluster", centered approximately 3 km east-northeast of Mt. Nansen and based on recent exploration work by Rockhaven Resources, contains an inferred resource of 948 koz of gold and 21.8 Moz of silver (Wegnzynowski *et al.*, 2015; Fig. 2).

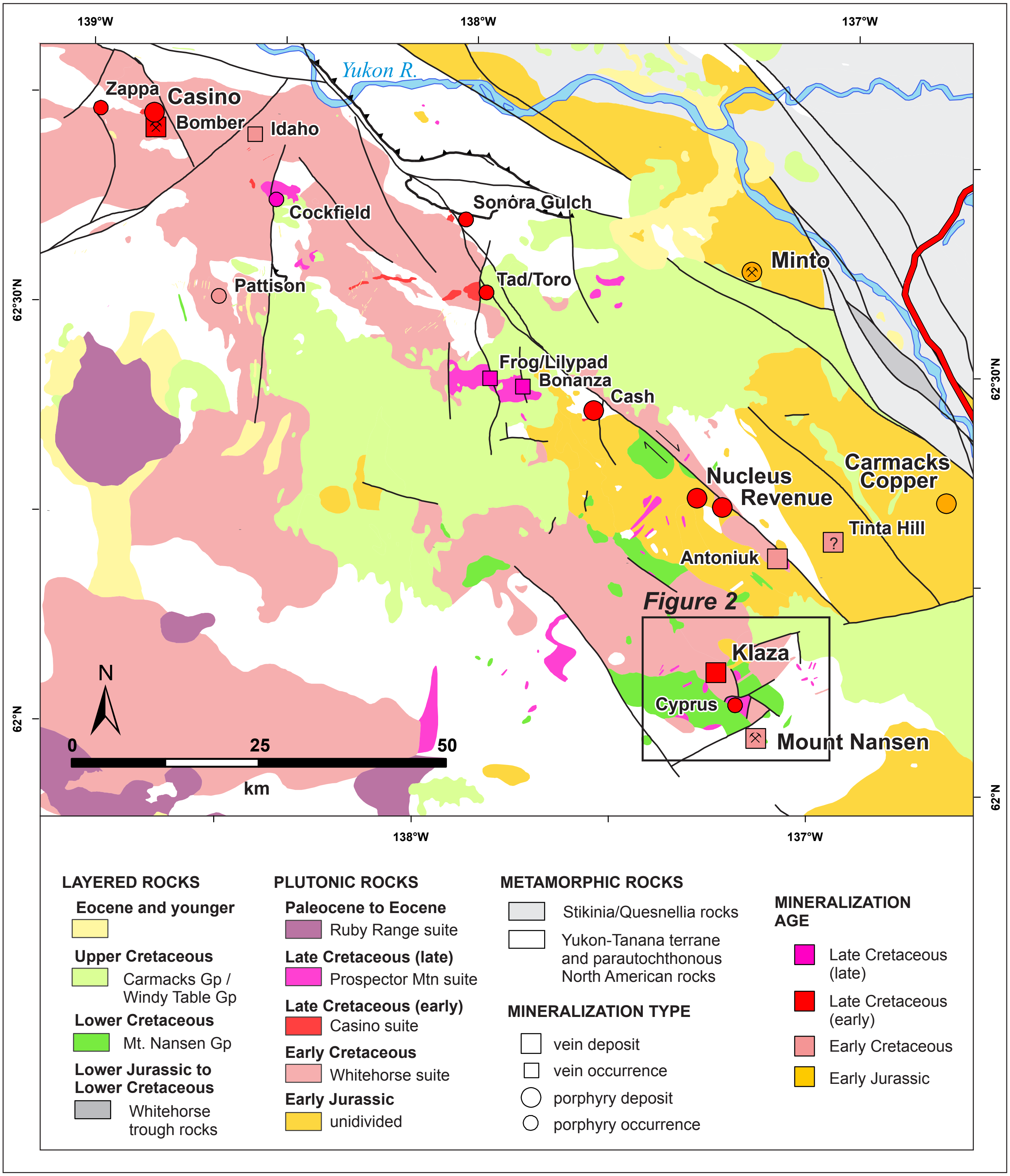

Figure 1. Regional geology of the central and eastern Dawson Range, showing locations of some of the main mineral deposits and occurrences referred to in the text. Box shows the location of Figure 2.

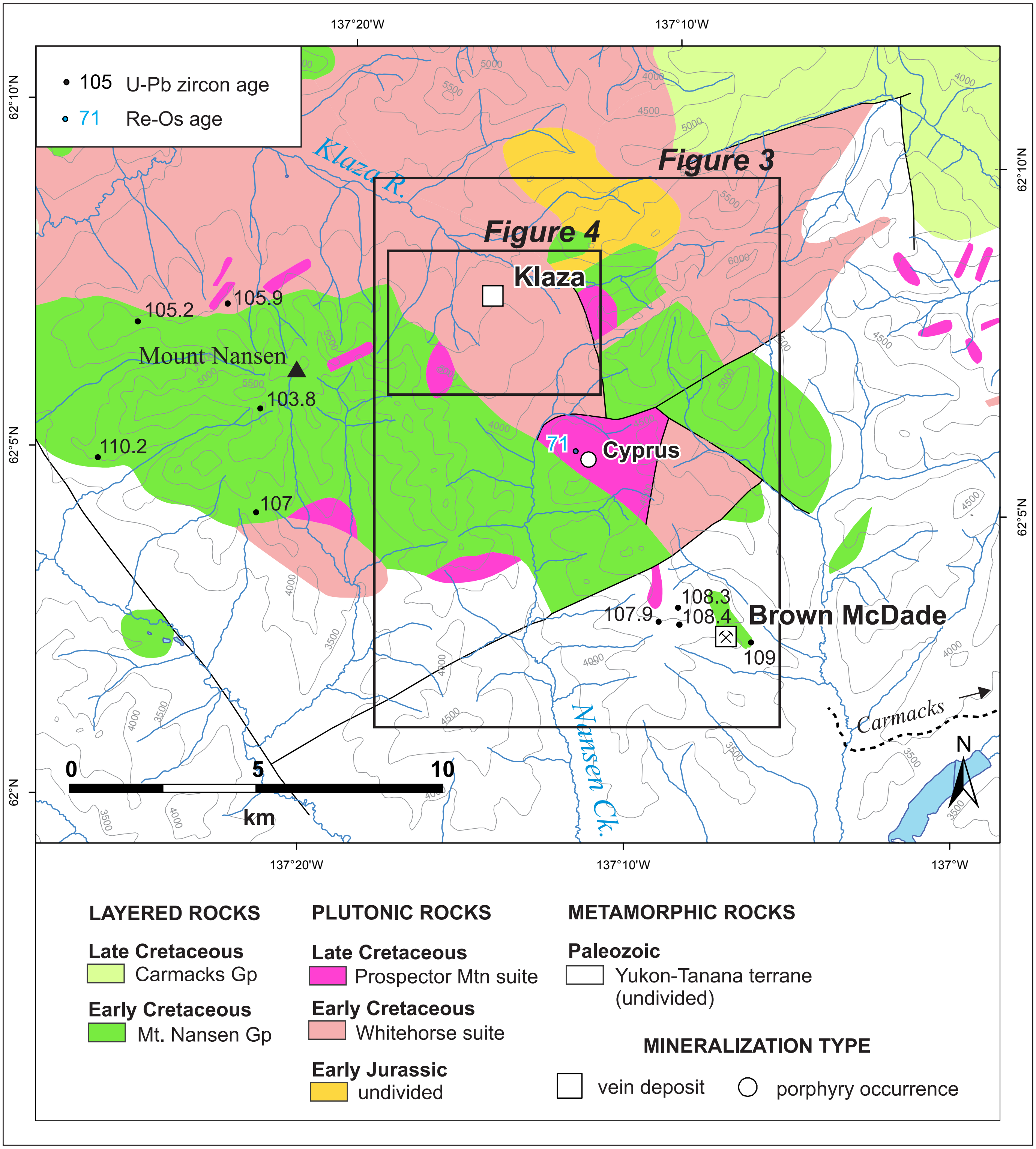

Figure 2. *Geology of the Mt. Nansen District, showing locations of the Klaza and Brown-McDade vein clusters and the Cyprus porphyry. Ages shown in the Brown-McDade cluster are ID-TIMS U-Pb zircon ages from Mortensen et al. (2003); ages for the Mt. Nansen Group are from Mortensen et al. (unpublished); Re-Os age from the Cyprus porphyry is from Selby and Creaser (2001).*

The Brown-McDade cluster consists of veins and deposits south of the Dickson fault, comprising the Webber, Flex, Heustis, Dickson, Vince and Brown-McDade occurrences (Fig. 3; Hart and Langdon, 1998; Anderson and Stroshein, 1998; Stroshein, 1999). These are historically amongst the most economic in the district and cumulatively host a resource of about 1 Mt with grades ranging from 5 to 14 g/t Au and 50 to 300 g/t Ag.

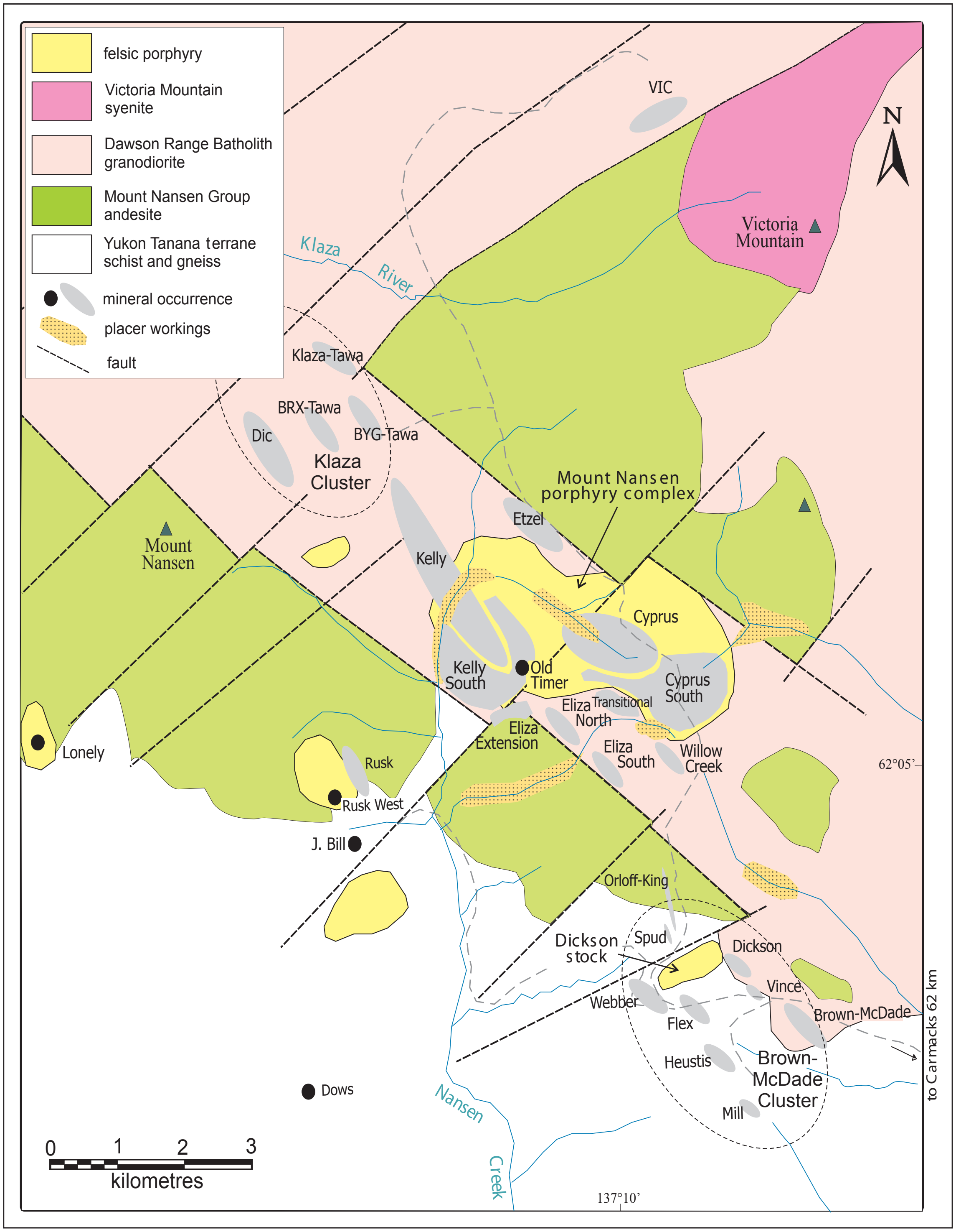

Figure 3. Geology the Mt. Nansen District including the Brown-McDade cluster in the southeast, the Cyprus porphyry and related occurrences in the central area, and the Klaza cluster in the northwest (modified from Hart and Langdon, 1998).

Most occurrences are hosted in Yukon-Tanana terrane schist and gneiss, but the Brown-McDade deposit, which is the largest, is mostly hosted in granodiorite. Each occurrence typically includes a 'swarm' of several veins, but may be dominated by a larger, single vein. Most veins are at least partly hosted by, northwest-trending quartz-feldspar porphyry dikes and small quartz-porphyry plugs. Most veins strike northwesterly between 320 and 340° and dip moderate to steeply (65 to 80°) to the southwest. Many of these veins have strike lengths of 500 m or greater, but their extents are variably displaced along north-northeast-striking sinistral strike slip faults. They are typically 0.2 to 0.8 m wide, but locally up to 2.5 m thick. The thicker parts result from intersections with 020°-striking fractures.

The veins are typically crudely banded, but are locally, variably brecciated. The Brown-McDade deposit occurs mostly as a breccia pipe (Stroshein, 1999). All veins are generally similar in mineralogy consisting of 'cherty' fine-grained grey and white quartz, with varying abundances of sulphide minerals dominated by pyrite and arsenopyrite, with essential galena and sphalerite typically to 10%, and lesser stibnite, tetrahedrite and various sulphosalt minerals such as boulangerite and jamesonite.

The Klaza area (Fig. 4) is mainly underlain by massive and unfoliated, medium to coarse-grained, equigranular hornblende-biotite granodiorite and quartz monzonite of the Dawson Range batholith, which is part of the regionally developed Whitehorse plutonic suite. A stock of quartz monzonite to granite, termed the Cyprus porphyry, intrudes the Dawson Range batholith on the southeastern corner of the Klaza property (Figs. 2 and 3). The Dawson Range batholith is cut by a set of northwest-trending, steeply to moderately southwest-dipping fault zones, along which dikes of vari-coloured (grey, green, tan, red and purple) feldspar and quartz-feldspar porphyry have been emplaced (Fig. 4). Individual porphyry dikes commonly pinch and swell along strike, and are up to 30 m wide. They consist of an aphanitic groundmass with up to 15% K-feldspar phenocrysts (1 to 2 mm) and minor biotite and rare quartz phenocrysts. Contacts with the granodiorite range from sharp and undulating to brecciated with locally abundant gouge development. A second, much less common set of northwest-trending dikes is also locally present, particularly in the southeastern part of the Klaza property, near the Cyprus porphyry stock. These dikes are typically fine grained to aphanitic, and appear to be intermediate to mafic in composition. They contain a significant amount of magnetite, and are locally strongly magnetic. These mafic dikes are up to 100 m in width, and are larger and more abundant near the Cyprus porphyry.

The main mineralized zones at Klaza range from 1 to 100 m wide and are usually associated with feldspar porphyry dikes. Mineralization occurs as veins, sheeted veinlets and tabular breccia bodies. The feldspar porphyry dikes generally occupy the same northwest-trending structural zones as the mineralized veins and they are commonly strongly fractured. They are locally cut by the main mineralized veins as well as by late stage white carbonate veinlets. Mineralization at Klaza mainly consists of gold and silver bearing, sulphide-rich veins that comprise pyrite, arsenopyrite, galena, sphalerite, various sulphosalts and electrum in a gangue of quartz, rhodocrosite and barite. The mafic dikes are also locally mineralized, hosting small amounts of disseminated pyrite and pyrite stringers, together with minor chalcopyrite and rare molybdenite. The strongest copper mineralization on the property is always associated with argillic altered versions of the mafic dikes.

The feldspar porphyry dikes at the Klaza property have been interpreted to emanate from the Cyprus porphyry stock to the southeast. Two distinct centres of Cu-Mo ± Au porphyry-style mineralization have been identified within the Cyprus porphyry stock, the Cyprus zone and the Kelly zone (Fig. 3). These zones appear to contain modest grades and be of limited extent (Wengzynowki *et al.*, 2015).

The northwest-trending feldspar porphyry dikes and the mineralized structures at Klaza have been displaced by two northeast trending faults (Fig. 4). The exact timing of these faults is uncertain; however, they appear to be coeval with, or post-date, the mineralized zones on the property.

U-PB ZIRCON GEOCHRONOLOGY

METHODOLOGY

Zircons were separated from 2-4 kg samples using conventional crushing, grinding, wet shaking table, heavy liquids and magnetic separation methods. U-Pb dating of zircons was done using laser ablation (LA-) ICP-MS methods at the Pacific Centre for Isotopic and Geochemical Research (PCIGR) at the University of British Columbia. Analytical techniques employed are as described by Allan *et al.* (2013). Twenty individual

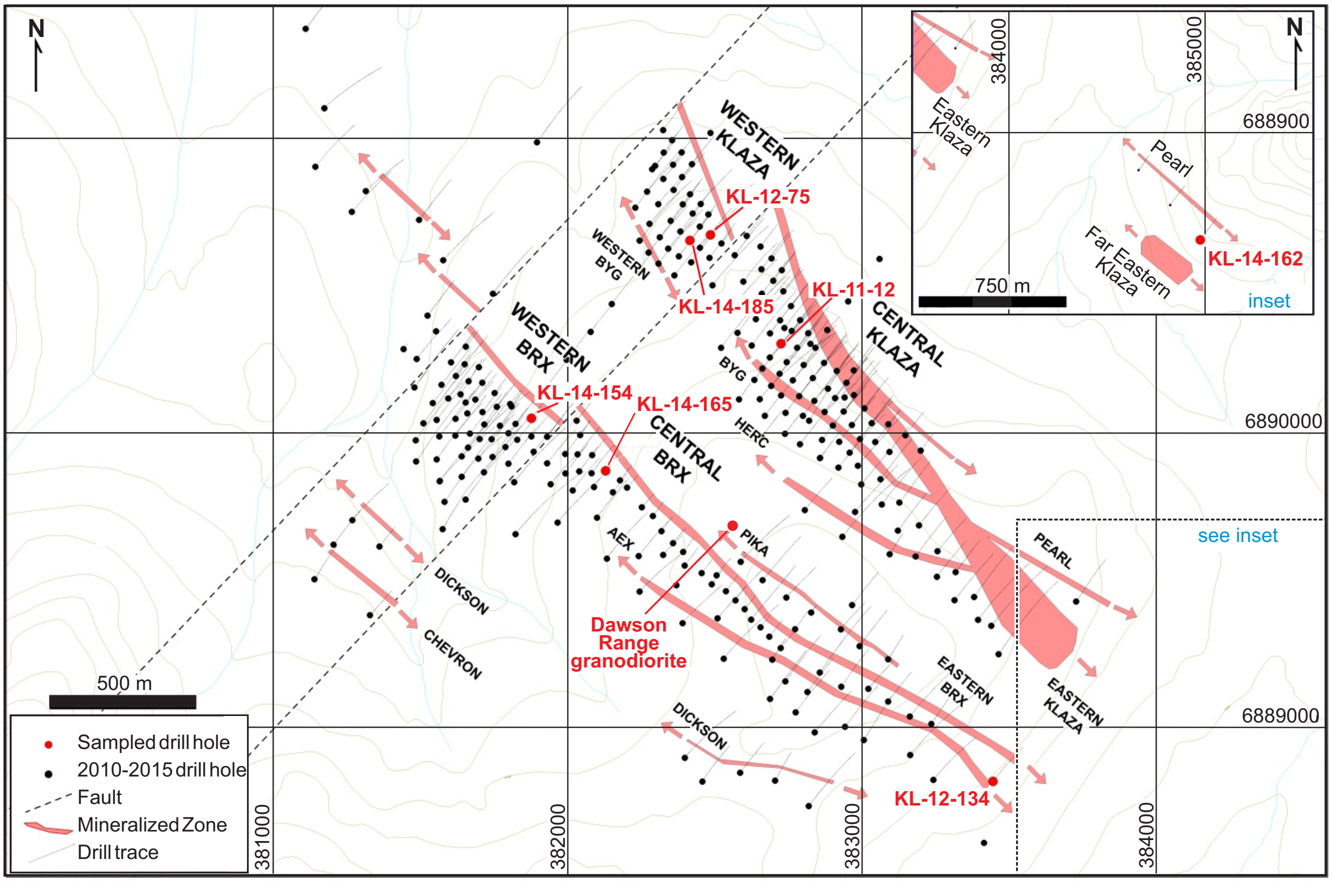

Figure 4. *Map of the Klaza property showing the distribution of the various zones as well as drill holes and the specific locations of samples that were analyzed in this study (modified from Wengzynowki et al., 2015). UTM coordinates are in NAD83 datum.*

zircon grains were analyzed from each sample. Complete analytical data are provided in Appendix 1 and the results are plotted as compilations of the calculated $^{206}Pb/^{238}U$ ages for individual sample analyses in Figures 3 and 4. Errors quoted for final assigned ages are given at the 2σ level.

RESULTS

All zircons analyzed from the Klaza U-Pb samples yielded concordant analyses. Sample locations are shown on Figure 3, and interpretations of the results for each of the samples are presented briefly below.

Granodiorite of the Dawson Range batholith

Twenty zircon analyses from a sample of massive medium-grained granodiorite from the Pika Zone (Fig. 4) yield a weighted $^{206}Pb/^{238}U$ age of 107.9±0.3 Ma (MSWD=0.74; POF=0.78; Fig. 5a).

Feldspar porphyry dikes in the Western Klaza Zone

Twenty zircon grains from a sample of feldspar porphyry from DDH KL-12-75 (189-191 m; Fig. 4) yield a weighted $^{206}Pb/^{238}U$ age of 76.9±0.3 Ma (MSWD=1.00; POF=0.45; Fig. 5b). Eighteen zircon grains from a second feldspar porphyry dike from the Western Klaza Zone in DDH KL-14-185 (0-11.5 m; Fig. 4) yield a weighted $^{206}Pb/^{238}U$ age of 76.8±0.4 Ma (MSWD=1.4; POF=0.14; Fig. 5c). A single grain from this sample gives a much older age ($^{207}Pb/^{206}Pb$ age of 1600.6±40.6 Ma) and represents an older xenocryst likely entrained from underlying metamorphic basement rocks. One of the analyses gave a significantly younger $^{206}Pb/^{238}U$ age, likely related to post-crystallization Pb-loss, and is not included in the calculated weighted average age.

Feldspar porphyry dike from the Western BRX Zone

Eighteen zircon grains from a porphyry dike sample in DDH KL-14-154 (52.1-52.5 m; Fig. 4) yield a weighted $^{206}Pb/^{238}U$ age of 77.1±0.4 Ma (MSWD=0.78; POF=0.72; Fig. 5d). Two grains give $^{206}Pb/^{238}U$ ages of 102.6 and 105.0 Ma, and are interpreted to have been xenocrystic zircons entrained from the underlying Dawson Range batholith.

Feldspar porphyry dike from the Central BRX Zone

Sixteen zircon grains from a porphyry dike in DDH KL-14-165 (85.7-87.5 m; Fig 4) give a weighted $^{206}Pb/^{238}U$ age of 76.5±0.4 Ma (MSWD=0.68; POF=0.80; Fig. 5e). Four grains give $^{206}Pb/^{238}U$ ages of 105.0-105.7 Ma and a single grain gives an age of 369.7 Ma; these are interpreted to have been xenocrysts from the Dawson Range batholith and the metamorphic basement rocks, respectively.

Feldspar porphyry dike from the Central Klaza Zone

Seventeen zircon grains from a porphyry dike in DDH KL-11-12 (181-187 m; Fig. 4) give a weighted $^{206}Pb/^{238}U$ age of 71.6±0.3 Ma (MSWD=0.55; POF=0.92; Fig. 5f). Two grains give slightly younger $^{206}Pb/^{238}U$ ages and are not included in the calculated weighted average age. A single grain gave a $^{206}Pb/^{238}U$ age of 77.1±1.7 Ma. The calculated age for this sample is significantly younger than that of most of the other Klaza dikes that were dated, and it appears to represent a distinctly younger intrusion. The presence of the single 77.1 Ma zircon indicates that the magma did interact to some extent with the "early Late" Cretaceous rocks.

Mafic dike in the Eastern BRX Zone

Sixteen zircon grains from a mafic dike in DDH KL-12-134 (218-221.5 m) give a weighted $^{206}Pb/^{238}U$ age of 78.2±1.0 Ma (MSWD=0.34; POF=1.00; Fig. 6a). Four grains give $^{206}Pb/^{238}U$ ages of 107.4-109.8 Ma, and are interpreted to have been xenocrysts entrained from the Dawson Range batholith.

Feldspar porphyry dike from the Far Eastern Klaza/ Pearl Zone

Fifteen zircon grains from a feldspar porphyry dike in DDH KL-14-162 (86.2-86.5 m; Fig. 4) give a weighted $^{206}Pb/^{238}U$ age of 76.3±0.3 Ma (MSWD=0.49; POF=0.94; Fig. 6b). Two grains give slightly older $^{206}Pb/^{238}U$ ages and are excluded from the weighted average age calculation. Two other grains gave $^{206}Pb/^{238}U$ ages of 101.4 and 102.6 Ma, and a single grain gave an age of 446.9 Ma; these are interpreted to have been xenocrysts from the Dawson Range batholith and the underlying metamorphic bedrock, respectively.

Cyprus porphyry

Seventeen zircon grains from sample 97-CH-33-3 in the Cyprus porphyry stock give a weighted $^{206}Pb/^{238}U$ age of 76.0±0.4 Ma (MSWD=0.75; POF=0.74; Fig. 6c). Three grains give slightly younger $^{206}Pb/^{238}U$ ages, likely reflecting the effects of post-crystallization Pb-loss and were excluded from the weighted average age calculation.

SUMMARY OF KLAZA DATING RESULTS

Results from the dating study of the Klaza samples confirm an Early Cretaceous age of 107.9±0.6 Ma for granodiorite of the Dawson Range batholith in the Mt. Nansen area. All but one of the northwest-trending dikes associated with Klaza mineralization give ages ranging from 78.2 to 76.0 Ma, indicating that these intrusions are part of the ~78-72 Ma Casino plutonic suite. An intermediate composition dike that contains disseminated chalcopyrite and minor molybdenite (sample KL-12-134; Eastern BRX zone), and was initially speculated to be part of the younger Prospector Mountain suite, actually yielded the oldest age at 78.2±1.0 Ma. A sample of the felsic porphyry that hosts the Cyprus Cu-Mo-Au porphyry occurrence returned a crystallization age of 76.0±0.4 Ma, confirming that this body is coeval and likely co-magmatic with the felsic dikes in the Klaza area. One of the quartz-feldspar dike samples from Klaza (KL-11-12; Central Klaza zone) gave a significantly younger age of 71.6±0.3 Ma, suggesting that this body either represents a late stage Casino suite intrusion or (less likely) an early intrusion of the Prospector Mountain suite.

RE-EXAMINATION OF DATING RESULTS FROM THE BROWN-MCDADE CLUSTER

The porphyry dikes at Klaza are very similar to those previously dated in the Brown-McDade cluster, in terms of composition, structural setting in northwest-trending faults, and association with sulphide-rich epithermal veins. However, Mortensen *et al.* (2003) report multi-grain TIMS zircon ages for five porphyry dikes and small stocks from the Brown-McDade cluster ranging from 109.0 to 107.9 Ma, suggesting that these intrusions are temporally related to the Dawson Range batholith. The TIMS data for

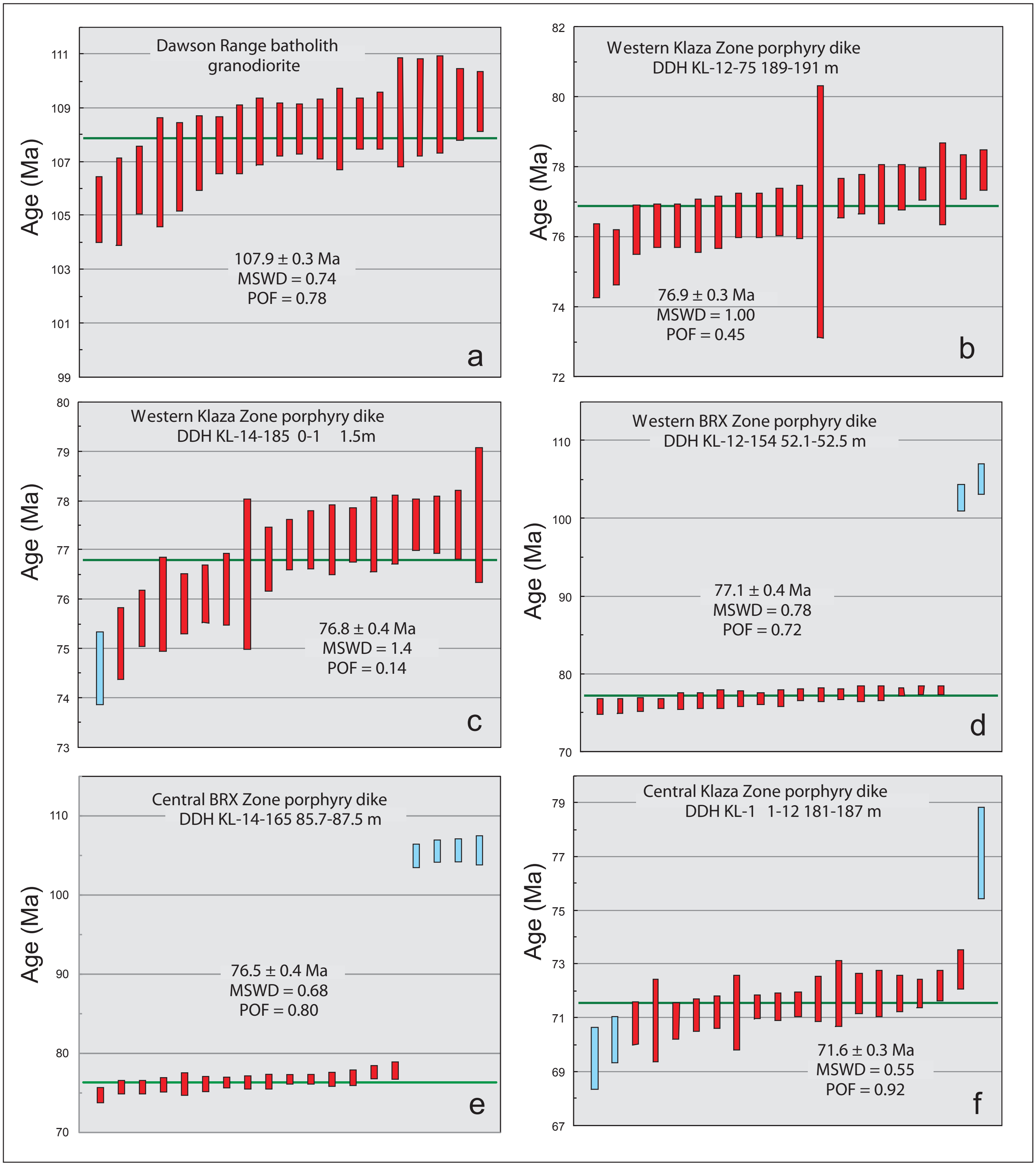

Figure 5. *Plots of $^{206}Pb/^{238}U$ ages for zircons from Klaza igneous samples, with calculated weighted average ages. Error bars are shown at the 2σ level. Analyses shown by blue boxes were not used in calculation of the weighted average ages.*

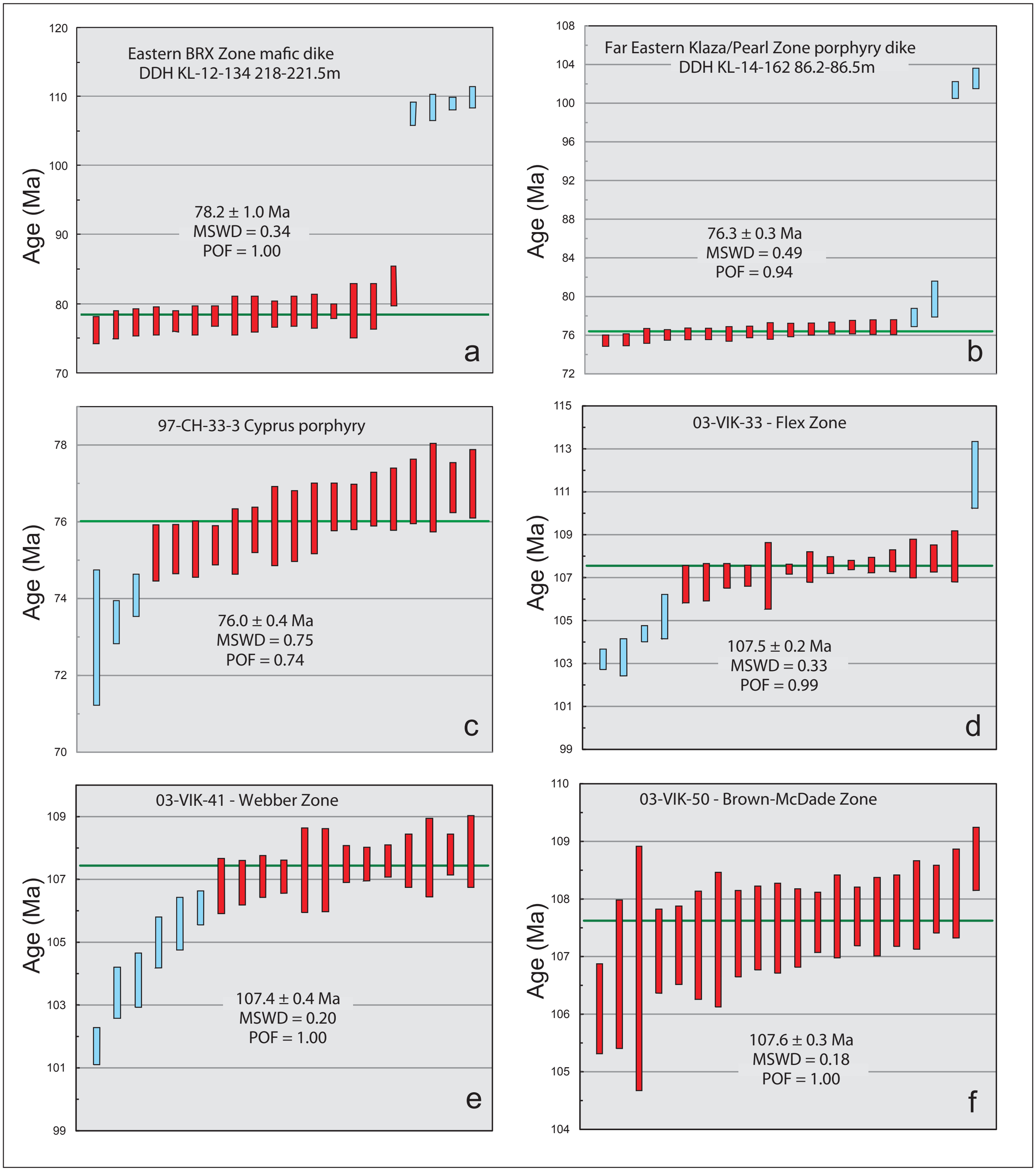

Figure 6. *Plots of $^{206}Pb/^{238}U$ ages for zircons from Klaza igneous samples, as well as the Cyprus porphyry and re-analysis of three porphyry samples from the Brown-McDade cluster. Error bars are shown at the 2σ level. Analyses shown by blue boxes were not used in calculation of the weighted average ages.*

some of the samples show considerable scatter and there is evidence for a substantial amount of older inherited zircon present in some cases. Although considered unlikely, it is conceivable that the Early Cretaceous zircons dated in 2003 might have been of xenocrytic origin, and entrained from underlying bodies of 108 Ma Dawson Range batholith; the Brown-McDade cluster dikes and plugs are mostly emplaced into Yukon-Tanana terrane metamorphic rocks at the present level of exposure. In order to evaluate this possibility, twenty zircon grains from each of three samples from the 2003 study, selected as representative of the entire range of grain size and morphology present in the concentrate, were analyzed using LA-ICP-MS methods (Appendix 1; Fig. 6d-f). The new results confirm the original age assignments: Flex zone porphyry, 108.4 ± 0.7 Ma TIMS and 107.4 ± 0.2 Ma LA; Weber zone porphyry, 107.9 ± 0.9 Ma TIMS and 107.4 ± 0.4 LA; Brown-McDade porphyry: 109.0 ± 0.7 Ma TIMS; 107.6 ± 0.3 Ma LA. Therefore, the reanalysis of zircons from these samples strongly argues for an Early Cretaceous crystallization age for the intrusions in the Brown-McDade cluster. The most reasonable conclusion, therefore, is that two similar, but completely unrelated sets of felsic dikes and small stocks were emplaced into northwest-trending faults in the Mt. Nansen area.

Pb ISOTOPES

METHODOLOGY

In general the Pb isotopic compositions of sulphides precipitated from magmatic-hydrothermal fluids in intrusion-related vein systems are very similar to the Pb isotopic compositions of igneous feldspar within the genetically related intrusions (Tosdal *et al.*, 1999). Lead isotopes therefore provide a powerful tool for determining the source(s) from which Pb (and by analogy, other metals) in a deposit is derived, and in the case of intrusion-related mineralization, for identifying which intrusion (or intrusive suite) is genetically associated with the mineralization. In some cases, Pb compositions can also yield some indication of the age of formation of epigenetic mineralization, although this must be utilized with caution. Lead isotopic compositions of several samples of galena from veins from both the Brown-McDade and the Klaza cluster were determined at the PCIGR, using TIMS methods as described by Mortensen and Gabites (2002). Analytical data are given in Appendix 2. An extensive Pb isotopic database for both igneous feldspar minerals from intrusive rocks and galena and other sulphides from various mineral deposits and occurrences from throughout west-central Yukon, including data from various published and unpublished sources, is also discussed.

RESULTS

New galena Pb isotopic analyses from Klaza (n = 3) and Brown-McDade (n=3) from this study are plotted on a $^{207}Pb/^{204}Pb$ *vs.* $^{206}Pb/^{204}Pb$ diagram in Figure 7. Also shown for comparison on this plot are fields of Pb isotopic compositions from additional Klaza and Brown-McDade vein samples, as well as sulphides from a number of other epigenetic, polymetallic vein occurrences (Fig. 1) in the Dawson Range and elsewhere in western Yukon, including the Prospector Mountain area (Frog and Lilypad occurrences), the Tinta Hill deposit in the Freegold Mountain area, the Longline Au deposit in the Moosehorn Range (Yukon MINFILE 115N 024), the Bomber vein at Casino, and numerous other Late Cretaceous vein occurrences in the region (data from Godwin *et al.*, 1988; Glasmacher, 1990; Smuk, 1999; Selby *et al.*, 2001; Joyce, 2002; Selby *et al.*, 2001; Bineli-Betsi *et al.*, 2013; Mortensen, unpublished data). Also shown on the plot are fields for igneous K-feldspars from Early Cretaceous intrusions in the Moosehorn Range (from Joyce, 2002) and Late Cretaceous intrusions in the Casino area (from Selby *et al.*, 1999), as well as other Early and Late Cretaceous intrusions from throughout west-central and western Yukon (Mortensen, unpublished data).

The Pb isotopic study tries to resolve the question of whether veins in the Brown-McDade cluster formed at the same time as those in the Klaza cluster (*i.e.*, early Late Cretaceous), and coincidentally happen to be spatially associated with a lithologically similar but ~35 my older set of porphyry dikes, or represent a completely unrelated mineralizing event. The study also evaluates the relative importance of mid-Cretaceous *vs.* early Late and late Late Cretaceous mineralizing events in western Yukon.

The field for Early Cretaceous igneous feldspar from the Moosehorn Range (dotted green line in Fig. 7) is completely separate from that for sulphides in gold-bearing veins from the Longline occurrence that is hosted by those intrusions (solid green line). This observation led Joyce (2002) to conclude that the metals in the Longline veins were not derived from the host intrusions, or indeed from any other intrusions in western Yukon or eastern Alaska, but were actually orogenic rather than intrusion-related.

The field for igneous feldspar from other Early Cretaceous intrusions in western Yukon (dotted red line in Fig. 7) overlaps with the Moosehorn Range feldspar data but shows somewhat more scatter. Feldspar from early Late Cretaceous Casino suite intrusions and from other early and late Late Cretaceous intrusions in western Yukon (blue dotted lines on Fig. 7; including the Cyprus porphyry in the Mt. Nansen district, shown as the blue triangle) show considerable scatter; although there is substantial overlap with the fields for the Early Cretaceous feldspar, most of the Late Cretaceous feldspar show higher $^{206}Pb/^{204}Pb$ ratios and slightly lower $^{207}Pb/^{204}Pb$ ratios (Fig. 7). The field for galena from the Bomber veins, which are considered to be related to the early Late Cretaceous Casino porphyry deposit, overlap with both the more radiogenic (higher Pb/Pb compositions) part of the Early Cretaceous feldspar Pb field and the less radiogenic (lower Pb/Pb compositions) part of the Late Cretaceous feldspar field. However, galena from other early and late Late Cretaceous intrusion-related veins in western Yukon (solid blue line on Fig. 7), show a good overlap with Late Cretaceous feldspar but are completely separate from the Early Cretaceous feldspar field. Taken together, the data suggest: 1) Early and Late Cretaceous igneous feldspar minerals yield partly overlapping compositional fields, but most Late Cretaceous samples have higher $^{206}Pb/^{204}Pb$ and slightly lower $^{207}Pb/^{204}Pb$ ratios than the bulk of the Early Cretaceous samples; and 2) epigenetic vein occurrences that are known to be of Late Cretaceous age more closely match the compositional fields for the Late Cretaceous igneous feldspar than the Early Cretaceous samples, which is consistent with the bulk of the metals in these occurrences having been derived predominantly from the Late Cretaceous intrusions.

Sulphide Pb isotopic compositions from four separate areas (Klaza, Brown-McDade, Prospector Mountain, Tinta Hill), however, are more puzzling. Field relationships discussed above provide unequivocal evidence that the Klaza veins (pink field in Fig. 7) are spatially and temporally related with late Late Cretaceous porphyry intrusions, whereas very similar veins in the Brown-McDade cluster (blue field in Fig. 7) are most reasonably interpreted to be Early Cretaceous in age. Both of these compositional fields overlap with the least radiogenic part of the compositional ranges for the Early and Late Cretaceous igneous rocks. Veins in the Prospector Mountain area, whose galena Pb isotopic compositions overlap almost perfectly with the Brown-McDade galena field (Fig. 7), are interpreted to cut Late Cretaceous Carmacks Group volcanic rocks, and must therefore be Late Cretaceous in age. The Tinta Hill Au-Ag-Cu-Pb-Zn deposit in the Mt. Freegold area is a polymetallic, epithermal vein that closely resembles the Klaza and Brown-McDade veins in most respects (Bennett and Bineli Betsi, 2010). The age of the Tinta Hill veins is uncertain; Bineli Betsi and Bennett (2010) stated that the vein is crosscut by a porphyry dike that yielded a 108 Ma U-Pb zircon (TIMS) age; however, there is somewhat less certainty regarding this crosscutting relationship in subsequent publications (Bineli Betsi, 2012; Bineli Betsi *et al.*, 2013). These four vein systems were each emplaced into very different host rocks that would be expected to have quite distinct Pb isotopic characteristics. The Brown-McDade cluster of veins are mainly hosted by Yukon-Tanana terrane metasedimentary rocks; whereas the Klaza veins are hosted by the Early Cretaceous Dawson Range batholith, the Prospector Mountain veins by Late Cretaceous Carmacks Group volcanic rocks, and the Tinta vein by the Early Jurassic Granite Mountain batholith. The fact that sulphides from these four vein systems show rather similar Pb isotopic compositions suggests that the Pb in each was likely derived mainly from the associated intrusions rather than the host rocks, and in general the Pb isotopic compositions of the sulphides is more consistent with the metals having been derived from Early, rather than Late, Cretaceous magma.

The implications of the Pb isotopic study are therefore uncertain at this time. It is very difficult to directly date epithermal veins such as those in the eastern Dawson Range, and vein ages typically must be inferred from contact relations with dated igneous rock units. More detailed geological investigations will be required to resolve the age relations between the various intrusive suites and vein systems in the area.

IMPLICATIONS FOR THE METALLOGENY OF WEST-CENTRAL YUKON

At least three distinct ages of porphyry-style mineralization are known to exist in western Yukon: Early Cretaceous (*e.g.*, Pattison, Idaho); early Late Cretaceous (*e.g.*, Casino, Cash, Cyprus, Nucleus, Revenue, Sonora Gulch, Tad/Toro and Bluff/Taurus in eastern Alaska); and late Late Cretaceous (*e.g.*, Mt. Cockfield, Sixtymile; Allan *et al.*, 2013). Similarly there are gold-bearing vein and breccia systems of the same three ages: Early Cretaceous (*e.g.*, Antoniuk, possibly Brown-McDade, possibly Tinta Hill); early Late Cretaceous (*e.g.*, Klaza); and late Late Cretaceous (*e.g.*, Prospector Mountain, Connaught (Yukon

MINFILE 115N 040)). The largest and most prospective porphyry systems, however, appear to be related to the early Late Cretaceous Casino suite, and the most significant epithermal vein systems identified thus far appear to be the Klaza deposit and some zones in the Sonora Gulch area, also of early Late Cretaceous age. Our new age constraints strongly support the "porphyry-to-epithermal transition" model that was proposed by Hart and Langdon (1998), at least for veins of the Klaza cluster and the Cyprus and Kelly porphyry deposits. The age of the epithermal veins in the Brown-McDade cluster, however, is still not resolved, and it remains unclear whether the Brown-McDade veins have any relationship to any of the Late Cretaceous magma in the Mt. Nansen area.

Lead isotopic studies of many of the mineral deposits and occurrences in western Yukon, together with analyses of igneous feldspars from potentially related intrusive rocks, indicate that there is a substantial amount of scatter within each of the plutonic suites in the region. It appears that lead isotopes do not provide a simple tool for identifying which intrusive rocks are genetically related to specific mineralization in this region. It is unclear whether this is because of the isotopic heterogeneity of the igneous rocks themselves, or the fact that some amount of mixing has occurred between metal-bearing magmatic fluids and metals derived from compositionally variable host rocks.

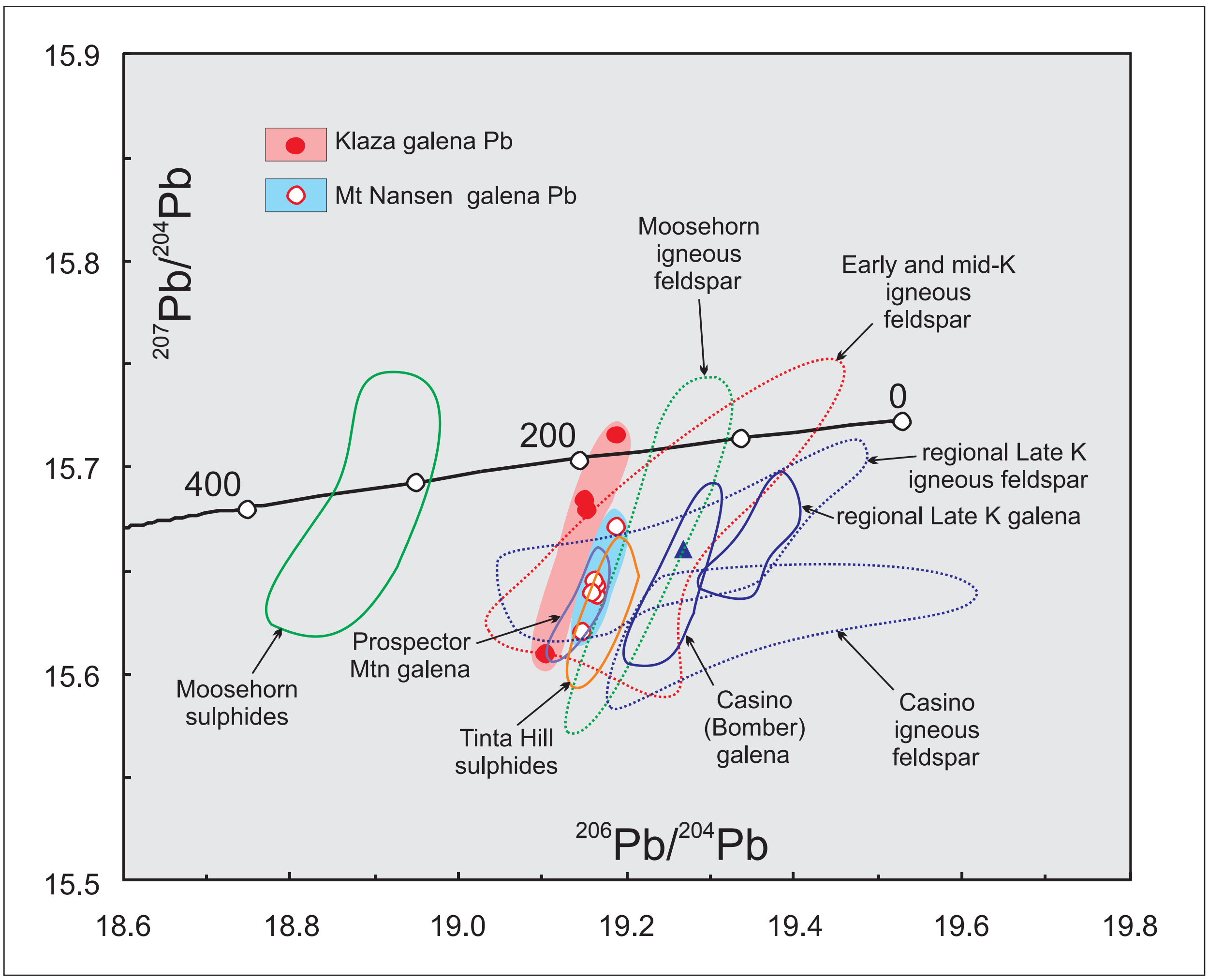

Figure 7. *Compilation plot showing Pb isotopic compositional fields for igneous feldspars from Early to Late Cretaceous intrusions from west-central Yukon, together with sulphide (mainly galena) compositions from a variety of intrusion-related orogenic gold deposits and occurrences. Fields for sulphide Pb analyses from the Mt. Nansen veins and from the Klaza deposit are shown as colored fields. The Cyprus porphyry feldspar Pb is shown by the blue triangle. Sources of data are discussed in the text.*

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***APPENDIX 1.** U-Pb analytical data by laser ablation (LA)-ICP-MS methods.*

Fraction	Isotopic Ratios							Isotopic Ages						Background corrected mean counts per second at specified mass							
	$^{207}Pb/^{235}U$	% 1σ	$^{206}Pb/^{238}U$	% 1σ	rho	$^{207}Pb/^{206}Pb$	% 1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	202	204	206	207	208	232	235	238
Dawson Range batholith granodiorite - Pika Zone																					
1	0.11355	0.00624	0.01703	0.00032	0.34	0.04933	0.00256	163.7	117.2	109.2	5.69	108.8	2.02	1	15	4014	194	378	21508	692	72551
2	0.11273	0.00341	0.01708	0.00018	0.35	0.04837	0.00138	117.5	65.74	108.5	3.11	109.2	1.11	24	32	3436	163	524	32456	585	61901
3	0.11333	0.00504	0.0165	0.00025	0.34	0.04987	0.0021	188.8	94.96	109	4.6	105.5	1.61	50	0	6206	304	605	31463	1084	115710
4	0.11395	0.00431	0.01678	0.00022	0.35	0.04926	0.00176	160.4	81.28	109.6	3.93	107.3	1.38	0	8	7453	361	630	36829	1279	136678
5	0.1122	0.0033	0.01684	0.00017	0.34	0.04839	0.00134	118.4	63.98	108	3.01	107.6	1.05	36	9	4504	214	456	24503	771	82318
6	0.11538	0.00401	0.01646	0.00019	0.33	0.04969	0.00163	180.7	74.67	110.9	3.65	105.2	1.22	0	0	5200	254	671	37560	889	97243
7	0.11335	0.00304	0.01693	0.00015	0.33	0.04901	0.00124	148.2	58.03	109	2.77	108.2	0.98	0	0	5375	259	743	42442	922	97722
8	0.10818	0.00282	0.01693	0.00015	0.34	0.04706	0.00116	51.7	57.93	104.3	2.59	108.2	0.94	27	2	12980	601	1285	76215	2241	235989
9	0.1135	0.00625	0.01706	0.00028	0.3	0.0491	0.00258	152.8	118.81	109.2	5.7	109.1	1.8	0	1	1309	63	175	8412	224	23616
10	0.11789	0.0034	0.01698	0.00017	0.35	0.05042	0.00137	214.3	61.62	113.2	3.09	108.5	1.06	16	3	4327	214	483	23909	734	78429
11	0.11212	0.0039	0.01691	0.0002	0.34	0.04837	0.00159	117.5	75.51	107.9	3.56	108.1	1.25	55	0	3592	171	429	24405	615	65367
12	0.11682	0.00349	0.01692	0.00017	0.34	0.05148	0.00144	262.3	63.16	112.2	3.17	108.2	1.1	0	21	3481	176	437	24168	609	63311
13	0.10328	0.00474	0.01671	0.00026	0.34	0.04829	0.00211	113.3	99.98	99.8	4.36	106.8	1.65	0	0	4156	197	595	33906	771	76564
14	0.10225	0.00436	0.01693	0.00024	0.33	0.04474	0.00181	0.1	26.11	98.9	4.02	108.2	1.52	26	7	4808	211	781	43916	835	87436
15	0.11135	0.00301	0.01696	0.00015	0.33	0.04807	0.00123	102.5	59.18	107.2	2.75	108.4	0.96	68	7	4579	216	491	25890	784	83092
16	0.11023	0.00562	0.01706	0.00028	0.32	0.04823	0.00234	110.4	110.52	106.2	5.14	109	1.78	0	24	2028	96	173	9235	352	36607
17	0.11931	0.00658	0.01667	0.00032	0.35	0.05012	0.0026	200.6	115.98	114.4	5.97	106.6	2.01	0	0	6677	329	409	14809	1113	123250
18	0.10491	0.00371	0.01686	0.0002	0.34	0.04726	0.00158	61.8	78.25	101.3	3.41	107.8	1.28	0	17	5088	236	660	38469	910	92867
19	0.10711	0.00416	0.01707	0.00021	0.32	0.04467	0.00164	0.1	13.97	103.3	3.82	109.1	1.32	0	0	3610	158	431	27237	597	65101
20	0.05001	0.00549	0.01662	0.0002	0.11	0.022	0.0024	0.1	0	49.5	5.31	106.3	1.26	0	0	3772	81	601	32671	658	69853
Western Klaza Zone porphyry dyke - DDH KL-12-75 189-191m																					
1	0.07326	0.00194	0.01197	0.00011	0.35	0.04433	0.00113	0.1	0	71.8	1.83	76.7	0.67	0	10	9147	399	485	36628	2197	235218
2	0.07988	0.00195	0.01196	0.0001	0.34	0.04959	0.00117	175.9	53.97	78	1.83	76.6	0.64	7	0	5256	256	290	20110	1295	135282
3	0.0782	0.00189	0.01191	0.0001	0.35	0.04733	0.0011	65.2	55.14	76.5	1.78	76.3	0.62	0	0	5489	255	310	24373	1318	141857
4	0.07836	0.00221	0.01192	0.00012	0.36	0.04742	0.0013	69.6	64.35	76.6	2.08	76.4	0.74	27	22	8117	379	357	29685	1950	209572
5	0.0708	0.00299	0.01175	0.00017	0.34	0.04369	0.0018	0.1	0	69.5	2.83	75.3	1.06	32	16	6166	265	363	29922	1510	161600
6	0.07708	0.00209	0.01189	0.00011	0.34	0.04727	0.00124	62.4	61.84	75.4	1.97	76.2	0.7	26	7	6747	314	268	18457	1642	174712
7	0.07658	0.0014	0.01209	0.00007	0.32	0.04638	0.00081	17.3	40.8	74.9	1.32	77.5	0.47	18	12	10463	478	410	34578	2515	266434
8	0.07786	0.0017	0.01204	0.00009	0.34	0.04766	0.001	81.8	49.9	76.1	1.6	77.2	0.57	0	15	6838	321	322	23773	1661	174846
9	0.07456	0.0022	0.01198	0.00012	0.34	0.04383	0.00125	0.1	0	73	2.08	76.7	0.75	18	10	6340	273	296	23159	1479	162987
10	0.082	0.00258	0.01205	0.00013	0.34	0.04928	0.0015	161	69.69	80	2.42	77.2	0.84	9	6	5790	281	333	24996	1381	147866
11	0.07627	0.0021	0.01195	0.0001	0.3	0.04541	0.00121	0.1	29.72	74.6	1.98	76.6	0.63	19	3	5472	245	340	25093	1293	140995
12	0.07299	0.01077	0.01198	0.00057	0.32	0.04686	0.00682	41.7	315.76	71.5	10.19	76.7	3.6	0	20	580	26	80	6594	147	14916
13	0.08298	0.00366	0.01209	0.00018	0.34	0.04825	0.00206	111.4	97.75	80.9	3.43	77.5	1.16	0	0	2593	123	62	5205	598	66035
14	0.07909	0.00191	0.0119	0.0001	0.35	0.04831	0.00112	114.7	54.01	77.3	1.8	76.3	0.63	0	8	5443	259	258	21769	1320	140839
15	0.07854	0.00241	0.01177	0.00012	0.33	0.04744	0.00141	70.6	69.64	76.8	2.26	75.4	0.78	5	1	5609	262	265	20678	1344	146734
16	0.07708	0.00234	0.01191	0.00012	0.33	0.04674	0.00137	35.6	69.02	75.4	2.21	76.3	0.76	5	1	4816	222	191	14864	1159	124492
17	0.07665	0.00167	0.01215	0.00009	0.34	0.04598	0.00095	0.1	45.6	75	1.57	77.9	0.57	25	3	6977	316	302	23875	1661	176803
18	0.0739	0.00178	0.01213	0.0001	0.34	0.04496	0.00104	0.1	0	72.4	1.68	77.7	0.62	0	17	6020	267	293	20051	1453	152876
19	0.07548	0.0019	0.01208	0.0001	0.33	0.04594	0.00111	0.1	51.19	73.9	1.79	77.4	0.65	0	12	5154	233	383	27285	1245	131415
tt	0.07909	0.00169	0.01203	0.00009	0.35	0.04767	0.00097	82	48.46	77.3	1.59	77.1	0.56	0	0	7301	343	314	23695	1746	186893
Western Klaza Zone porphyry dyke - DDH KL-14-185 189-191m																					
1	0.07721	0.0022	0.01165	0.00012	0.361498244	0.0489	0.00135	142.9	63.64	75.5	2.07	74.6	0.74	4	1	8362	398	613	49708	2090	217369
2	0.07886	0.00193	0.01198	0.0001	0.341069312	0.0477	0.00113	83.6	55.92	77.1	1.81	76.8	0.64	0	0	9871	459	559	42674	2357	249407
3	0.0804	0.00289	0.01184	0.00015	0.352450201	0.04953	0.00173	172.9	79.7	78.5	2.72	75.9	0.95	0	13	3126	151	571	47198	760	79977

Fraction	Isotopic Ratios							Isotopic Ages						Background corrected mean counts per second at specified mass							
	$^{207}Pb/^{235}U$	% 1σ	$^{206}Pb/^{238}U$	% 1σ	rho	$^{207}Pb/^{206}Pb$	% 1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	202	204	206	207	208	232	235	238
4	0.07703	0.0017	0.01204	0.00009	0.338709205	0.04757	0.00101	77.1	50.65	75.4	1.61	77.2	0.58	14	0	6750	313	283	24680	1646	169744
5	0.08021	0.00408	0.01212	0.00021	0.340631673	0.04918	0.00244	156.3	112.36	78.3	3.84	77.7	1.36	39	7	1249	59	186	14525	302	31219
6	0.08055	0.00223	0.01189	0.00011	0.334173119	0.04931	0.00132	162.6	61.39	78.7	2.09	76.2	0.72	0	10	5212	250	208	16508	1260	132781
7	0.07726	0.00154	0.01209	0.00008	0.331969106	0.04702	0.0009	49.8	44.2	75.6	1.45	77.5	0.52	8	5	8588	393	350	27676	2064	215233
8	0.08345	0.00177	0.01209	0.00009	0.350969424	0.05051	0.00103	218.5	46.5	81.4	1.66	77.5	0.57	7	1	7115	350	301	22047	1700	178400
9	0.07668	0.00153	0.01203	0.00008	0.333284436	0.04676	0.0009	36.8	44.6	75	1.44	77.1	0.52	0	0	8677	395	394	28650	2090	218657
10	0.0729	0.00203	0.01205	0.00011	0.32782127	0.04424	0.0012	0.1	0	71.4	1.92	77.2	0.71	13	1	6910	298	234	18684	1656	173922
11	0.07594	0.00163	0.01207	0.00009	0.347390732	0.04568	0.00094	0.1	29.92	74.3	1.54	77.3	0.55	16	0	10163	452	662	52701	2415	255440
12	0.07951	0.00222	0.01172	0.00011	0.33615057	0.0485	0.00131	123.7	62.48	77.7	2.09	75.1	0.72	7	3	6853	324	707	49634	1651	177445
13	0.08379	0.00485	0.01194	0.00024	0.347262084	0.04941	0.00278	167.4	126.55	81.7	4.54	76.5	1.52	0	0	2799	134	79	5193	652	71104
14	2.5523	0.13393	0.19079	0.0025	0.249711333	0.09875	0.00218	1600.6	40.58	1287.1	38.28	1125.7	13.53	0	12	9579	922	2135	9061	146	15236
15	0.0809	0.0018	0.01187	0.00009	0.340775063	0.04947	0.00106	169.9	49.22	79	1.69	76.1	0.58	0	8	6820	328	310	23322	1647	174347
16	0.08017	0.00215	0.0121	0.00011	0.338985201	0.04833	0.00125	115.5	59.94	78.3	2.02	77.5	0.7	30	0	5068	238	232	15379	1207	127180
17	0.07627	0.00171	0.0118	0.00009	0.340187333	0.04659	0.00101	28.1	50.32	74.6	1.61	75.6	0.57	46	0	7794	354	537	40609	1881	200631
18	0.07654	0.0022	0.01206	0.00012	0.3461782	0.04507	0.00125	0.1	14.02	74.9	2.07	77.3	0.75	0	0	4391	192	239	20370	1021	110565
19	0.08083	0.00215	0.01208	0.00011	0.342341753	0.04892	0.00126	143.9	59.31	78.9	2.02	77.4	0.69	2	8	4718	225	478	37962	1128	118664
20	0.0783	0.00182	0.01185	0.0001	0.363054667	0.04909	0.0011	152.1	51.67	76.5	1.71	75.9	0.61	5	24	8008	383	509	36882	1984	205312
Western BRX Zone porphyry dyke - DDH KL-12-154 52.1-52.5m																					
1	0.07857	0.00308	0.01194	0.00016	0.34	0.04797	0.00183	96.5	88.86	76.8	2.9	76.5	1.02	23	0	3149	149	192	15596	763	81217
2	0.12332	0.00648	0.01643	0.0003	0.35	0.05707	0.00285	493.5	107.18	118.1	5.85	105	1.89	37	0	1241	69	110	5766	228	23282
3	0.10066	0.00516	0.01604	0.00028	0.34	0.04701	0.00229	49.2	112.8	97.4	4.76	102.6	1.76	22	0	4055	188	260	14533	751	77855
4	0.08324	0.00309	0.01209	0.00015	0.33	0.04793	0.00172	94.6	83.76	81.2	2.9	77.5	0.99	45	0	5123	242	378	27894	1171	130489
5	0.08827	0.00424	0.01198	0.0002	0.35	0.05256	0.00245	309.7	102.69	85.9	3.95	76.8	1.24	13	0	1334	69	129	11351	315	34303
6	0.07564	0.00318	0.01199	0.00016	0.32	0.04462	0.00182	0.1	20.42	74	3	76.9	1.02	0	0	2102	92	330	24144	492	53970
7	0.07502	0.00218	0.01207	0.00012	0.34	0.04653	0.00131	25	65.09	73.5	2.06	77.3	0.75	17	11	4022	184	548	41025	990	102669
8	0.08131	0.00165	0.01212	0.00008	0.33	0.04803	0.00092	100.5	44.61	79.4	1.55	77.7	0.53	0	12	8726	413	371	27849	2045	221743
9	0.08134	0.00209	0.01189	0.0001	0.33	0.04863	0.0012	129.9	56.89	79.4	1.96	76.2	0.66	15	0	5058	242	506	37076	1200	131005
10	0.08249	0.00289	0.01184	0.00014	0.34	0.04933	0.00166	163.8	77	80.5	2.71	75.9	0.92	56	0	4163	202	533	42260	988	108256
11	0.07457	0.00284	0.01199	0.00016	0.35	0.04548	0.00168	0.1	56.52	73	2.68	76.8	0.99	35	3	3911	175	570	45074	946	100459
12	0.08073	0.00267	0.01206	0.00014	0.35	0.04707	0.0015	52.5	74.57	78.8	2.51	77.3	0.87	2	0	2915	135	349	28126	674	74440
13	0.0762	0.00309	0.01182	0.00016	0.33	0.04648	0.00183	22.6	91.94	74.6	2.92	75.8	1.03	5	11	4247	195	447	35211	1028	110631
14	0.07933	0.00307	0.01196	0.00016	0.35	0.04814	0.0018	106.2	86.2	77.5	2.89	76.6	1.02	0	0	4290	204	124	10926	1033	110482
15	0.0717	0.00225	0.01199	0.00012	0.32	0.04417	0.00134	0.1	0	70.3	2.13	76.8	0.78	42	2	3632	158	499	42268	888	93326
16	0.07925	0.00292	0.01209	0.00015	0.34	0.04803	0.00171	100.9	82.15	77.4	2.75	77.5	0.97	54	0	3064	145	249	20693	737	78067
17	0.07647	0.00262	0.01187	0.00013	0.32	0.04828	0.0016	113.2	76.55	74.8	2.47	76.1	0.86	13	0	2868	136	312	23742	718	74399
18	0.07375	0.00213	0.01207	0.00011	0.32	0.04515	0.00125	0.1	18.28	72.3	2.01	77.4	0.73	4	5	4228	188	230	19216	1027	107871
19	0.07802	0.00175	0.01216	0.00009	0.33	0.04633	0.00098	14.7	49.77	76.3	1.65	77.9	0.59	13	3	7029	321	364	30861	1656	178127
20	0.07852	0.00166	0.01215	0.00009	0.35	0.04747	0.00094	72.5	47.14	76.7	1.56	77.9	0.56	14	4	7944	372	521	40287	1906	201352
Central BRX Zone porphyry dyke - DDH KL-14-165 85.7-87.5m																					
1	0.4214	0.02236	0.05902	0.00094	0.300159007	0.05357	0.00215	352.8	88.13	357.1	15.97	369.7	5.73	0	0	4977	259	464	7052	250	25637
2	0.07612	0.00177	0.01198	0.00009	0.323080841	0.04639	0.00104	17.9	52.3	74.5	1.67	76.8	0.6	20	6	7759	350	588	44796	1869	196970
3	0.08222	0.00191	0.01198	0.0001	0.359324878	0.04959	0.00111	176	51.21	80.2	1.79	76.8	0.61	27	0	5991	289	556	42236	1428	152096
4	0.07761	0.00247	0.01213	0.00013	0.336746648	0.04787	0.00148	91.7	72.61	75.9	2.33	77.7	0.83	0	0	3283	153	450	33599	800	82357
5	0.07443	0.00265	0.01183	0.00013	0.308646071	0.0453	0.00157	0.1	42.22	72.9	2.5	75.8	0.85	7	1	2898	128	169	15214	697	74560
6	0.08214	0.00448	0.01189	0.00022	0.339248168	0.04969	0.00264	180.3	119.42	80.2	4.21	76.2	1.42	10	11	1770	85	119	8716	423	45320
7	0.08011	0.00336	0.01215	0.00017	0.333595434	0.04669	0.0019	33.3	94.74	78.3	3.16	77.9	1.09	31	0	3059	139	102	9127	705	76636
8	0.103	0.00434	0.01652	0.00023	0.33041921	0.04609	0.00184	2.5	92.31	99.5	3.99	105.7	1.45	35	15	2680	120	399	20584	474	49377
9	0.07675	0.0029	0.01166	0.00015	0.340465488	0.04738	0.00174	67.9	85.72	75.1	2.73	74.8	0.96	32	0	2691	124	188	13815	657	70253

Fraction	Isotopic Ratios							Isotopic Ages						Background corrected mean counts per second at specified mass							
	$^{207}Pb/^{235}U$	% 1σ	$^{206}Pb/^{238}U$	% 1σ	rho	$^{207}Pb/^{206}Pb$	% 1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	202	204	206	207	208	232	235	238
10	0.0763	0.00204	0.01192	0.00011	0.345152323	0.04743	0.00122	70.1	60.85	74.7	1.92	76.4	0.68	21	0	4743	219	231	17288	1165	121141
11	0.07701	0.00265	0.01187	0.00014	0.34275087	0.04914	0.00164	154.5	76.43	75.3	2.5	76.1	0.91	0	0	3779	181	202	17852	953	97018
12	0.07456	0.00244	0.01183	0.00013	0.335795352	0.04725	0.0015	61.3	74.49	73	2.3	75.8	0.85	12	9	3181	146	376	29971	797	81920
13	0.07798	0.00247	0.01192	0.00013	0.344312964	0.04789	0.00147	92.9	72.21	76.2	2.33	76.4	0.83	6	0	3070	143	286	20322	745	78502
14	0.07638	0.00287	0.01189	0.00015	0.335743151	0.04759	0.00174	78.2	85.39	74.7	2.71	76.2	0.96	39	1	3602	167	282	22474	887	92353
15	0.10795	0.0055	0.01654	0.00029	0.344129933	0.05074	0.00245	229.1	107.96	104.1	5.04	105.7	1.84	39	12	2382	117	277	16336	442	43923
16	0.10907	0.00459	0.01642	0.00023	0.332849042	0.04976	0.00198	184	90.28	105.1	4.2	105	1.48	0	0	2615	126	304	16974	472	48563
17	0.11018	0.00446	0.01652	0.00022	0.328988371	0.04905	0.00188	150.4	87.4	106.1	4.08	105.6	1.4	7	13	2596	124	321	18549	457	47945
18	0.06905	0.00269	0.01201	0.00015	0.320597148	0.04333	0.00165	0.1	0	67.8	2.56	77	0.98	8	2	5098	215	853	65617	1265	129486
19	0.07623	0.00275	0.01193	0.00015	0.34853311	0.04807	0.00168	102.7	80.72	74.6	2.59	76.5	0.93	0	6	3122	146	345	26623	778	79838
20	0.08083	0.00276	0.01199	0.00014	0.34195767	0.04837	0.00159	117.3	75.89	78.9	2.59	76.8	0.89	0	4	3892	183	220	15896	921	99036
Central Klaza Zone porphyry dyke - DDH KL-11-12 181-187m																					
1	0.07448	0.00364	0.01084	0.00018	0.339767244	0.04901	0.00234	148.3	108.21	72.9	3.44	69.5	1.16	5	20	2757	131	225	19019	718	77966
2	0.07481	0.0024	0.01105	0.00012	0.338506787	0.04945	0.00153	169.4	70.65	73.3	2.27	70.8	0.79	18	8	7257	349	600	53997	1900	201387
3	0.073	0.00244	0.01118	0.00013	0.347884102	0.04887	0.00158	141.8	74.04	71.5	2.31	71.7	0.83	2	11	8464	403	641	56851	2244	232176
4	0.0792	0.00515	0.01204	0.00027	0.344869851	0.04701	0.00297	49.5	144.68	77.4	4.85	77.1	1.69	0	6	2273	104	539	37604	534	57918
5	0.06699	0.0038	0.01122	0.00019	0.298529412	0.04307	0.0024	0.1	0	65.8	3.62	71.9	1.21	34	0	2368	99	341	34958	603	64751
6	0.07674	0.00495	0.01106	0.00024	0.336412954	0.04963	0.00313	177.8	140.63	75.1	4.67	70.9	1.52	29	5	1227	59	249	22588	314	34054
7	0.07187	0.00216	0.01121	0.00011	0.326498332	0.04655	0.00134	26	66.76	70.5	2.05	71.9	0.73	0	0	9272	420	752	58934	2379	253765
8	0.07572	0.00262	0.01121	0.00014	0.360937277	0.04947	0.00166	170.4	76.31	74.1	2.48	71.9	0.86	32	12	4320	208	289	22619	1118	118276
9	0.07565	0.00187	0.0111	0.00009	0.328009828	0.04915	0.00115	154.9	53.99	74	1.77	71.2	0.6	8	0	7332	351	1037	88488	1887	202730
10	0.07119	0.00202	0.01106	0.0001	0.318648954	0.04669	0.00127	33.4	62.68	69.8	1.91	70.9	0.67	0	0	5329	242	410	34305	1385	147894
11	0.0744	0.00413	0.01111	0.00022	0.356723324	0.05107	0.00278	243.8	120.58	72.9	3.91	71.2	1.38	0	2	2417	120	199	15090	657	66888
12	0.07431	0.00265	0.01095	0.00013	0.332912897	0.04698	0.00161	47.7	80.35	72.8	2.51	70.2	0.85	0	0	9223	422	920	80042	2310	258871
13	0.0736	0.00141	0.01114	0.00007	0.327998268	0.04705	0.00083	51.5	40.78	72.1	1.34	71.4	0.45	3	17	12350	566	1332	113347	3129	340633
14	0.07094	0.00151	0.01114	0.00008	0.337379766	0.04591	0.00091	0.1	39.81	69.6	1.43	71.4	0.5	11	5	9350	418	751	70332	2398	257988
15	0.07458	0.00142	0.01116	0.00007	0.329433591	0.04805	0.00084	101.7	40.73	73	1.34	71.5	0.46	0	18	12284	574	1185	97514	3137	338457
16	0.07397	0.0022	0.01135	0.00011	0.325859031	0.04655	0.00132	25.9	65.81	72.5	2.08	72.8	0.71	0	16	6118	277	1038	85866	1526	165778
17	0.07529	0.00177	0.01127	0.00009	0.339689892	0.0496	0.00109	176.5	50.52	73.7	1.67	72.2	0.57	9	0	7123	344	563	48264	1860	194460
18	0.07442	0.00207	0.01122	0.00011	0.352467557	0.04901	0.0013	148.1	60.98	72.9	1.96	71.9	0.68	3	7	7404	353	501	46832	1933	203052
19	0.07411	0.00165	0.01121	0.00008	0.320536318	0.04865	0.00101	130.9	48	72.6	1.56	71.9	0.54	10	0	7872	373	941	76164	2048	216055
ttt	0.07248	0.00184	0.01109	0.00009	0.319676951	0.04785	0.00114	90.7	56.67	71.1	1.74	71.1	0.61	0	6	7918	368	728	60397	2072	219614
Eastern BRX Zone porphyry dyke - DDH KL-12-134 218-221.5m																					
1	0.07253	0.00674	0.01231	0.00034	0.3	0.04388	0.00401	0.1	92.74	71.1	6.38	78.9	2.15	0	0	744	32	132	10868	178	18607
2	0.08244	0.00745	0.01201	0.00032	0.29	0.04826	0.00428	111.9	196.98	80.4	6.99	77	2.02	22	0	716	33	126	9651	166	18353
3	0.11223	0.00478	0.01718	0.00024	0.33	0.04928	0.00199	161.4	91.69	108	4.36	109.8	1.55	0	26	2445	118	347	19648	426	43790
4	0.0689	0.00647	0.0121	0.00033	0.29	0.04549	0.00424	0.1	182.37	67.7	6.15	77.5	2.08	21	0	530	23	57	5774	139	13490
5	0.08195	0.00849	0.01225	0.0004	0.32	0.0503	0.00512	208.7	219.94	80	7.97	78.5	2.56	35	13	648	32	93	8795	157	16277
6	0.07507	0.00415	0.0122	0.00023	0.34	0.0457	0.00247	0.1	107.82	73.5	3.92	78.2	1.44	24	17	1405	63	236	16881	339	35437
7	0.08152	0.00661	0.01211	0.00032	0.33	0.05007	0.00399	198.5	174.99	79.6	6.21	77.6	2.07	16	0	806	39	94	8161	196	20473
8	0.11126	0.00587	0.01695	0.00029	0.32	0.04729	0.00237	63.3	115.64	107.1	5.36	108.3	1.85	0	4	1678	77	253	14575	283	30463
9	0.10709	0.00515	0.0168	0.00026	0.32	0.04667	0.00214	32.3	106.29	103.3	4.72	107.4	1.62	10	14	2180	99	262	15335	377	39906
10	0.06928	0.00672	0.01232	0.00038	0.32	0.04149	0.00394	0.1	0	68	6.38	78.9	2.39	19	1	1136	46	139	11505	270	28387
11	0.07806	0.00325	0.01231	0.00017	0.33	0.04595	0.00186	0.1	88.68	76.3	3.06	78.9	1.09	0	9	2373	107	131	9687	554	59314
12	0.07277	0.00798	0.01289	0.00045	0.32	0.04469	0.00481	0.1	171.16	71.3	7.55	82.6	2.88	21	15	753	33	141	10173	183	17971
13	0.07544	0.00993	0.01242	0.00051	0.31	0.04592	0.00594	0.1	278.95	73.8	9.38	79.6	3.24	0	3	737	33	161	10879	178	18258
14	0.08267	0.00654	0.01225	0.0003	0.31	0.04839	0.00375	118.4	173	80.7	6.13	78.5	1.89	45	0	792	37	121	10968	184	19914
15	0.10015	0.01412	0.01234	0.00061	0.35	0.05407	0.00737	373.8	280.9	96.9	13.03	79	3.91	0	0	657	34	105	8427	141	16402

Fraction	Isotopic Ratios							Isotopic Ages						Background corrected mean counts per second at specified mass							
	$^{207}Pb/^{235}U$	% 1σ	$^{206}Pb/^{238}U$	% 1σ	rho	$^{207}Pb/^{206}Pb$	% 1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	202	204	206	207	208	232	235	238
16	0.07928	0.00508	0.0121	0.00024	0.31	0.04704	0.00296	50.9	143.99	77.5	4.78	77.5	1.52	41	9	932	43	134	9851	219	23715
17	0.11182	0.00284	0.01704	0.00015	0.35	0.04773	0.00114	85	56.58	107.6	2.59	108.9	0.92	41	0	6592	309	1728	97796	1117	119019
18	0.09223	0.00926	0.01222	0.00044	0.36	0.05166	0.00503	270.6	208.22	89.6	8.61	78.3	2.8	73	0	664	33	93	5998	147	16728
19	0.08685	0.006	0.01189	0.00031	0.38	0.05622	0.00383	460.3	144.96	84.6	5.61	76.2	1.99	55	7	613	33	96	7680	157	15883
20	0.08647	0.00788	0.01207	0.00032	0.29	0.04942	0.00441	167.8	196.17	84.2	7.37	77.3	2.03	29	6	620	30	84	5436	140	15815
Far Eastern Klaza/Pearl Zone porphyry dyke - DDH KL-14-162 86.2-86.5m																					
1	0.07827	0.00191	0.01189	0.0001	0.344651452	0.04709	0.0011	53.3	55.29	76.5	1.8	76.2	0.61	46	0	6051	277	259	20298	1440	155386
2	0.07727	0.00261	0.01194	0.00014	0.347131571	0.04738	0.00155	67.8	76.58	75.6	2.46	76.5	0.86	4	0	4427	204	445	35175	1074	113202
3	0.08229	0.00186	0.01192	0.00009	0.334041459	0.05048	0.00108	217.1	49	80.3	1.74	76.4	0.6	28	0	6395	314	376	28739	1552	163878
4	0.07904	0.00183	0.0119	0.00009	0.326656564	0.04809	0.00106	103.7	51.41	77.2	1.72	76.2	0.59	3	0	6711	314	417	30824	1616	172337
5	0.08151	0.00192	0.0118	0.0001	0.359772246	0.0502	0.00113	204.4	51.36	79.6	1.8	75.6	0.62	29	6	5823	284	376	28965	1419	150761
6	0.11074	0.00335	0.01604	0.00017	0.350351733	0.04903	0.00139	149.3	64.98	106.6	3.06	102.6	1.05	0	14	11681	558	542	30614	2047	222507
7	0.1019	0.00263	0.01585	0.00014	0.342229312	0.04707	0.00114	52.5	56.96	98.5	2.42	101.4	0.87	0	6	11506	527	479	29190	2104	221925
8	0.07809	0.00284	0.01216	0.00015	0.339183539	0.04443	0.00156	0.1	0	76.3	2.68	77.9	0.94	34	0	5510	238	298	24746	1241	138511
9	0.07699	0.00226	0.01188	0.00012	0.344104764	0.04724	0.00134	60.7	66.54	75.3	2.13	76.2	0.76	0	0	7854	361	446	33974	1907	202081
10	0.08125	0.00237	0.01186	0.00012	0.346873866	0.05065	0.00142	224.8	63.52	79.3	2.22	76	0.77	10	8	3672	181	162	11947	906	94665
11	0.08182	0.0022	0.012	0.00011	0.340916667	0.04929	0.00127	161.7	58.98	79.9	2.06	76.9	0.7	0	7	4653	223	176	16420	1109	118630
12	0.07927	0.00177	0.01178	0.00009	0.342162815	0.04875	0.00103	135.9	49.06	77.5	1.67	75.5	0.58	15	12	7001	332	529	42440	1704	181784
13	0.08199	0.00177	0.01188	0.00009	0.350924499	0.04967	0.00101	179.4	46.76	80	1.66	76.1	0.55	0	15	7759	375	614	50901	1861	199932
14	0.07562	0.00185	0.01196	0.0001	0.341769864	0.0467	0.00109	33.8	54.27	74	1.75	76.7	0.62	12	0	6169	280	275	20459	1508	157848
15	0.07864	0.00188	0.01198	0.0001	0.349163499	0.04814	0.0011	106.2	52.99	76.9	1.77	76.8	0.62	7	11	6204	291	379	28025	1504	158536
16	0.07673	0.00542	0.01246	0.00029	0.329492753	0.04572	0.00315	0.1	141.25	75.1	5.11	79.8	1.85	0	5	2354	104	170	14159	555	57850
17	0.07093	0.00236	0.012	0.00012	0.300550847	0.04396	0.00142	0.1	0	69.6	2.24	76.9	0.76	3	5	5406	231	273	22454	1326	137967
18	0.07774	0.00234	0.012	0.00012	0.332222222	0.04807	0.00139	102.9	66.91	76	2.2	76.9	0.77	11	9	4768	223	279	20907	1167	121672
19	0.87863	0.02022	0.07178	0.00053	0.32084649	0.09108	0.00139	1448.2	28.84	640.2	10.93	446.9	3.17	17	20	26815	2379	1477	12699	1100	114451
20	0.08145	0.00216	0.01196	0.00011	0.346815775	0.04941	0.00125	167.3	58.02	79.5	2.03	76.6	0.7	21	18	6977	335	284	20493	1676	178794
Cyprus porphyry - 97-CH-33-3																					
1	0.07823	0.00319	0.01200	0.00018	0.37	0.04851	0.00204	76.5	3.0	76.9	1.2	124.3	96.3	0	31	4058	199	206	25117	2866	369794
2	0.07570	0.00202	0.01173	0.00011	0.35	0.04732	0.00130	74.1	1.9	75.2	0.7	65.0	64.6	0	12	7167	344	338	40058	5103	667546
3	0.07585	0.00193	0.01195	0.00011	0.36	0.04580	0.00120	74.2	1.8	76.6	0.7	0.1	48.5	39	0	7408	344	404	47264	5094	677031
4	0.07751	0.00180	0.01175	0.00010	0.37	0.04765	0.00113	75.8	1.7	75.3	0.6	81.0	56.4	85	0	8408	406	568	63811	5887	781633
5	0.07898	0.00227	0.01195	0.00013	0.38	0.04740	0.00140	77.2	2.1	76.6	0.8	69.0	69.4	14	0	8927	429	429	51214	6103	815232
6	0.07714	0.00251	0.01188	0.00014	0.36	0.04752	0.00159	75.4	2.4	76.1	0.9	74.9	78.5	85	0	6582	317	481	54016	4619	604393
7	0.07893	0.00207	0.01175	0.00011	0.36	0.04860	0.00131	77.1	2.0	75.3	0.7	128.5	62.3	0	0	7530	371	881	107359	5281	698728
8	0.07811	0.00139	0.01177	0.00008	0.38	0.04815	0.00087	76.4	1.3	75.4	0.5	106.5	42.3	0	0	10572	517	731	89253	7423	979639
9	0.07701	0.00153	0.01155	0.00009	0.39	0.04836	0.00098	75.3	1.4	74.1	0.6	116.8	47.2	0	1	10923	537	658	82360	7814	1030032
10	0.07753	0.00610	0.01139	0.00028	0.31	0.04750	0.00383	75.8	5.8	73.0	1.8	73.9	181.9	0	0	827	39	117	16137	577	79103
11	0.07882	0.00172	0.01193	0.00010	0.38	0.04750	0.00106	77.0	1.6	76.4	0.6	73.8	52.9	15	6	8534	412	591	70917	5859	779124
12	0.07273	0.00292	0.01184	0.00016	0.34	0.04439	0.00182	71.3	2.8	75.9	1.0	0.1	8.5	0	11	3281	148	1781	211812	2281	301746
13	0.07789	0.00177	0.01200	0.00010	0.37	0.04794	0.00111	76.2	1.7	76.9	0.7	95.1	55.2	58	24	7898	385	485	60332	5537	715886
14	0.07904	0.00163	0.01183	0.00009	0.37	0.04854	0.00102	77.2	1.5	75.8	0.6	125.5	48.8	22	0	8236	406	424	53690	5762	756780
15	0.07945	0.00160	0.01145	0.00009	0.39	0.04968	0.00102	77.6	1.5	73.4	0.6	180.0	47.3	21	13	10015	506	758	90551	7134	950501
16	0.07935	0.00166	0.01192	0.00009	0.36	0.04778	0.00102	77.5	1.6	76.4	0.6	87.4	50.9	38	15	9466	460	567	67342	6494	862678
17	0.08048	0.00245	0.01202	0.00014	0.38	0.04931	0.00155	78.6	2.3	77.0	0.9	162.4	71.8	2	17	10521	528	496	67269	7344	950693
18	0.07165	0.00234	0.01198	0.00013	0.33	0.04314	0.00144	70.3	2.2	76.8	0.8	0.1	0.0	1	0	4580	201	272	32364	3142	415040
19	0.07959	0.00240	0.01178	0.00013	0.37	0.04898	0.00152	77.8	2.3	75.5	0.9	147.0	71.1	35	15	7221	360	405	43613	5064	665072
20	0.07719	0.00254	0.01185	0.00014	0.36	0.04751	0.00161	75.5	2.4	75.9	0.9	74.0	79.4	0	15	8200	396	579	76078	5750	750960

Fraction	Isotopic Ratios							Isotopic Ages						Background corrected mean counts per second at specified mass							
	$^{207}Pb/^{235}U$	% 1σ	$^{206}Pb/^{238}U$	% 1σ	rho	$^{207}Pb/^{206}Pb$	% 1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	202	204	206	207	208	232	235	238
Mt. Nansen - Weber Zone porphyry dyke - 97-VIK-41																					
1	0.11622	0.00205	0.01686	0.0001	0.34	0.04938	0.00086	166.1	40.26	111.6	1.87	107.8	0.65	100	24	12054	604	5903	271666	3360	472169
2	0.10882	0.00201	0.01675	0.00011	0.36	0.04718	0.00086	57.9	43.49	104.9	1.84	107.1	0.67	0	0	12377	593	1682	88518	3520	488017
3	0.37652	0.00348	0.05209	0.00017	0.35	0.05173	0.00042	273.7	18.41	324.5	2.57	327.4	1.05	49	28	107919	5675	18825	282402	9725	1367797
4	0.10947	0.00257	0.01652	0.00013	0.34	0.04683	0.00109	40.4	53.84	105.5	2.36	105.6	0.84	49	48	12368	588	2916	126309	3470	494365
5	0.11301	0.00247	0.01617	0.00013	0.37	0.0502	0.00109	204.2	49.52	108.7	2.26	103.4	0.81	54	33	17940	915	3187	155430	5225	732383
6	0.1091	0.00341	0.01688	0.00018	0.34	0.04748	0.00147	72.7	72.62	105.1	3.12	107.9	1.14	11	18	9949	480	1859	75784	2839	388812
7	0.1117	0.00371	0.01685	0.0002	0.36	0.04762	0.00156	79.5	76.83	107.5	3.38	107.7	1.25	19	0	14532	704	2557	130584	4061	568758
8	0.1101	0.00259	0.01623	0.00013	0.34	0.04775	0.00111	86.2	55.28	106.1	2.37	103.8	0.86	0	41	15475	752	30213	1370423	4400	628805
9	0.1117	0.00177	0.01681	0.00009	0.34	0.04829	0.00076	113.7	36.57	107.5	1.62	107.5	0.59	14	35	12343	607	8736	393269	3498	484000
10	0.10929	0.00155	0.01681	0.00008	0.34	0.04696	0.00066	46.7	32.64	105.3	1.42	107.5	0.53	95	0	21874	1046	16503	749173	6161	857643
11	0.11399	0.00153	0.01675	0.00008	0.36	0.04982	0.00066	186.6	30.45	109.6	1.39	107.1	0.53	1	11	30706	1560	36053	1691828	8796	1207075
12	0.10762	0.00157	0.01659	0.00009	0.37	0.04711	0.00068	54.4	33.38	103.8	1.44	106.1	0.55	37	0	33669	1618	39525	2042991	9659	1335921
13	0.10744	0.00233	0.01641	0.00013	0.37	0.04815	0.00103	106.8	49.87	103.6	2.13	105	0.81	55	0	26875	1320	16315	842788	7893	1077725
14	0.11181	0.00151	0.01683	0.00008	0.35	0.04725	0.00063	61.6	30.83	107.6	1.38	107.6	0.51	18	9	22550	1087	3211	142410	6245	881542
15	0.11593	0.00216	0.01673	0.00011	0.35	0.04997	0.00092	193.4	42.14	111.4	1.96	106.9	0.71	0	0	16180	825	14023	598261	4569	636482
16	0.39148	0.00203	0.05341	0.00011	0.40	0.05245	0.00025	305.2	10.65	335.4	1.48	335.4	0.69	0	12	354473	18990	11302	162561	31120	4366004
17	0.11003	0.00406	0.01678	0.00021	0.34	0.04646	0.00169	21.5	85.29	106	3.71	107.3	1.35	0	6	10115	480	6752	290829	2798	396492
18	0.10786	0.00186	0.01589	0.00009	0.33	0.04757	0.00081	77.1	40.71	104	1.7	101.7	0.59	42	13	12246	595	2856	130622	3538	506584
19	0.11267	0.00265	0.0167	0.00014	0.36	0.04852	0.00113	124.8	53.9	108.4	2.42	106.8	0.88	29	0	13591	674	3025	143236	3834	534812
20	0.10673	0.00381	0.01679	0.00021	0.35	0.04628	0.00163	12.1	81.71	103	3.49	107.3	1.32	0	0	12271	580	9596	414715	3485	480350
21	0.10925	0.00253	0.01682	0.00013	0.33	0.04661	0.00107	29	53.27	105.3	2.32	107.6	0.85	38	6	13523	644	6781	314510	3778	528108
Mt. Nansen - Brown-McDade Zone porphyry dyke - 97-VIK-50																					
1	0.1541	0.00195	0.017	0.00009	0.42	0.06621	0.00083	812.9	25.96	145.5	1.72	108.7	0.55	80	1	20267	1340	6383	234736	5733	797876
2	0.1204	0.00257	0.0166	0.00012	0.34	0.05156	0.00109	265.7	47.88	115.4	2.33	106.1	0.78	89	34	10529	542	8336	355830	2968	424498
3	0.11153	0.00191	0.01686	0.0001	0.35	0.04799	0.00081	97.4	40.87	107.4	1.74	107.8	0.62	170	0	14668	703	2465	108137	4154	582055
4	0.11731	0.00408	0.01668	0.0002	0.34	0.04989	0.00171	189.8	78.04	112.6	3.7	106.7	1.29	47	7	12135	605	2160	99934	3397	486530
5	0.11672	0.00366	0.01678	0.00018	0.34	0.04981	0.00155	186.1	70.74	112.1	3.33	107.3	1.17	12	0	11396	567	2831	125265	3201	454282
6	0.11181	0.0024	0.01687	0.00012	0.33	0.04843	0.00103	120.5	49.44	107.6	2.19	107.9	0.77	62	22	10951	530	2834	129312	3122	433859
7	0.12392	0.00215	0.01677	0.00011	0.38	0.05386	0.00093	365.2	38.47	118.6	1.94	107.2	0.68	0	0	21807	1176	12607	561864	6238	868993
8	0.113	0.00236	0.01691	0.00012	0.34	0.04831	0.001	114.3	48.04	108.7	2.15	108.1	0.77	30	14	12928	625	3307	139039	3637	510714
9	0.11333	0.00233	0.01684	0.00011	0.32	0.04876	0.00099	136.2	47.24	109	2.12	107.7	0.72	66	31	9535	465	1874	81384	2699	378233
10	0.08741	0.00798	0.01671	0.00033	0.22	0.03812	0.00347	0.1	0	85.1	7.45	106.8	2.12	52	0	2214	84	686	33952	635	88497
11	0.11359	0.00224	0.0168	0.00012	0.36	0.04833	0.00094	115.6	45.39	109.2	2.04	107.4	0.75	52	0	26295	1274	18559	842315	7360	1044630
12	0.11154	0.0022	0.01676	0.00012	0.36	0.04925	0.00096	159.8	45.14	107.4	2.01	107.1	0.73	0	15	16401	810	7649	328817	4763	653059
13	0.12065	0.00234	0.01681	0.00012	0.37	0.05149	0.00099	262.9	43.61	115.7	2.12	107.5	0.73	0	0	10623	548	2288	99116	2982	421409
14	0.11116	0.0016	0.01684	0.00008	0.33	0.04766	0.00068	81.4	34.37	107	1.46	107.6	0.52	23	14	16174	773	4043	174440	4560	640548
15	0.11204	0.00183	0.0169	0.00009	0.33	0.04743	0.00077	70.3	38.6	107.8	1.67	108	0.59	21	5	12471	594	2761	124309	3472	492136
16	0.11209	0.00152	0.01684	0.00008	0.35	0.04778	0.00064	87.6	32.43	107.9	1.38	107.7	0.51	0	0	27343	1312	20987	968835	7664	1081990
17	0.1071	0.00236	0.01682	0.00012	0.32	0.04675	0.00102	36.2	50.88	103.3	2.17	107.5	0.78	12	0	10097	474	7130	297126	2897	399998
18	0.11516	0.00215	0.01684	0.00011	0.35	0.04868	0.0009	132.6	42.87	110.7	1.96	107.7	0.68	123	0	11597	567	2010	81549	3223	458584
19	0.11107	0.00289	0.01677	0.00015	0.34	0.04711	0.00121	54.4	60.77	106.9	2.64	107.2	0.94	121	22	11220	531	1640	73941	3128	445418
20	0.11466	0.002	0.01681	0.00011	0.38	0.05039	0.00087	212.9	39.57	110.2	1.82	107.5	0.68	0	0	28797	1459	26846	1200323	8319	1140298

Appendix 2. *Pb isotopic analyses of igneous feldspar from the Cyprus porphyry and galenas from the Klaza and Brown-McDade clusters. Errors are given at the 1σ level.*

Sample	$^{206}Pb/^{204}Pb$	error	$^{207}Pb/^{204}Pb$	error	$^{208}Pb/^{204}Pb$	error	$^{207}Pb/^{206}Pb$	error	$^{208}Pb/^{206}Pb$	error
Cyprus porphyry feldspar (97CH33-3)	19.267	0.09	15.6602	0.04	39.0727	0.1	0.8128	0.085	2.028	0.028
Brown-McDade - Dickson Zone galena	18.829	0.012	15.634	0.011	38.552	0.013	0.8303	0.005	2.0475	0.003
Brown-McDade - Flex Zone galena	19.156	0.006	15.64	0.005	38.816	0.009	0.8165	0.003	2.0263	0.007
Brown-McDade - Heustis Zone galena	19.186	0.002	15.672	0.002	38.92	0.002	0.8168	0.001	2.0285	0.001
Klaza - Pika vein galena	19.1485	0.01	15.685	0.01	38.9112	0.01	0.8191	0.008	2.0321	0.007
Klaza - KL11-12-196 galena	19.1859	0.01	15.7165	0.01	39.026	0.02	0.8192	0.006	2.0341	0.011
Klaza - KL14-165 galena	19.1518	0.01	15.68	0.01	38.9108	0.01	0.8187	0.005	2.0317	0.006