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A.S. Rukhlov and J.G. Pawlowicz

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Energy Resources Conservation Board
Alberta Geological Survey
4th Floor, Twin Atria Building
4999 – 98th Avenue
Edmonton, AB T6B 2X3
Canada

Tel: 780.422.1927
Fax: 780.422.1918
E-mail: AGS-Info@ercb.ca
Website: www.ags.gov.ab.ca

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## Abstract

This report provides results and interpretation of whole-rock and in situ geochemical and quantitative mineralogical analyses for samples of magmatic and sedimentary rocks from the Rocky Mountain foreland fold-and-thrust belt of the Canadian Cordillera in southwestern Alberta. This work was completed as part of an Energy Resources Conservation Board/Alberta Geological Survey project on metallic mineral resources in Alberta. We carried out in situ geochemical analyses using a portable X-ray fluorescence (PXRF) analyzer. Rietveld X-ray diffraction and mineral liberation analyses (MLA) were used for the quantitative mineralogical characterization of selected samples. Analyzed samples came from outcrops of the

- Mesoproterozoic Belt-Purcell Supergroup and mafic sills and dikes, and the Cretaceous alkaline sills and dikes in the Clark Range;
- Crowsnest Formation volcanic and epiclastic rocks in the Crowsnest Pass area;
- Oldman River Mississippi Valley–type Pb-Zn prospect within the Upper Devonian Palliser Formation dolomitized limestone on the east flank of Mount Gass; and
- overlying Devonian–Mississippian Exshaw Formation black shale.

The documented styles of precious- and base-metal mineralization reflect metallogenic events related to Mesoproterozoic intracontinental rifting and basaltic magmatism, anoxic basins along the Paleozoic rifted continental margin, Cordilleran alkaline magmatism, and postorogenic collapse faulting. Based on geochemical and petrological evidence, we propose that the Belt-Purcell intracontinental rifting was accompanied by voluminous tholeiitic- to alkali-basalt magmatism and might have been triggered by a Mesoproterozoic mantle plume.

# 1 Introduction

Metallic mineralization was first discovered in southwestern Alberta in the late 19th century (Dawson, 1886). Several old Cu, Pb, Zn, Ag and Au mines and prospects occur within Waterton Lakes and Banff national parks (Hedley, 1954; Evans et al., 1968; Goble, 1974a; La Casse and Roebuck, 1978). Many base- and precious-metal mineral occurrences were subsequently discovered and explored in southwestern Alberta during the second half of the 20th century (e.g., Carter and Irvine, 1971; Halferdahl, 1971; Morton et al., 1974; Salat, 1988; Williamson et al., 1993; Graf, 1997).

In 2008, the Energy Resources Conservation Board/Alberta Geological Survey (ERCB/AGS) initiated a project to further evaluate the metallic-mineral potential in Alberta. In addition to the compilation of publicly available data and information (Rukhlov and Eccles, 2010; Rukhlov, 2011), AGS carried out field, microscopic, electron microprobe, quantitative mineralogical, and geochemical studies of selected formations and magmatic rocks to better understand the tectonic evolution, depositional environments, recurrent magmatic-hydrothermal activity, and metallic-mineral resource potential of southwestern Alberta (e.g., Rukhlov et al., 2010).

This report presents the results of new geochemical and quantitative mineralogical analyses on rock samples collected in the Rocky Mountain foreland fold-and-thrust belt of the Canadian Cordillera of southwestern Alberta during 2008 and 2009. Geological units examined in outcrop and sampled include

- sedimentary and volcanic strata of the Mesoproterozoic Belt-Purcell Supergroup, deposited in an intracontinental rift basin, and syn-rifting basaltic sills and dikes (Ross et al., 1989; Hein et al., 1994; Goble et al., 1999a; Lydon, 2007);
- dolomitized limestone of the Upper Devonian Palliser Formation from the Oldman River Mississippi Valley–type (MVT) Pb-Zn prospect (Hedley, 1954; Holter, 1973; Sangster, 1995, 1996; Graf, 1997; Pană, 2006);
- overlying Devonian–Mississippian Exshaw Formation black shale (Richards et al., 1994); and
- volcanic and epiclastic rocks of the Cretaceous Crowsnest Formation and coeval, compositionally similar, alkali trachyte and phonolite sills and dikes (e.g., Dawson, 1886; Pearce, 1970; Peterson et al., 1997; Goble et al., 1999b; Bowerman et al., 2006).

The examined occurrences were chosen so as to encompass the stratigraphy and distinct styles of metallic mineralization known in the region from historical data and identified during the recent AGS work.

# 2 Sample Location and Description

Figure 1 shows the locations of the 21 rock-sample sites on a simplified bedrock geology map of the Rocky Mountain foreland fold-and-thrust belt in the study area (after Hamilton et al., 1999). Table 1 and Appendix 1 list the site locations and sample descriptions.

The rock samples include both channel and grab samples collected from outcrops, and one float sample (Appendix 1). Some of the examined outcrops (sites RM01, 03, 04, 06–10, 13–17, 19–21) are metallic mineral occurrences or prospects discovered during the 1900s (e.g., Hedley, 1954; Evans et al., 1968; Carter and Irvine, 1971; Halferdahl, 1971; Holter, 1973; Goble, 1974a–c; Morton et al., 1974; Salat, 1988; Williamson et al., 1993; Graf, 1997). Rukhlov (2011) summarized historical information on these mineral occurrences and prospects.

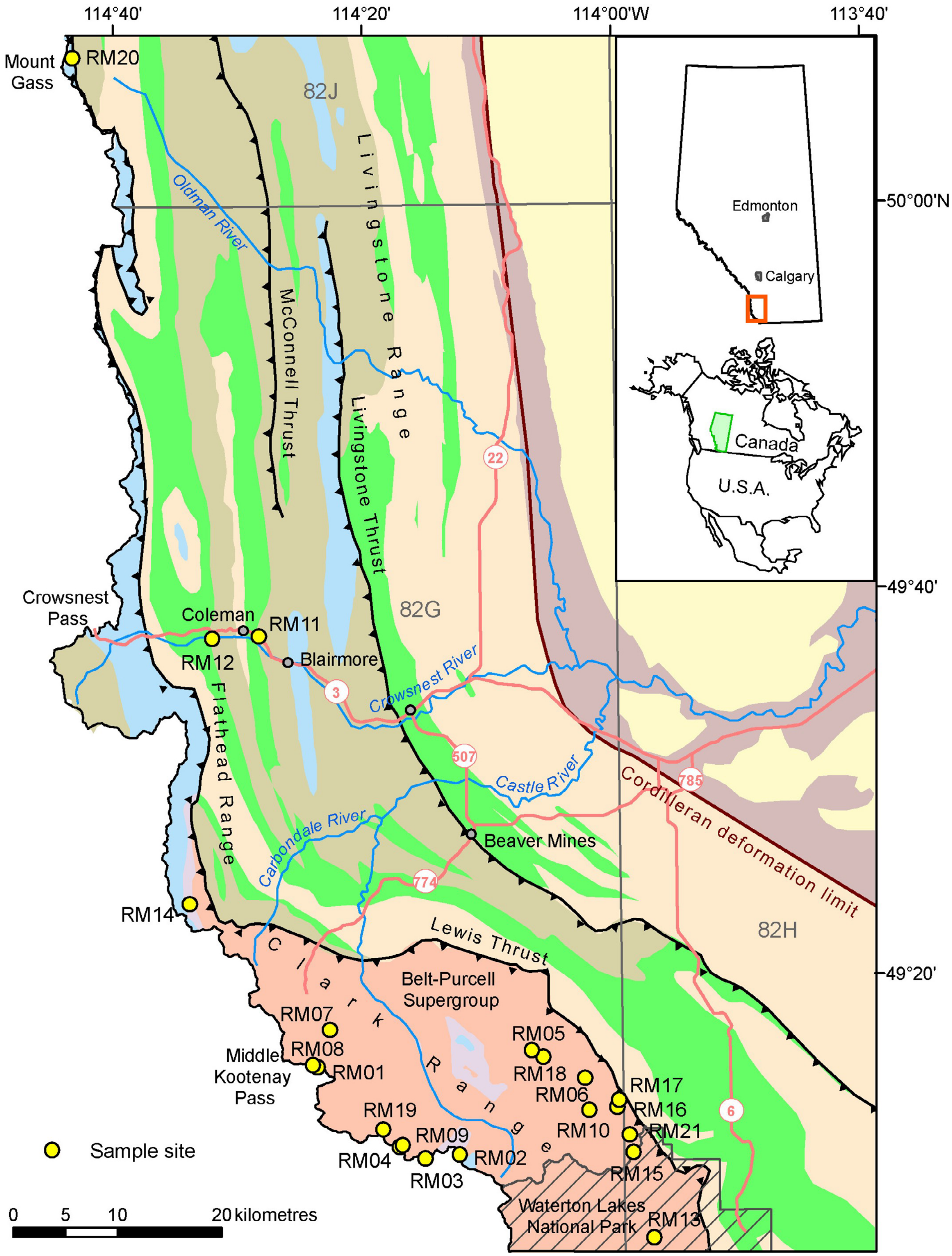


**Figure 1. Simplified bedrock geology of the study area (after Hamilton et al., 1999), with locations of rock-sample sites. See Table 1 and Appendix 1 for a list of all sites and samples, Appendix 2 for the types of analyses run on the samples, and Hamilton et al. (1999) for a complete legend for the geological map of Alberta at 1:1 000 000 scale.**

**Table 1. Locations of rock-sample sites in southwestern Alberta (see Figure 1).**

| Site | Area | Location | UTM Location (NAD 83) | | | Elevation (m asl) | Month | Year | No.of samples |
|---|---|---|---|---|---|---|---|---|---|
| | | | Easting | Northing | Zone | | | | |
| RM01 | Clark Range | Middle Kootenay Pass | 689039 | 5459435 | 11 | 2060 | Aug. | 2008 | 8 |
| RM02 | Clark Range | Font Creek | 702879 | 5451445 | 11 | 2052 | Aug. | 2008 | 3 |
| RM03 | Clark Range | Jutland Brook | 699614 | 5451005 | 11 | 2152 | Aug. | 2008 | 4 |
| RM04 | Clark Range | La Coulotte Ridge | 697134 | 5452029 | 11 | 2137 | Aug. | 2008 | 5 |
| RM05 | Clark Range | Drywood Creek | 710662 | 5461052 | 11 | 1696 | Aug. | 2008 | 1 |
| RM06 | Clark Range | South Drywood Creek | 714686 | 5459123 | 11 | 1716 | Aug. | 2008 | 5 |
| RM07 | Clark Range | Southwest flank of Barnaby Ridge | 690113 | 5463038 | 11 | 1586 | Aug. | 2008 | 8 |
| RM08 | Clark Range | Middle Kootenay Pass | 688586 | 5459653 | 11 | 2086 | Aug. | 2008 | 4 |
| RM09 | Clark Range | La Coulotte Ridge | 697419 | 5452219 | 11 | 1988 | Aug. | 2008 | 3 |
| RM10 | Clark Range | Spionkop Creek | 715215 | 5456054 | 11 | 1774 | Aug. | 2008 | 1 |
| RM11 | Crowsnest Pass | Coleman, Hwy. 3 roadcut | 682285 | 5500537 | 11 | 1322 | Apr. | 2008 | 3 |
| RM12 | Crowsnest Pass | Star Creek | 677845 | 5500212 | 11 | 1402 | Apr. | 2008 | 4 |
| RM13 | Waterton | Coppermine Creek | 283874 | 5443815 | 12 | 1521 | Aug. | 2009 | 5 |
| RM14 | Clark Range | Carbondale River | 676387 | 5474707 | 11 | 1881 | Aug. | 2009 | 7 |
| RM15 | Clark Range | Cloudy Ridge | 282344 | 5452096 | 12 | 1869 | Aug. | 2009 | 7 |
| RM16 | Clark Range | Spionkop Ridge | 717877 | 5456456 | 11 | 1956 | Aug. | 2009 | 3 |
| RM17 | Clark Range | Spionkop Ridge | 718024 | 5457141 | 11 | 2046 | Aug. | 2009 | 3 |
| RM18 | Clark Range | Pincher Ridge | 709544 | 5461663 | 11 | 2320 | Aug. | 2009 | 6 |
| RM19 | Clark Range | La Coulotte Peak | 695519 | 5453659 | 11 | 2260 | Aug. | 2009 | 12 |
| RM20 | Oldman River | Mount Gass–Oldman River | 662953 | 5555447 | 11 | 2368 | Aug. | 2009 | 11 |
| RM21 | Clark Range | Yarrow Creek | 282046 | 5453748 | 12 | 1607 | Sep. | 2009 | 6 |

# 3 Geological Summary of the Study Area

## 3.1 Bedrock Geology and Tectonic Setting

The Rocky Mountain foreland fold-and-thrust belt of the Canadian Cordillera in southwestern Alberta contains Proterozoic, Paleozoic, Mesozoic and Cenozoic strata of the Western Canada Sedimentary Basin, which were deformed, imbricated and transported northeastward by Middle Jurassic to Eocene Cordilleran tectonism (Figure 1; Ross et al., 1989; Hein et al., 1994, Price and Sears, 2000). This stratigraphy records about 1.5 billion years of evolution in western Laurentia (ancestral North America) during three main tectonic phases: 1) Mesoproterozoic intracontinental rift, 2) Neoproterozoic to Early Jurassic rifted continental margin, and 3) Middle Jurassic to Oligocene foreland basin (e.g., Price, 1994; Ross and Eaton, 1999; Price and Sears, 2000; Nelson and Colpron, 2007).

The Mesoproterozoic (1.47–1.40 Ga) Belt-Purcell Supergroup, comprising a thick (15–20 km), predominantly siliciclastic succession, formed in a branching intracontinental rift, with a northwest-trending main branch extending from the northwestern United States into southern Canada and a prominent east-northeast-trending arm (Helena embayment) extending along the Central Montana trough in the southeast (e.g., Sears and Price, 1978; Winston et al., 1984; Anderson and Parrish, 2000; Chandler, 2000; Evans et al., 2000; Höy et al., 2000; Price and Sears, 2000; Sears and Price, 2003; Ross and Villeneuve, 2003; Lydon, 2007). A thick basin-plain turbidite fill and voluminous syn-rift mafic sills distinguish the symmetrical northwest-trending main branch from the asymmetrical Helena embayment (Price and Sears, 2000; Lydon, 2007). Relicts of a southwest-trending arm are preserved in the Salmon River arch to the southwest in Idaho (Doughty and Chamberlain, 1996).

In southwestern Alberta, the Mesoproterozoic rocks (Figure 1) represent the northeastern edge of the main branch of the Belt-Purcell Basin that has been detached from its basement and displaced northeastward for about 140 km over the craton in the Lewis thrust sheet during the Mesozoic orogenesis (e.g., Price, 1964; McMechan, 1981; Hein et al., 1994; Price and Sears, 2000). The preserved Belt-Purcell strata within this salient of the Lewis thrust sheet (Figure 2) are more than 5 km thick, with stratigraphic wedges outlining the margins of a northeastward-projecting sub-basin in the main branch of the basin (Price, 1964; McMechan, 1981; Price and Sears, 2000). These strata consist of shallow-water carbonate shelf rocks with subordinate clastic rocks (lateral equivalents of the deep-water rift-fill turbidites of the Aldridge Formation to the west in British Columbia), overlain by flood-plain argillites and siltites, transgressive carbonate platform rocks and shallow-water to subaerial lagoonal and fluviatile mudstones, carbonates and sandstones (e.g., Price, 1964; McMechan, 1981; Ross et al., 1989; Hein et al., 1994; Lydon, 2007). Pillowed, amygdaloidal and massive basaltic lava flows (Purcell Lava), up to 150 m thick, occur in the middle of the Belt-Purcell succession (Price, 1964). In the study area, the Belt-Purcell strata are unconformably overlain by a succession of Paleozoic shales and carbonate rocks, with the Middle Cambrian quartz sandstone of the Flathead Formation at its base (Price, 1964; McMechan, 1981).

The basement that underlies the Belt-Purcell Basin consists of the Archean, Paleoproterozoic and Mesoproterozoic terranes, with the age of the Priest River Complex orthogneiss (1.57 Ga) of Washington and Idaho and the younger detrital zircons in the lower Belt-Purcell strata (1.50 Ga) constraining the upper limit for the onset of Belt-Purcell deposition (e.g., Ross et al., 1991; Villeneuve et al., 1993; Doughty et al., 1998; Ross and Eaton, 1999; Anderson and Parrish, 2000; Buhlmann et al., 2000; Burwash et al., 2000; Ross and Villeneuve, 2003; Foster et al., 2006; Stewart et al., 2010). Development of the Belt-Purcell Basin involved rift-parallel normal and transfer syndepositional faulting (Höy et al., 2000; Lydon, 2007). The palinspastically restored outline of the Belt-Purcell Basin intersects the Cordilleran continental margin and truncates both the northwest-trending Archean and the northeast-trending Paleoproterozoic structures manifested by the geophysical discontinuities in the basement (e.g., Ross et al., 1991; Ross and Eaton, 1999; Price and Sears, 2000). Although these basement structures may not have controlled the large-scale structure of the rift basin, reactivation of the northeast- trending

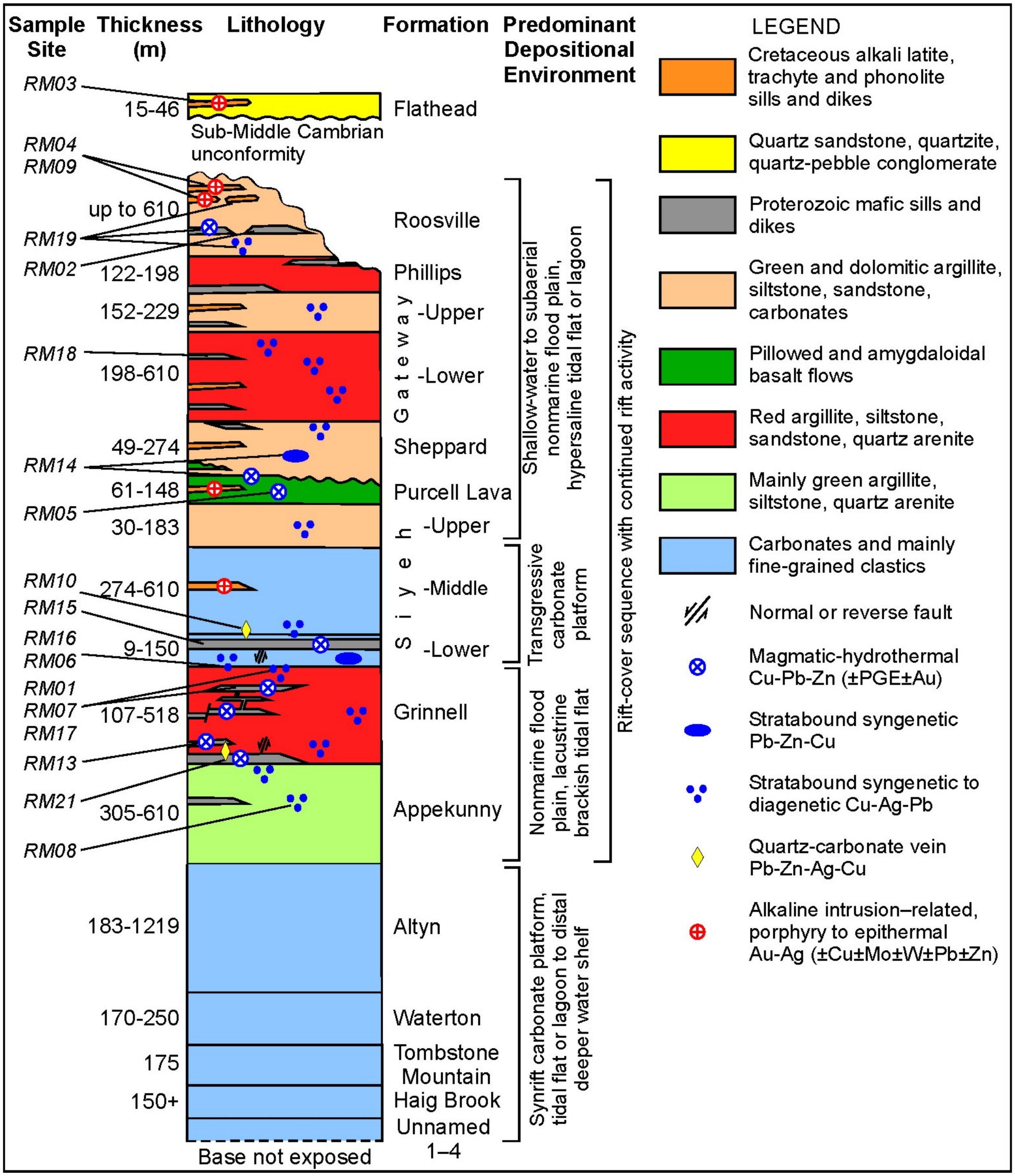


**Figure 2. Generalized stratigraphy (not to scale) of the Belt-Purcell Supergroup (after Price, 1964; Ross et al., 1989), sample-site locations, and distribution of Proterozoic mafic and Cretaceous alkaline sills and dikes and metallic mineralization (modified after Halferdahl, 1971; Morton et al., 1974; Williamson et al., 1993; Goble et al., 1999a, b) in the Clark Range area of southwestern Alberta. See Figure 1 and Table 1 for geographic locations of all sample sites.**

basement structures influenced the detailed configuration of the rift basin and several syndepositional, northeast-trending transform faults that segmented the axis of the Belt-Purcell Basin (Goble et al., 1999a; Höy et al., 2000; Chandler, 2000; Price and Sears, 2000; Ross and Villeneuve, 2003; Sears and Price, 2003; Lydon, 2007).

For example, the Paleoproterozoic Vulcan structure, a major northeast-trending graben-like structure in the basement of southern Alberta, is aligned with the marginal embayment of the Belt-Purcell Basin that is preserved in the salient of the Lewis thrust sheet, and with the syndepositional extensional faults within the axial zone of the rift basin that controlled the Sullivan deposit (Kanasewich, 1968; Höy et al., 2000; Price and Sears, 2000; Ross and Villeneuve, 2003; Lydon, 2007). The prominent east-northeast-trending Helena embayment is bounded to the south by a right-hand transfer fault along the uplifted margin of the Archean Wyoming craton and to the north by the Lewis and Clark Fault Zone, which comprises a complex, long-lived series of strike-slip and oblique-slip faults along the southern margin of the Medicine Hat basement of the Archean Hearne craton (Price and Sears, 2000; Foster et al., 2006). Therefore, the Helena embayment largely coincides with the northeast-trending Paleoproterozoic Great Falls Tectonic Zone, which is bounded by these structures and interpreted to mark either a cryptic suture or a shear zone between the Archean Wyoming and Medicine Hat–Hearne cratons (O'Neil and Lopez, 1985; Ross et al., 1991; Boerner et al., 1998; Foster et al., 2006).

The Mesoproterozoic Belt-Purcell rocks of the study area are generally unmetamorphosed. Elsewhere in the Belt-Purcell Basin, these rocks are at low metamorphic grade, except for the regions in the southern and western parts of the basin (McMechan and Price, 1982; Doughty and Chamberlain, 1996; Anderson and Parrish, 2000; Ross and Villeneuve, 2003). The regional metamorphic grade of the Belt-Purcell rocks generally increases with stratigraphic depth, reflecting burial diagenesis and metamorphism (Doughty and Chamberlain, 1996; Lydon, 2007). At least two enigmatic episodes of regional burial metamorphism have affected rocks of the Belt-Purcell Supergroup: 1) the 'East Kootenay Orogeny' (1.37–1.30 Ga), reflecting burial of a thick (11–20 km) sedimentary pile in the rift basin with high geothermal gradient (38–45$^{o}$C/km), accompanied by renewed basin subsidence and voluminous bimodal magmatism; and 2) the Grenville-age event (1.1–1.0 Ga) recorded by radiometric dates from mafic sills and related to assembly of the Rodinia supercontinent (e.g., McMechan and Price, 1982; Anderson and Davis, 1995; Doughty and Chamberlain, 1996; Anderson and Parrish, 2000; Evans et al., 2000; Price and Sears, 2000; Schandl and Davis, 2000; Ross and Villeneuve, 2003; Lydon, 2007; Zirakparvar et al., 2010).

The Neoproterozoic to Lower Cambrian successions, which unconformably overlie these Mesoproterozoic rocks, record episodic rifting followed by the break-up of Rodinia from 750 to 570 Ma and the subsequent development of the proto-Pacific passive margin along northwestern Laurentia (e.g., Sears and Price, 1978, 2003; Bond and Kominz, 1984; Bond et al., 1985; Arnott and Hein, 1986; Ross et al., 1989; Dalziel, 1991; Hein et al., 1994; Colpron et al., 2002). During the Middle Cambrian to Early Jurassic, evolution along this margin involved extensional tectonism and rift-related magmatism, with subsequent development of arcs and marginal basins, which created elongate shale-filled basins that were flanked to the east by shallow carbonate platforms (e.g., Pell, 1994; Price, 1994; Sears and Price, 2003; Nelson and Colpron, 2007). The inherited northeast-trending basement structures have been reactivated as crustal-scale transform and block faults during the Neoproterozoic and Early Paleozoic rifting and subsidence along the continental margin (Ross and Eaton, 1999; Price and Sears, 2000; Ross and Villeneuve, 2003). The Vulcan structure served as a major transform fault system that accommodated a 200 km right-hand offset in the rifted margin, with more than 10 km of throw during the Neoproterozoic and the Vendian/Early Cambrian to Late Devonian (Price and Sears, 2000; Ross and Villeneuve, 2003).

During the Middle Jurassic to Paleocene, compression and thickening of the accretionary wedge due to the oblique convergence with the continent transformed the western margin of North America into the Cordilleran Orogen (Price and Sears, 2000). To the east, the foreland basin was filled by Middle Jurassic to Oligocene clastic detritus derived from the west (e.g., Price, 1994; Pană, 2006). In the study area, the

Cordilleran foreland basin includes the Albian alkaline volcanic and epiclastic rocks of the Crowsnest Formation (e.g., Dawson, 1886; Pearce, 1970; Peterson et al., 1997; Goble et al., 1999b; Bowerman et al., 2006). The Cordilleran orogenesis involved episodes of Late Jurassic–Early Cretaceous left-lateral and Late Cretaceous–Paleocene right-lateral transpression, followed by an episode of Eocene right-lateral transtension (Price, 1994; Price and Sears, 2000; Larson et al., 2006). During the Mesozoic thrusting and basin inversion, the long-lived northeast-trending structures were reactivated as right-hand reverse faults (Price and Sears, 2000). The Lewis and Clark Fault Zone served as a major transfer structure during the Eocene episode of crustal extension and right-lateral shear (Foster et al., 2006).

## 3.2 Recurrent Magmatism of Southwestern Alberta

Magmatic rocks of at least two age groups occur in the study area:

- Mesoproterozoic (ca. 1.47–1.43 Ga) olivine-tholeiitic and alkali-olivine basalt sills and dikes (up to 25 m thick) and Purcell Lava flows (Figure 3; Price, 1964; Höy, 1989; Anderson and Davis, 1995; Goble et al., 1999a; Anderson and Goodfellow, 2000; Evans et al., 2000; Höy et al., 2000)
- Cretaceous (ca. 99 Ma) porphyritic alkali trachyte and phonolite sills and dikes (a few metres thick) and Crowsnest Formation volcanic and epiclastic rocks (Figure 4; Pearce, 1970; Peterson et al., 1997; Goble et al., 1999b; Bowerman et al., 2006).

The Mesoproterozoic mafic intrusions were intermittently emplaced at a shallow depth into unconsolidated sediment in an intracontinental-rift environment, contemporaneous with synrift faulting and outpouring of the basaltic Purcell Lava flows (Höy, 1989; Goble et al., 1999a; Anderson and Goodfellow, 2000; Höy et al., 2000; Lydon, 2007). In the study area, these intrusions occur within much of the rift-margin succession of the Belt-Purcell

Supergroup (Figure 2). Along the rift axis in the Purcell Mountains of southeastern British Columbia, the Mesoproterozoic intrusions, known as 'Moyie sills' or 'Purcell sills', are intercalated with Fort Steele Formation fluvial quartzites and Aldridge Formation turbidites of the basal Belt-Purcell rift sequence (e.g., Höy, 1989; Höy et al., 2000). The 'Moyie sills' comprise mainly sills, dikes and locally thick, lensoid bodies. Some of these intrusions are up to several hundred metres thick and persist laterally for tens of kilometres, with aggregate thicknesses of >2 km (Höy, 1989). They consist of coarse-grained gabbro and diorite with fine-grained margins. The central parts of some of these intrusions are composed of quartz diorite or biotite granodioritic granophyre (Höy, 1989).

Figure 3 shows outcrop photographs and photomicrographs of a selection of Mesoproterozoic intrusions and Purcell Lavas exposed in the Clark Range of southwestern Alberta. These rocks are dark green to black and massive or amygdaloidal, with cryptocrystalline to medium-grained, glomeroporphyritic and ophitic textures. Olivine, typically pseudomorphed by iddingsite, chlorite or serpentine, and augite are common phenocryst phases. Some intrusions also contain plagioclase phenocrysts, which occasionally form quench stellate rosettes (up to 10 cm in diameter) and brown hornblende. Based on microprobe analyses (not presented in this report), the latter corresponds to ferritschermakite, ferrimagnesiohastingsite or magnesiohastingsite, with the majority being Ti rich. The groundmass is composed of the same minerals with ubiquitous skeletal ilmenite (Figure 3e, f), minor euhedral magnetite, pyrrhotite or pyrite, interstitial quartz and accessory acicular apatite, rutile and titanite. Some of these sills and dikes contain poikilitic brown-red biotite (up to ~13 vol. %), minor K-feldspar, devitrified glass mesostasis and accessory covellite, chalcopyrite, Cu-sulphate and Cu-oxide (Goble et al., 1999a). Potassium feldspar occurs as an interstitial phase or mantles plagioclase crystals. Amygdules are filled mainly by chlorite and calcite (±quartz±chalcopyrite±galena±sphalerite). The Mesoproterozoic mafic intrusions and lava flows range from relatively unaltered to strongly propylitically altered. Secondary phases replacing primary minerals and/or forming veins include albite, actinolite, epidote, prehnite,

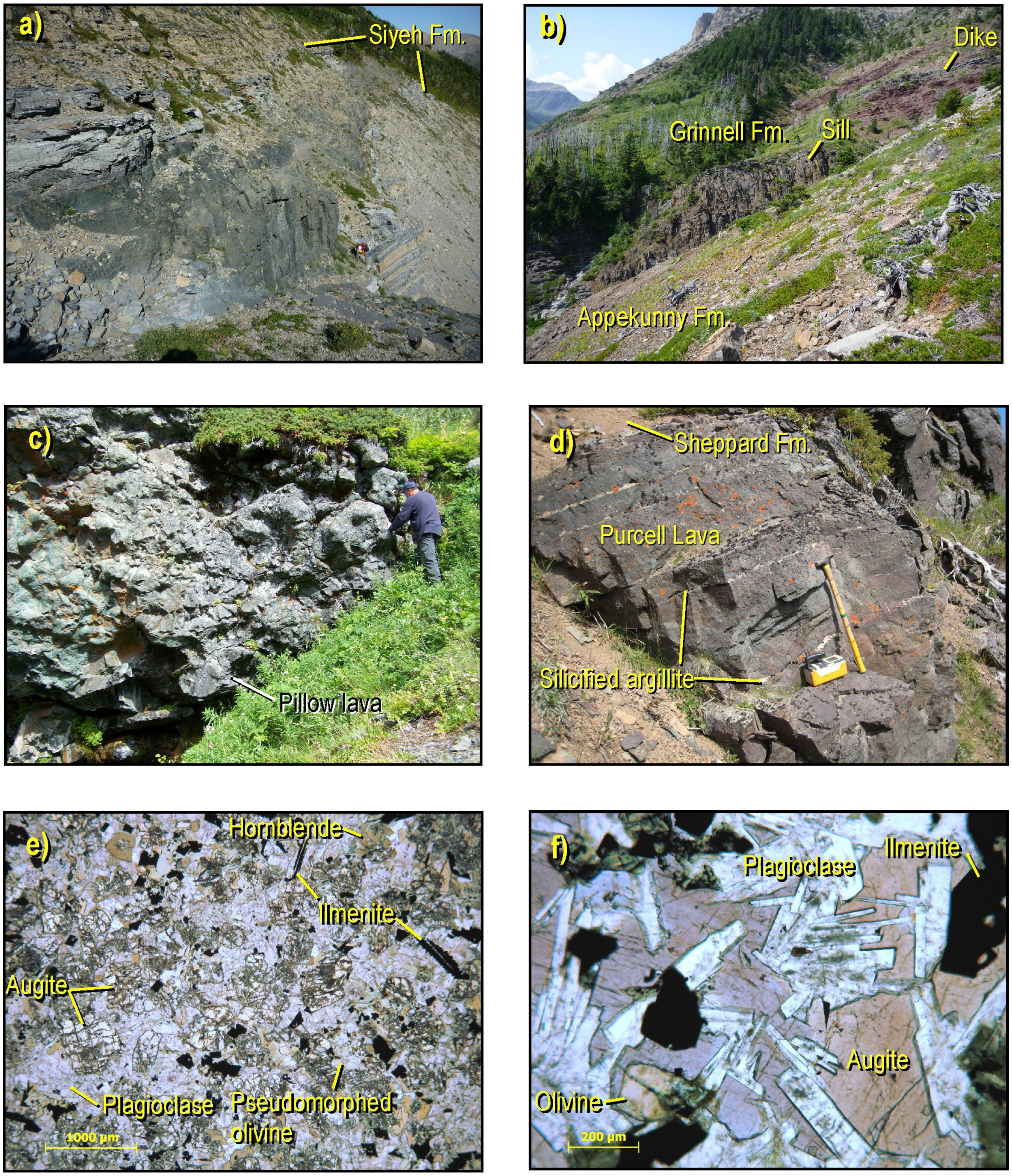


**Figure 3. Mesoproterozoic mafic magmatic rocks in southwestern Alberta: a) view toward 315° of olivine-hornblende basalt sill at Cloudy Ridge (site RM15), b) view toward 280° view of biotite-olivine basalt sill and smaller dike at Yarrow Creek (site RM21), c) pillowed basalt of the Purcell Lava at Drywood Creek (site RM05), d) massive olivine basalt of the Purcell Lava at Carbondale River (site RM14), e) photomicrograph of glomeroporphyritic olivine-hornblende basalt from a sill at La Coulotte Peak (site RM19), and f) photomicrograph of ophitic biotite-olivine basalt from sill shown in (b).**

muscovite, illite, serpentine, chlorite, talc, calcite, dolomite, scapolite, zeolite, jarosite, quartz and poorly crystalline smectite.

Proterozoic, Paleozoic and Mesozoic strata within southwestern Alberta and the Flathead Range of southeastern British Columbia are cut by Cretaceous alkali syenite, trachyte and phonolite sills and dikes (sites RM03, 04, 09 and 19). These intrusions are compositionally similar to the coeval volcanic flows, agglomerates and lithic tuffs of the Crowsnest Formation (site RM12) in the Crowsnest Pass area (Dawson, 1886; Pearce, 1970; Skupinski and Legun, 1989; Peterson et al., 1997; Brown and Cameron, 1999; Goble et al., 1999b; Bowerman et al., 2006). This phase of Cretaceous alkaline magmatism predates folds and thrust faults related to the Cordilleran compressional tectonism, and younger normal faults in southwestern Alberta (Larson et al., 2006).

In the study area, Cretaceous sills and dikes (1.2–76 m thick) intrude strata of the Belt-Purcell Supergroup and the Middle Cambrian Flathead Formation along the Continental Divide (Figure 2), and the Paleozoic strata in the Crowsnest Pass area (Halferdahl, 1971; Van Dyck, 1971; Bégin et al., 1995; Peterson et al., 1997; Goble et al., 1999b). In the adjacent Flathead region of southeastern British Columbia, the Cretaceous alkaline intrusions are more widespread and form stocks and plugs up to 1.2 km in diameter, and small dikes and sills (Skupinski and Legun, 1989; Brown and Cameron, 1999; Goble et al., 1999b).

Figure 4 shows outcrop photographs and photomicrographs of the Cretaceous alkaline magmatic rocks exposed in the Clark Range of southwestern Alberta.

The Cretaceous intrusive and volcanic alkali trachytes and phonolites are typically light grey, brown, green or pink porphyritic rocks. They contain abundant euhedral, normally or oscillatory-zoned phenocrysts of orthoclase, aegirine-augite, apatite and magnetite (±plagioclase±melanite±titanite±analcime±nosean), set in a dense groundmass. The latter consists of flow-aligned sanidine, aegirine-augite, melanite (±analcime) and optically irresolvable mesostasis. Some of these intrusions also contain sporadic analcime amygdules with green hornblende. Microprobe analyses indicate that the latter corresponds to potassic ferrian hastingsite. Many of the intrusions display strong propylitic, argillic and supergene alteration (Figure 4d). Alteration minerals include mainly carbonate, chlorite, illite, smectite, hematite, goethite, jarosite, albite and silica. Analcime phonolite with only sporadic feldspar phenocrysts, which forms blocks or bombs in agglomerates within the Crowsnest Formation, was described as ‘blairmorite’ after the town of Blairmore in the Crowsnest Pass (e.g., Pearce, 1970).

## 4 Analytical Methods

Ninety-nine rock samples, along with sixteen quality-control samples, were analyzed at Acme Analytical Laboratories Ltd. (Acme) in Vancouver, British Columbia (Appendix 1). All samples were analyzed using standard Acme methods (Appendix 2). Appendix 3 gives details on sample crushing and quality control of the whole-rock geochemical analyses. Appendix 4 (A through G) lists the analytical results, the laboratory minimum detection limits (MDL), and the estimated precision (reproducibility) and accuracy of the results.

In addition to whole-rock geochemical analyses, we performed in situ geochemical analyses of rocks using a portable X-ray fluorescence (PXRF) analyzer (Appendix 5). Appendix 6 lists the estimated long-term accuracy and precision of the PXRF results, based on multiple analyses of six reference materials. Selected in situ PXRF results are given in Tables 2–7 for comparison with the whole-rock laboratory data; Table 5 includes the measured 2σ errors of the PXRF results compared with the laboratory data for the same samples. In case of disagreement between the in situ PXRF and the whole-rock laboratory data reported in Tables 2–7, the laboratory whole-rock data should be treated as the representative results.

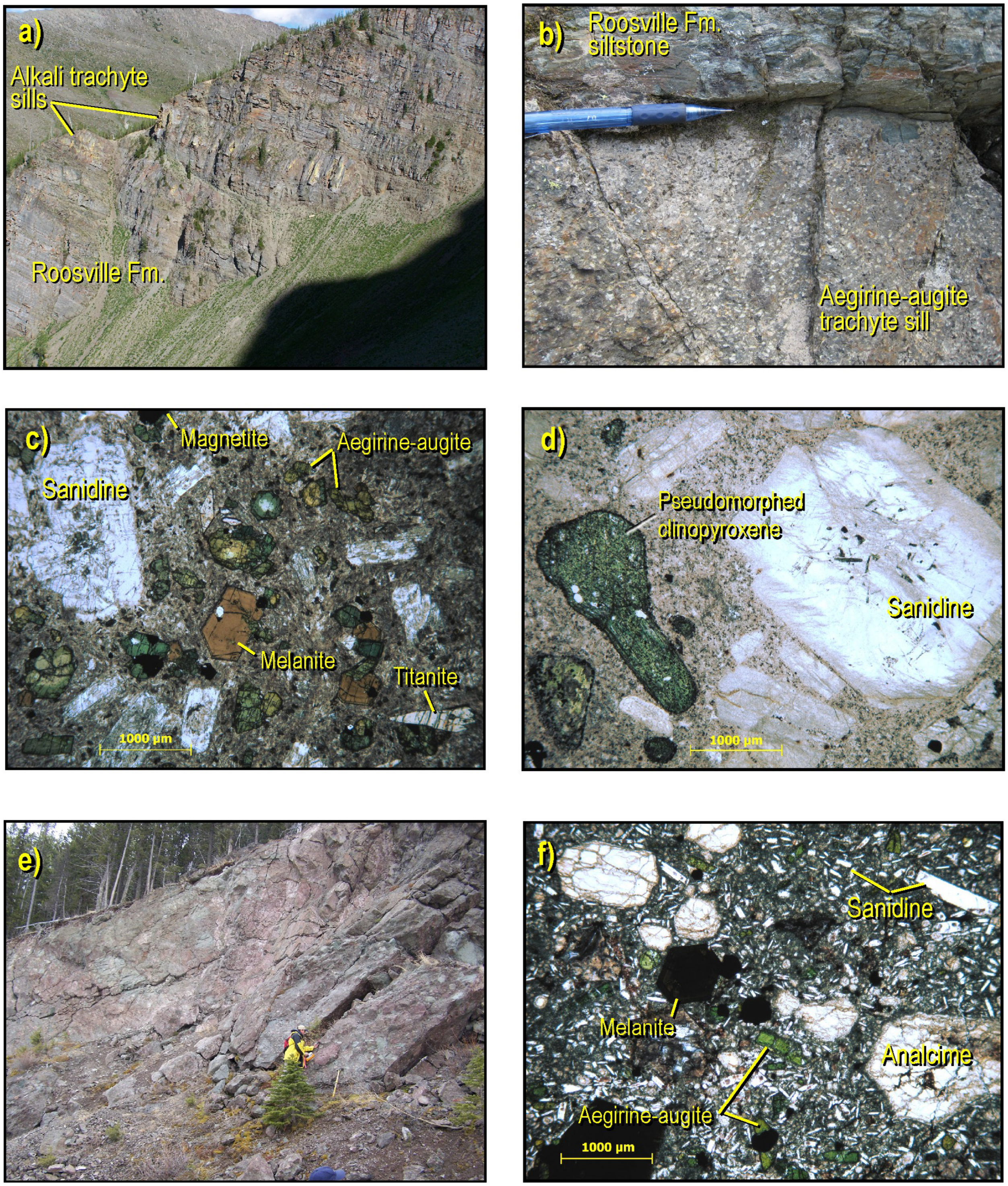


**Figure 4. Cretaceous alkaline magmatic rocks in southwestern Alberta: view toward 090° of exposure (a) and upper contact (b) of alkali trachyte sills at La Coulotte Ridge (sites RM04 and 09); photomicrographs of fresh melanite–aegirine-augite trachyte (c) and propylitically altered alkali trachyte (d) from the same sills; proximal debris flow (e) and photomicrograph of melanite-analcime phonolite (f) of the Crowsnest Formation at Star Creek (site RM12).**

To identify minerals and their relative proportions in some of the rock samples analyzed for whole-rock geochemistry, we performed quantitative Rietveld X-ray diffraction (XRD) and mineral-liberation analyses (MLA) on 11 samples at Activation Laboratories Ltd. (Actlabs) in Ancaster, Ontario. The MLA method involves scanning electron microscopy (SEM), back-scattered electron (BSE) imaging and energy-dispersive spectrometry (EDS; Appendix 7). Appendices 8 and 9 list the analytical results by the Rietveld XRD and MLA methods, respectively.

# 5 Chemical Classification and Nature of Recurrent Magmatism of Southwestern Alberta

Figure 5 shows whole-rock compositions of the analyzed Mesoproterozoic and Cretaceous magmatic rocks of southwestern Alberta plotted on the total alkalis versus silica (TAS) classification diagram (after Le Bas et al., 1986). Also included are data for similar rocks from southwestern Alberta and southeastern British Columbia (cf., Höy, 1989; Goble et al., 1999a, b; Bowerman et al., 2006).

The data points for the Mesoproterozoic mafic intrusions and the Purcell Lava fall within subalkaline to mildly alkaline fields of basalt, basaltic andesite, hawaiite, potassic trachybasalt and mugearite. The Mesoproterozoic 'Moyie sills' of the Purcell Mountains in southeastern British Columbia define two compositionally distinct groups: 1) subalkaline basaltic andesites, and (2) subalkaline to alkaline basalts that are more silica undersaturated (Höy, 1989; Anderson and Goodfellow, 2000). The Mesoproterozoic sills and dikes of the Clark Range in southwestern Alberta scatter between these two groups and overlap the more silica undersaturated alkali compositions.

The data for the Cretaceous sills, dikes and Crowsnest Formation volcanic rocks fall into the fields of shoshonite, phonotephrite, tephriphonolite, latite, trachyte, phonolite and peralkaline phonolite. Our results confirm previous observations that the Cretaceous alkaline intrusions of southwestern Alberta and adjacent southeastern British Columbia are chemically and petrographically similar to the coeval Crowsnest Formation volcanic rocks (Goble et al., 1999b; Bowerman et al., 2006).

For petrogenetic classification, whole-rock chemical compositions of the Mesoproterozoic intrusions and the Purcell Lava were projected onto the normative nepheline-olivine-diopside-hypersthene-quartz surface of the Yoder-Tilley basalt tetrahedron (Figure 6a). The data points for the 'Moyie sills' define two broadly scattered fields corresponding to 1) quartz tholeiitic basalt, and 2) silica-undersaturated olivine-tholeiitic to nepheline-normative, alkali-olivine basalt and basanite (Höy, 1989). However, the compositions of the Mesoproterozoic intrusions of southwestern Alberta partly overlap the Moyie quartz-tholeiitic basalts and scatter across the field of olivine tholeiitic basalts towards more silica undersaturated alkali-olivine basalts, basanites and ankaramites.

The Proterozoic intrusions also separate into two groups on the Zr-Nb-Y discrimination diagram (Figure 6b; Meschede, 1986) and on the Al-($Fe_{total}$+Ti)-Mg classification diagram (Figure 6c; Jensen and Pyke, 1982). The high-Fe olivine-tholeiitic and alkali-basalt intrusions, the Purcell Lava of the Clark Range and some of the intrusions of the Purcell Mountains have trace-element compositions similar to the modern within-plate alkali and tholeiitic basalts (Figure 6b). However, the silica-oversaturated tholeiitic basalts of the 'Moyie sills' plot within fields of overlapping compositions for modern mid-ocean ridge basalts (MORB), within-plate tholeiitic basalts and volcanic-arc basalts (Figure 6b). On the V versus Ti discrimination diagram (Figure 6d; Shervais, 1982), the whole-rock compositions of the Mesoproterozoic intrusions and the Purcell Lava of southwestern Alberta partly overlap with the field of modern ocean-island basalts (OIB) and indicate two groups with distinct V/Ti ratios.

Extrapolating the experimental compositions of initial melts determined at different pressures for the synthetic CaO-MgO-$Al_2O_3$-$SiO_2$ (CMAS) system, MORB source, and fertile anhydrous mantle (Thompson, 1984) to the natural system, the Mesoproterozoic intrusions of southwestern Alberta and southeastern British Columbia could have been derived from mantle sources at pressures between 9 and >20 kbar (Figure 6a). Therefore, the quartz-tholeiitic basalts and alkali basalts to basanites may represent partial melts derived from the shallow and the deeper regions of the mantle, respectively. The increasing depth of the synrift magmatism may positively correlate with the distance from the Belt-Purcell rift axis and/or with time (Goble et al., 1999a).

The Mesoproterozoic intrusions of the Clark Range were emplaced at the margin of the rift basin and stratigraphically higher in the Belt-Purcell succession than the 'Moyie sills' that were emplaced within turbiditic strata of the Aldridge Formation in the central part of the rift basin (Höy, 1989; Goble et al., 1999a; Anderson and Goodfellow, 2000; Höy et al., 2000; Lydon, 2007). Höy (1989) distinguished two geochemically different groups of the 'Moyie sills': 1) silica-oversaturated, high-Fe tholeiitic basalts, and 2) more mafic, alkali basalts. However, the Mesoproterozoic intrusions and lavas of the Clark Range are mainly olivine-tholeiitic basalts, transitional between the two compositional end-members defined by the 'Moyie sills' (Goble et al., 1999a). Therefore, the compositionally diverse, tholeiitic to alkali basaltic magmatism persisted across the rift basin and possibly through the deposition of the Belt-Purcell Supergroup, with the deeper seated, transitional olivine-tholeiitic and alkali-basalt magmas generated at the rift margin and during the late stages of rifting (Höy, 1989; Goble et al., 1999a; Anderson and Goodfellow, 2000;). Höy (1989) pointed out that the observed chemical diversity of mafic magmatism of the Belt-Purcell basin is typical of basic volcanism in an incipient rift environment or during the early stages of continental rifting.

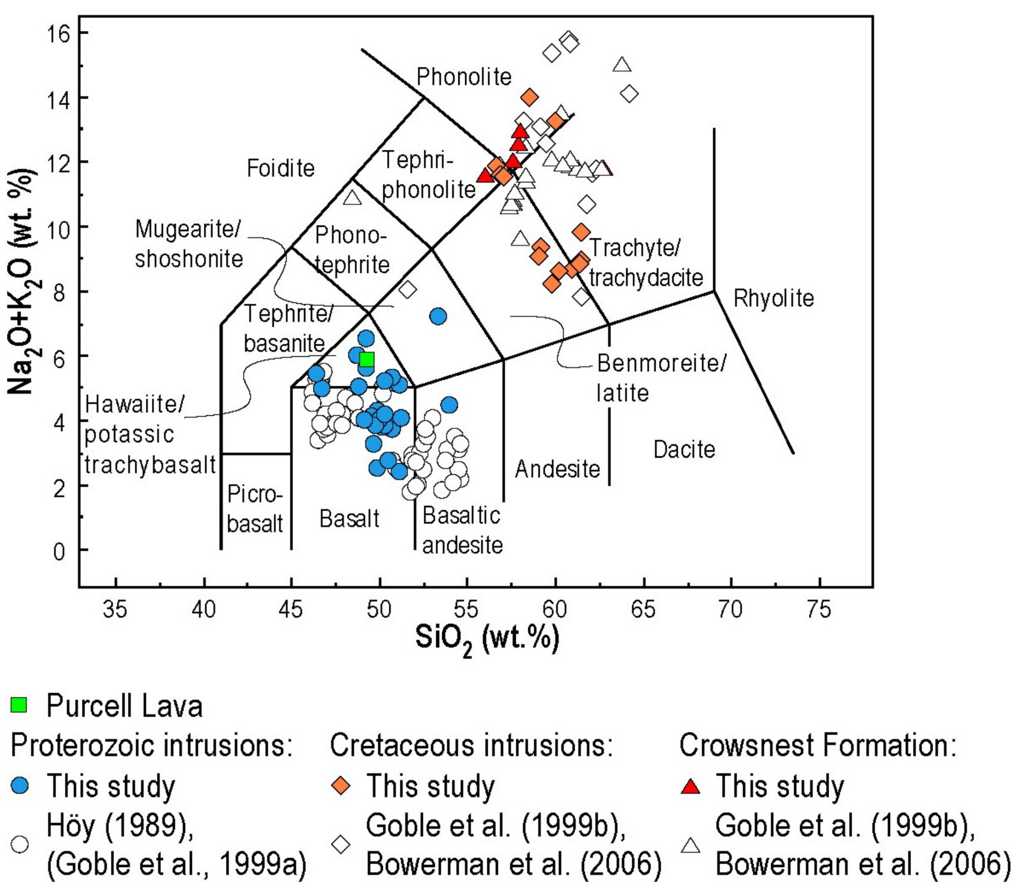


**Figure 5. Whole-rock compositions of magmatic rocks of southwestern Alberta plotted on the total alkalis versus silica classification diagram after Le Bas et al. (1986).**

Figure 7 displays whole-rock, primordial mantle–normalized, incompatible-element patterns for the Mesoproterozoic and Cretaceous magmatic rocks of southwestern Alberta. The normalized patterns for the Mesoproterozoic basaltic intrusions and Purcell Lava show enrichment in incompatible elements similar to the modern OIB (e.g., Sun and McDonough, 1989; Hofmann, 1997). The positive Ba and K and negative U and Sr spikes for the Purcell Lava may indicate an alteration signature consistent with strong chloritization of the analyzed sample (Goble et al., 1999a). The normalized, incompatible-element patterns for Cretaceous alkaline intrusions and the Crowsnest Formation volcanic rocks parallel the average composition of the upper continental crust (Figure 7).

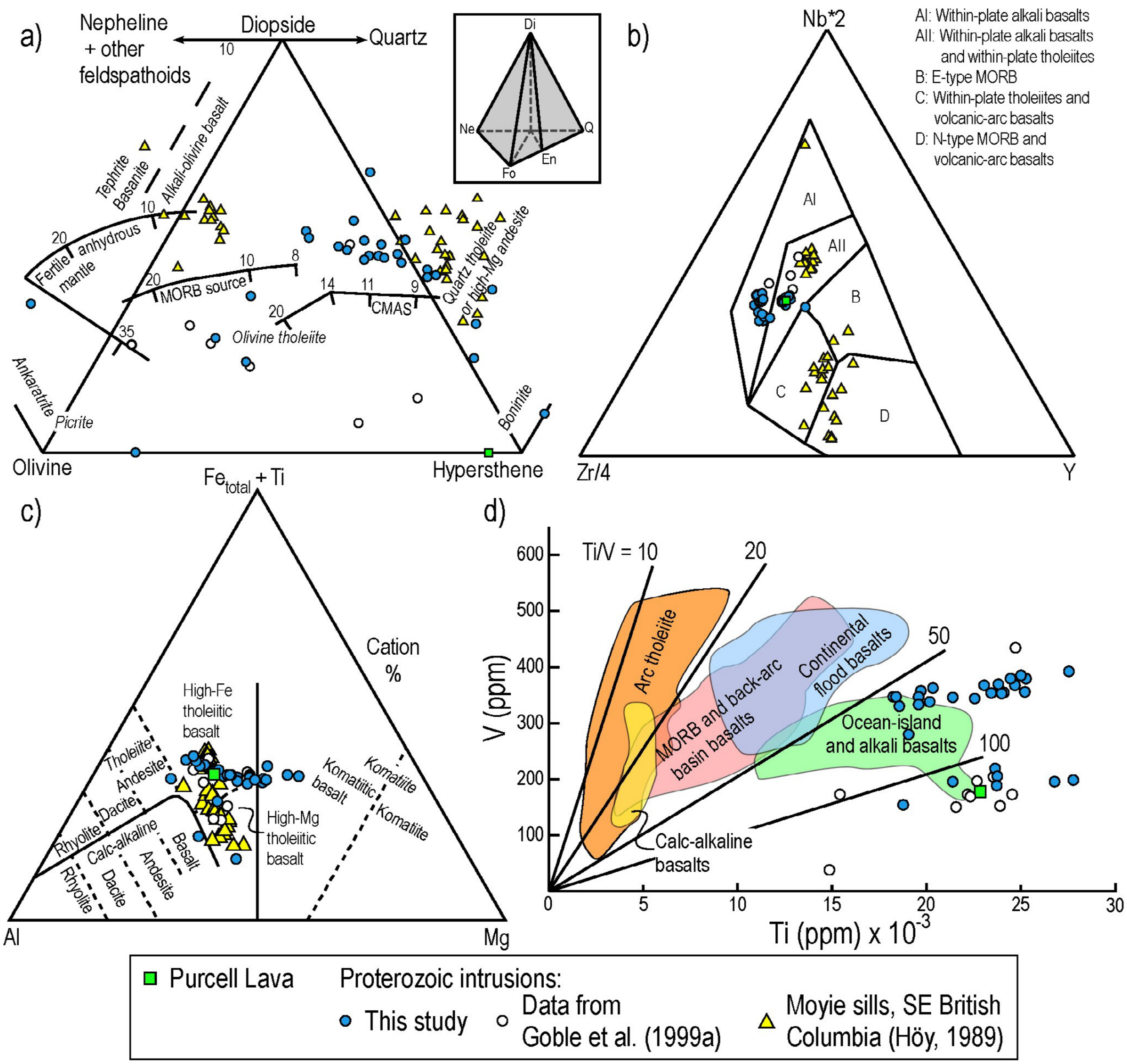


**Figure 6. Whole-rock compositions of the Mesoproterozoic intrusions and Purcell Lava plotted on a) the normative nepheline-olivine-diopside-hypersthene-quartz projection (after Thompson, 1984), showing the compositions of initial melts in the CaO-MgO-$Al_2O_3$-$SiO_2$ (CMAS) system, mid-ocean ridge basalt (MORB) source and fertile anhydrous mantle at a range of pressures (in kbar); inset shows the relationship of the projection to the surface of the Yoder-Tilley basalt tetrahedron; b) Zr-Nb-Y discrimination plot (after Meschede, 1986); c) Al-($Fe_{total}$+Ti)-Mg classification plot (after Jensen and Pyke, 1982); and d) V versus Ti discrimination plot (after Shervais, 1982). Abbreviations: E-type, enriched; N-type, normal.**

Modern OIB (e.g., Hawaii, Iceland, Réunion and Galápagos) and geochemically similar, 'OIB-like', mantle-derived igneous rocks in continental settings (e.g., East African rift system) are often attributed to mantle plumes (e.g., Morgan, 1971; Hofmann and White, 1982; Hofmann, 1997; Bell, 2001; White, 2010). Therefore, the OIB-like geochemistry of the Mesoproterozoic high-Fe, olivine-tholeiitic and alkali-olivine basalts of southwestern Alberta and southeastern British Columbia suggests that a mantle plume might have triggered the Belt-Purcell intracontinental rifting and the associated basaltic magmatism (Morton et al., 1974; Anderson and Goodfellow, 2000).

Deposition of the Belt-Purcell Supergroup was attributed to a subsiding delta environment along the continental margin (Price, 1964), the embayment of a marine miogeocline (Harrison, 1972) or an intracratonic rift basin (e.g., Sears and Price, 1978, McMechan, 1981; Winston et al., 1984). Gower and Tucker (1994) linked the Belt-Purcell basin with a system of interconnected Mesoproterozoic rifts that extended from western North America to Labrador and led to the opening of the Grenville Ocean (Lydon, 2007). Chandler (2000) interpreted the Belt-Purcell basin to represent a passive-type rift caused by lithospheric tension. However, this interpretation does not explain the petrological and geochemical characteristics of the voluminous synrift magmatic burst within the Belt-Purcell intracontinental rift, including the ca. 1.50 Ga mafic dike swarm aligned with the rift axis on the adjacent Wyoming craton (Höy, 1989; Goble et al., 1999a; Anderson and Goodfellow, 2000; Anderson and Parrish, 2000; Ross and Villeneuve, 2003; Sears and Price, 2003).

Alternatively, Morton et al. (1974) proposed that the geometry of the Belt-Purcell basin and the buried southern Alberta aulacogen, inferred based on the deep seismic-reflection, magnetic and gravity

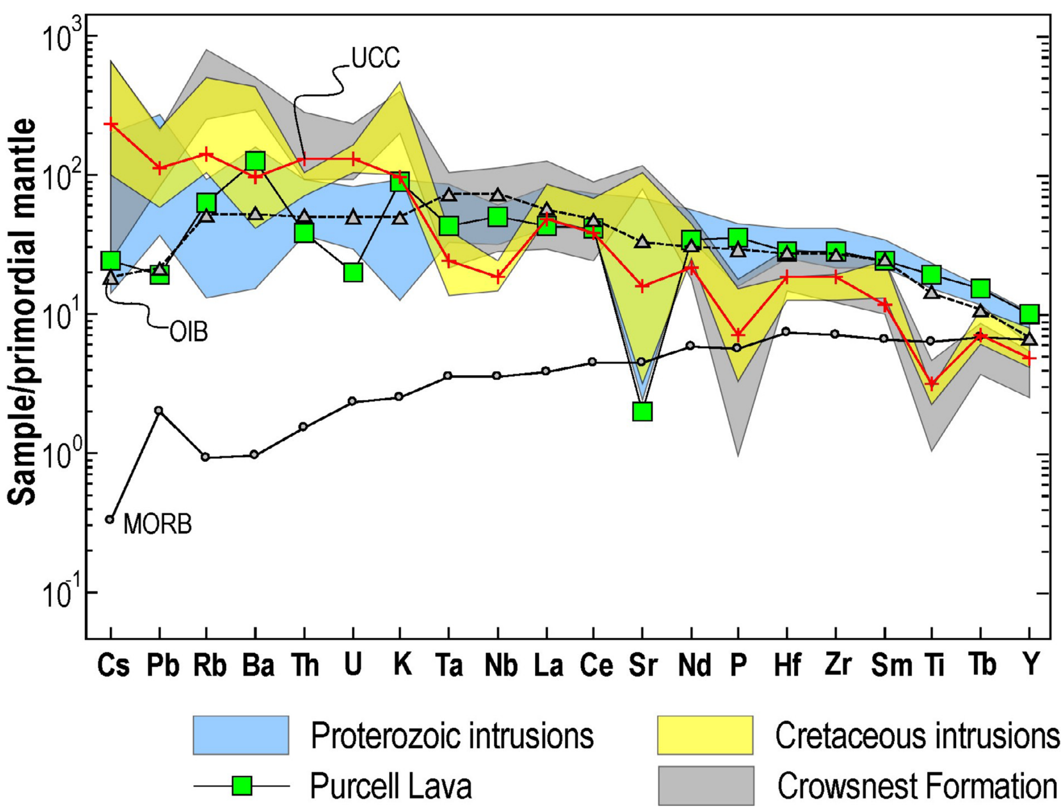


**Figure 7. Primordial mantle–normalized incompatible-element plots for whole-rock compositions of magmatic rocks of southwestern Alberta. Normalization values are from McDonough and Sun (1995); average compositions of modern mid-ocean ridge basalts (MORB) and ocean-island basalts (OIB) are from Sun and McDonough (1989), and the upper continental crust (UCC) is from Rudnick and Gao (2004).**

anomalies in the Precambrian basement of southern Alberta (Kanasewich, 1968; Ross et al., 1991; Price and Sears, 2000), resembles an ancient triple junction above a subcontinental mantle plume. Indeed, the OIB-like geochemistry of the synrift, tholeiitic to alkali-basalt magmatism of the Belt-Purcell basin, coupled with the estimated minimum volume of the basaltic magma upflow (>50 000 $km^3$) along the rift axis during a relatively short time of 2–5 Ma (e.g., Anderson and Davis, 1995; Evans et al., 2000; Lydon, 2007), are similar to large igneous provinces elsewhere (e.g., Central Iapetus, Keweenawan, Pan-Superior and Bushveld) attributed to mantle plumes (e.g., Ernst and Bell, 2010). Anderson and Goodfellow (2000) also suggested an involvement of a mantle plume in the petrogenesis of the Moyie sills based on the geochemical and Sr-Nd isotopic signatures of these rocks.

The crust-like trace-element signature, coupled with the negative Ta-Nb-Ti anomalies (Figure 7), of the Cretaceous shoshonite, tephriphonolite, latite, trachyte and phonolite intrusions and the coeval Crowsnest Formation volcanic rocks are consistent with a subduction-modified mantle source for these alkaline magmas generated at the Cordilleran continental margin (e.g., Goble et al., 1999b; Bowerman et al., 2006).

# 6 Mineralization

Previous studies and exploration have identified several types of base- and precious-metal mineralization in southwestern Alberta (e.g., Dawson, 1886; Hedley, 1954; Evans et al., 1968; Carter and Irvine, 1971; Halferdahl, 1971; Holter, 1973; Goble, 1974a–c; Morton et al., 1974; Salat, 1988; Richards et al., 1994; Williamson et al., 1993; Sangster, 1995, 1996; Graf, 1997; Pană, 2006):

- magmatic-hydrothermal Cu-Pb-Zn sulphides associated with Mesoproterozoic basaltic intrusions and Purcell Lava flows
- stratabound, sediment-hosted Pb-Zn-Cu and Cu-Ag-Pb sulphides at different stratigraphic levels within the Belt-Purcell Supergroup
- stratabound, black shale–hosted, polymetallic Zn-Ni-Mo mineralization in the Devonian–Mississippian Exshaw Formation
- alkaline intrusion–related, porphyry or epithermal Au-Ag (±Cu±Mo±W±Pb±Zn) mineralization
- vein Pb-Zn-Ag-Cu sulphides

Rukhlov (2011) provided a detailed review of the history of mineral exploration and known mineral occurrences in the area. Figure 2 shows the stratigraphic positions of the sample sites within the Belt-Purcell Supergroup and distribution of Proterozoic mafic and Cretaceous alkaline sills and dikes, and metallic mineralization in the Clark Range area. In this section, we discuss historical information on the studied sites and the new data from our study in light of the mineral-deposit models applicable to the diverse metallic mineralization of southwestern Alberta.

## 6.1 Magmatic-Hydrothermal Cu-Pb-Zn Sulphides Associated with Proterozoic Basaltic Intrusions and Purcell Lava Flows

Table 2 lists selected geochemical results from the Purcell Lava, Proterozoic intrusions and adjacent sedimentary rocks of the Belt-Purcell Supergroup. Dawson (1886) first reported Cu-sulphide mineralization in the Mesoproterozoic basaltic intrusions and Purcell Lava flows in the North Kootenay Pass–Carbondale River area (site RM14; Figure 1). Between 1900 and 1910, small-scale mining took place on a basaltic dike with chalcopyrite veins within the top of the Appekunny Formation at Coppermine Creek (formerly Blakiston Brook), now within Waterton Lakes National Park (site RM13; Goble, 1974a). Subsequent exploration discovered numerous occurrences of amygdule-filling chalcopyrite (blobs up to 1 cm) in the top 0.3–0.8 m section of the Purcell Lava in the area (Halferdahl, 1971; Goble, 1973; Morton et al., 1974).

**Table 2. Selected results from Proterozoic mafic intrusions, adjacent sedimentary rocks of the Belt-Purcell Supergroup and Purcell Lava of southwestern Alberta. The data obtained by in situ PXRF analysis are shown for comparison with the whole-rock laboratory data. Anomalous concentrations are in bold type. Thickness refers to either the true thickness of the formation or intrusion, or the width of the channel sample (in red type). See Figure 1 for locations of sample sites.**

| Location | La Coulotte Peak (RM19) | | | Spionkop Ridge (RM17) | Carbondale River (RM14) | | Coppermine Creek (RM13) | | Southwest flank of Barnaby Ridge (RM07) | Drywood Creek (RM05) | Middle Kootenay Pass (RM01) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Host Formation | Proterozoic sill | Roosville | | Proterozoic sill | Purcell Lava | | Proterozoic sill | Grinnell Formation | Proterozoic sill | Purcell Lava | Proterozoic sill |
| Lithology | Olivine-hornblende basalt | Siltstone adjacent to sill | | Basalt | Amygdaloidal olivine basalt from the top 0.5 m of lava flow | | Olivine basalt | Quartz arenite adjacent to sill | Olivine-hornblende basalt | Chloritized amygdaloidal basalt | Olivine basalt |
| Analysis | Lab | Lab | PXRF[1] | Lab | Lab | PXRF[1] | Lab | Lab | Lab | Lab | Lab |
| Ag (ppm) | 0.3 | 0.2 | <68 | **21.4** | 0.3 | 138 | 0.5 | 0.4 | 0.2 | 0.01 | **5.1** |
| As (ppm) | **89** | 6.7 | 49 | **36** | 2.0 | <19 | **109** | **24** | **21** | 4 | **24** |
| Au (ppb) | 2.2 | <0.2 | <54860 | **56.0** | 3.0 | <63760 | 3.0 | 1.4 | 2.0 | <0.2 | 0.7 |
| Ba (ppm) | 485 | 1900 | 2479 | 450 | 320 | 508 | 598 | 130 | 1100 | 960 | 530 |
| Be (ppm) | 2.0 | 4.0 | n.d. | 0.4 | 0.5 | n.d. | 2.0 | 0.5 | 1.3 | 1.1 | 3.0 |
| Bi (ppm) | 0.1 | 0.3 | <25 | **39** | <0.02 | <20 | **1.0** | 0.5 | 0.07 | <0.02 | 0.2 |
| Br (ppm) | <0.5 | 0.8 | n.d. | <0.5 | 0.9 | n.d. | 0.7 | 1.0 | 2.1 | 3.6 | <0.5 |
| Cd (ppm) | 0.4 | 0.1 | <24 | 0.3 | 0.6 | <35 | **6.3** | 0.01 | 0.3 | <0.01 | 0.3 |
| Ce (ppm) | 76 | 59 | n.d. | 120 | 58 | n.d. | 106 | 6.7 | 83 | 74 | 94 |
| Co (ppm) | **72** | 2.7 | <283 | 44 | 16 | <350 | 48 | 4.9 | **64** | 43 | 44 |
| Cr (ppm) | **1047** | 35 | <119 | 59 | 47 | <128 | 54 | 16 | **490** | 33 | **320** |
| Cs (ppm) | 4.2 | 12 | n.d. | 0.7 | 0.5 | n.d. | 1.8 | 0.5 | 1.0 | 0.5 | 1.8 |
| Cu (ppm) | **181** | **139** | 977 | **36000** | **5910** | 78495 | **254** | **1833** | 102 | **181** | **165** |
| F (ppm) | 900 | 800 | n.d. | 1090 | 620 | n.d. | 790 | 290 | 913 | 760 | 930 |
| Ga (ppm) | 20 | 26 | n.d. | 23 | 20 | n.d. | 25 | 6.2 | 21 | 25 | 22 |
| Ge (ppm) | 0.4 | <0.1 | n.d. | <0.1 | 0.4 | n.d. | 0.4 | <0.1 | 0.2 | 0.3 | 0.2 |
| Hg (ppb) | 6 | 5 | n.d. | 43 | 10 | n.d. | 82 | <5 | 9 | <5 | <5 |
| In (ppm) | 0.06 | 0.03 | n.d. | 0.08 | 0.12 | n.d. | 0.16 | 0.11 | 0.03 | 0.08 | 0.04 |
| Ir (ppb) | <5 | <5 | n.d. | <5 | <5 | n.d. | <5 | <5 | <5 | **8** | <5 |
| Li (ppm) | 81 | **107** | n.d. | **113** | 70 | n.d. | **127** | 83 | 56 | 73 | 53 |
| Mn (wt. %) | 0.17 | 0.04 | 0.17 | 0.28 | 0.15 | 0.06 | 0.24 | 0.03 | 0.15 | 0.07 | 0.15 |
| Mo (ppm) | 1.5 | 0.17 | <9 | **19** | **24** | 36 | 1.8 | 10 | 1.5 | 1.0 | 2.9 |
| Ni (ppm) | **321** | 19 | <88 | 43 | 33 | <118 | 49 | 8.2 | 167 | 28 | 145 |
| Pb (ppm) | 29 | **105** | 900 | 7 | 9 | 39 | **2374** | 1 | 10 | 3 | 35 |
| Pd (ppb) | **6.1** | <0.5 | <11410 | 0.5 | <0.5 | <16410 | <0.5 | <0.5 | **3.7** | <0.5 | <0.5 |
| Pt (ppb) | **10.8** | 0.2 | n.d. | 0.3 | 0.6 | n.d. | 0.6 | <0.1 | 0.4 | <0.1 | **3.0** |
| Re (ppb) | 3 | <1 | n.d. | <1 | 1 | n.d. | <1 | <1 | 1 | <1 | <1 |
| S (wt. %) | 0.31 | <0.02 | 0.28 | 0.78 | 0.20 | 1.58 | 0.09 | 0.04 | 0.20 | <0.02 | 0.09 |
| Sb (ppm) | 1.2 | 1.0 | <47 | 0.4 | 0.3 | <69 | 0.6 | 0.4 | 0.5 | 0.3 | 0.8 |
| Se (ppm) | 0.7 | 0.2 | <7 | **1.0** | 0.7 | <11 | 0.5 | 0.1 | 0.4 | <0.1 | 0.3 |
| Sn (ppm) | 3.2 | 7.0 | <56 | 3.0 | 2.0 | <79 | 2.3 | 0.6 | 2.3 | 2.0 | 3.1 |
| Te (ppm) | 0.04 | <0.02 | n.d. | <0.02 | <0.02 | n.d. | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 |
| Th (ppm) | 5.2 | **21** | n.d. | 3.8 | 2.7 | n.d. | 4.9 | 5.3 | 5.2 | 3.1 | 6.1 |
| Tl (ppm) | 0.14 | 0.13 | n.d. | 0.37 | <0.02 | n.d. | 0.03 | <0.02 | <0.02 | <0.02 | 0.10 |
| U (ppm) | 0.9 | 5.7 | n.d. | 1.3 | 4.0 | n.d. | 1.2 | 1.4 | 1.0 | 0.4 | 1.6 |
| V (ppm) | **363** | 45 | 462 | 193 | 120 | 307 | 198 | 12 | **343** | 175 | **381** |
| W (ppm) | 0.7 | 2.0 | <131 | **4.0** | 1.4 | <180 | 1.0 | 0.2 | 1.9 | 0.4 | 2.0 |
| Y (ppm) | 30 | 59 | n.d. | 44 | 40 | n.d. | 60 | 10 | 32 | 42 | 31 |
| Zn (ppm) | 160 | 74 | 39 | 190 | **220** | 195 | **1036** | 150 | 150 | **190** | 140 |
| Thickness (m) | 2.0 | 0.05 | | 3.0 | 80 | | 10 | 0.12 | 3.2 | >8 | 4.5 |

[1] in situ analysis with portable X-ray fluorescence analyzer

Erratically distributed but locally abundant chalcopyrite and/or bornite (±chalcocite±covellite± digenite), accompanied by magnetite (±pyrite±arsenopyrite±galena±sphalerite), forms disseminated or interstitial grains and veins in basaltic dikes and sills that cut strata of the Appekunny, Grinnell and Siyeh formations in the Spionkop Ridge–Yarrow Creek area (sites RM17 and RM21; Duncan, 1970; Halferdahl, 1971; Goble, 1972a, b, 1973, 1974a; Morton et al., 1974; Goble et al., 1999a). Some of the intrusions show gradual zonation of the disseminated sulphide mineralization from a pyrite-chalcopyrite assemblage along chilled margins, through chalcopyrite, chalcopyrite-bornite, bornite and bornite-chalcocite assemblages, to the central chalcocite zone (Goble, 1972b). Goble (1972a) described galena-sphalerite amygdules in a 2.4 m thick basaltic dike within the lower Siyeh Formation carbonates at Spionkop Creek (site RM10).

Some of the sills and dikes occupy numerous high-angle, normal and reverse faults with displacements of up to 90 m, whereas other intrusions are cut by these faults. At Yarrow Creek (site RM21; Figure 3b), some faults cut the lower Grinnell Formation strata but do not penetrate an approximately 30 m thick basaltic sill within the underlying upper Appekunny Formation, indicating some intrusion-induced faulting in the unconsolidated sediments (Goble, 1972b).

Assays from these intrusions returned up to 20.82% Cu, 6.26% Zn, 4.3% Pb, 299 ppm Ag, and 1.37 ppm Au (Duncan, 1970; Halferdahl, 1971; Goble, 1972a, b; Morton et al., 1974). Kennco Exploration (Western) Ltd. estimated approximately 1 million tonnes grading 1.83%–3.45% Cu and up to 29.49 ppm Ag for the upper basaltic intrusion at Spionkop Ridge (site RM17; Stevenson, 1968). Goble (1972b) estimated a possible combined 0.08 million tonnes grading 1.0% Cu and <3.43 ppm Ag for the basaltic sill and dike within the lower Grinnell Formation strata at Yarrow Creek (site RM21; Figure 1).

Our field observations and geochemical results confirm the presence of erratic but locally abundant Cu-Pb-Zn sulphide mineralization in the Proterozoic intrusions and Purcell Lava (Table 2). Figure 8 shows examples of different styles of sulphide mineralization in the Proterozoic basaltic intrusions of the Clark Range area.

The mineralized basalt sill (3 m thick) at Spionkop Ridge (site RM17; Figure 8b) returned highly anomalous concentrations of Cu, Ag and Au, coupled with the elevated concentrations of As, Bi, Mo, Se, W and Li. Microscopic observations and quantitative mineralogical analyses (Appendices 8 and 9) indicate strong alteration of this basaltic intrusion; the alteration consists mainly of secondary albite, chlorite, illite and illitic clay, with accessory covellite, Cu-oxide, malachite and Cu-sulphate (probably brochantite).

Analyses from an olivine basalt sill (10 m thick) at Coppermine Creek (site RM13) indicate anomalous values for Pb, Zn and Cu, coupled with enrichment in As, Bi, Cd and Li. The adjacent quartz arenite of the Grinnell Formation also shows anomalous concentrations of Cu and As. An olivine-hornblende basalt sill (2 m thick) at La Coulotte Peak (site RM19) shows the highest Cr, Co, Ni, Pd and Pt concentrations of all the basaltic intrusions and lavas analyzed in this study. The adjacent siltstone of the Roosville Formation contains elevated concentrations of Cu, Pb, Li and Th. An olivine basalt sill (4.5 m thick) at Middle Kootenay Pass (site RM01) contains elevated concentrations of Cu, Ag, Cr, V and As, and traces of Pt (Table 2).

Amygdaloidal olivine basalts with vesicle-filling chalcopyrite of the Purcell Lava at Carbondale River (site RM14) and Drywood Creek (site RM05) returned anomalous concentrations of Cu and Zn (±Ir±Mo). Similar abundant amygdule-filling chalcopyrite was observed in talus float of amygdaloidal basalt from a quenched margin of the Mesoproterozoic sill (about 30 m thick) that intrudes redbed strata along the contact between the Appekunny and Grinnell formations at Yarrow Creek (site RM21; Figure 8a). Other analyzed basaltic intrusions on the southwest flank of Barnaby Ridge (site RM07) and at Font Creek (site RM02), Cloudy Ridge (site RM15) and Pincher Ridge (RM18) returned lower metal concentrations (Appendix 4).

Based on petrographic, mineralogical, fluid-inclusion and sulphur-isotopic evidence, Morton et al. (1974) suggested that cyclic circulation of hydrous fluids between wet sediments and synrift basaltic intrusions emplaced at shallow levels in the Belt-Purcell basin played an important role in the enrichment of sulphides, both within the Mesoproterozoic intrusions and in their country rocks. The barite-sulphide and sphalerite-chalcopyrite sulphur-isotope thermometers and the fluid-inclusion homogenization temperatures indicate ~400°C for the sulphide mineralization at the contact between the mafic intrusions and the host sediments, ~250°C about 1.5 m away and ~100°C about 3 m from the intrusion (Morton et al., 1974). The isotopic data, coupled with the documented oxide-sulphide assemblages and the geochemistry of the studied Mesoproterozoic basaltic intrusions and Purcell Lava of southwestern Alberta indicate at least three styles of the magmatic-hydrothermal sulphide mineralization:

- vesicle-fill chalcopyrite, galena and sphalerite concentrated in the chilled margins of the intrusions and in the upper portions of the Purcell Lava flows (Figure 8a)
- digenite, chalcocite, covellite, galena and sphalerite as veins in the chilled margins and concentrations along joints in central parts of some of the intrusions (Figure 8b)

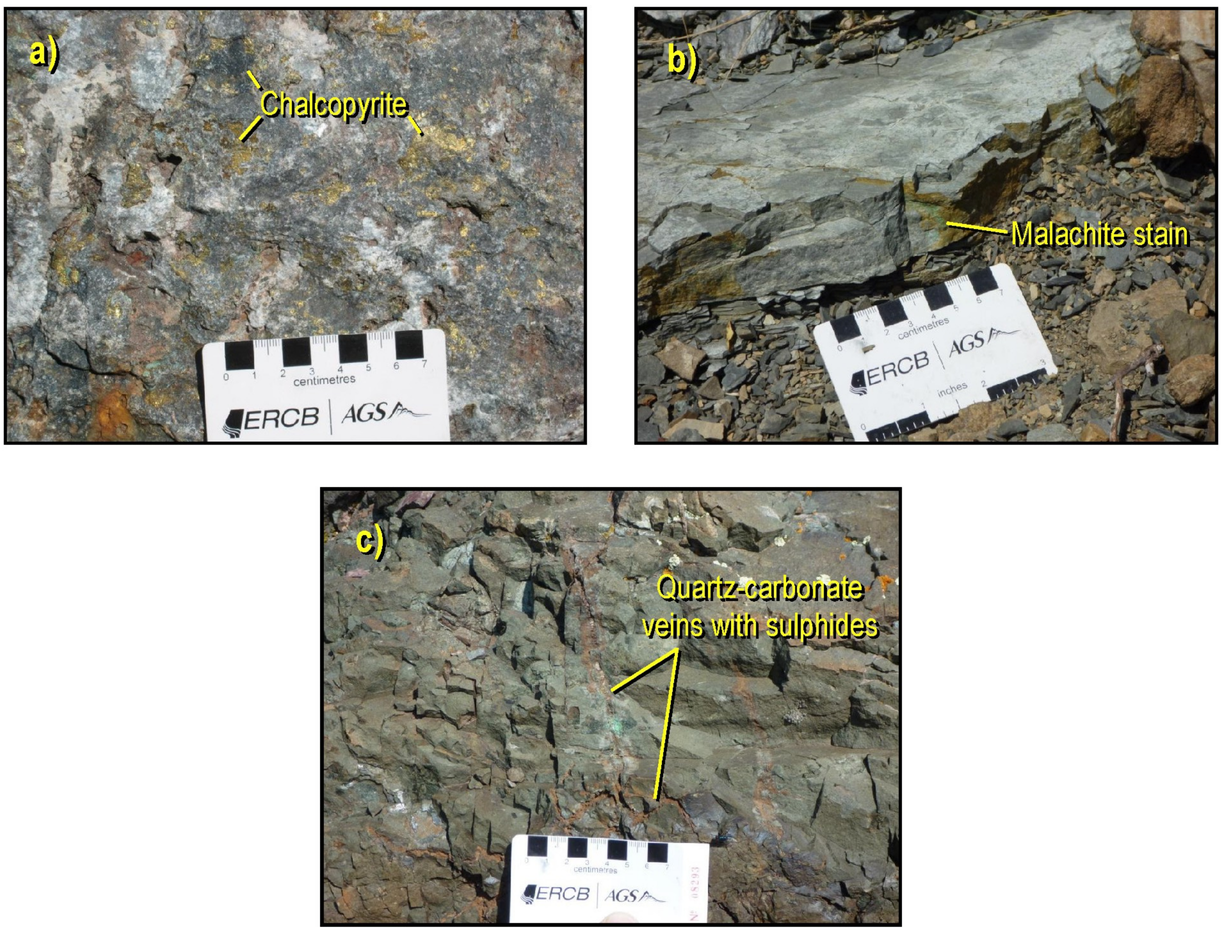


**Figure 8. Magmatic-hydrothermal sulphide mineralization in the Mesoproterozoic basaltic intrusions of southwestern Alberta: a) close-up of abundant vesicle-filling chalcopyrite from quenched margin of amygdaloidal biotite-olivine basalt sill at Yarrow Creek (site RM21); b) secondary malachite staining along fracture in basaltic intrusion containing disseminated Cu-sulphides at Spionkop Ridge (site RM17); and c) quartz-carbonate veins with Pb-Zn-Cu sulphides and secondary malachite in the upper quenched margin of the basaltic sill at Yarrow Creek (site RM21).**

- disseminated pyrrhotite, pyrite, arsenopyrite, chalcopyrite, sphalerite and galena, along with elevated concentrations of Ni, Co, Cr, Pt and Pd (Figure 8c).

## 6.2 Stratabound, Sediment-Hosted Pb-Zn-Cu Sulphides of the Belt-Purcell Supergroup

Table 3 lists selected geochemical results from stratabound, sediment-hosted Pb-Zn-Cu sulphide occurrences within the Belt-Purcell Supergroup of southwestern Alberta. In the 1970s, exploration in the Clark Range area discovered this mineralization, which comprises fine-grained, disseminated and conformable streaks and blebs (2–5 mm) of sphalerite (0.15%–0.90% Fe), galena, minor chalcopyrite, arsenopyrite and traces of pyrite. The mineralization occurs within laminated siltstones, dolomitic siltstones and argillaceous or silty dolomites of the Siyeh and Sheppard formations in the North Kootenay Pass–Carbondale River area (site RM14; Figure 1; Carter and Irvine, 1971; Goble, 1973, 1975; Morton et al., 1974).

At Carbondale River (site RM14), the 7.6–9.1 m thick mineralized zone is about 24 m stratigraphically above the Purcell Lava. It consists of buff-weathered, grey, flaggy to blocky dolomite grading upwards into oxidized, black, thinly laminated siltstone of the Sheppard Formation (Figure 9a), and contains up to 5% combined galena and sphalerite, with 0.25%–0.50% arsenopyrite, minor chalcopyrite and pyrite (Carter and Irvine, 1971; Goble, 1973, 1975). The dolomite is alternately thin and thick bedded, and contains thin, discontinuous bands and lenses of dolomitic siltstone, which are characterized by the highest concentrations of Pb-Zn sulphides, and two to three intraformational conglomerate units. The overlying black siltstone (about 1.8 m thick) contains thin, discontinuous quartzitic and sandy layers with pale sphalerite. The black siltstone is overlain by a 3.0–4.6 m succession of thick-bedded, buff-weathered, grey to green dolomite, interbedded with green, flaggy, gritty siltstone that contains scattered chalcopyrite and traces of galena. Sphalerite and galena occur in discontinuous lenses and laminae (<3.8 cm thick) and along conjugate fracture sets with chalcopyrite. Sphalerite forms pale grey and brown spots, patches (up to 3–4 mm in diameter), disseminations and rarely white stringers or fracture-fills. It also mantles disseminated galena grains and forms streaks intergrown with galena, parallel to bedding in silty bands. Secondary hydrozincite commonly occurs as a stain on weathered faces of the mineralized grey dolomite and black siltstone (Carter and Irvine, 1971; Goble, 1973, 1975).

Based on drillcore and outcrop assays, Goble (1973, 1975) estimated that the mineralized section at Carbondale River continues along a northerly strike for about 12 km, and could contain 167 million tonnes of 2.61% Pb, 0.80% Zn and 126.86 ppm Ag. Morton et al. (1974) reported grades of up to 7.0% Zn, 4.17% Pb, 0.25% Cu and 6.17 ppm Ag for the stratabound Pb-Zn occurrences of the Clark Range area.

Our field and microscopic observations, and quantitative mineralogical analyses of the Sheppard Formation mineralized siltstone at Carbondale River (site RM14; sample 8253) confirm the presence of stratabound sulphide mineralization. The mineralization comprises disseminated or interstitial galena (Figure 9b), with accessory pyrite, covellite and cerussite, in a matrix composed mainly of quartz, microcline/orthoclase, muscovite/illite, smectite and traces of other minerals (Appendices 8 and 9). Whole-rock geochemical analyses agree with the historical data and indicate anomalous concentrations of Zn, Pb, Hg, Cu, Cd, Ag and As across a 2.0 m thick section of laminated dolomite and siltstone of the Sheppard Formation at Carbondale River (Table 3).

A 0.03–0.20 m thick quartzite bed with abundant sulphide spheres (Figure 9c) at the base of the Siyeh Formation on South Drywood Creek (site RM06) and Spionkop Ridge (site RM16) represents a different style of stratabound sulphide mineralization (Morton et al., 1974). Nevertheless, this bed had not been previously analyzed. Our Rietveld XRD and MLA studies of the mineralized quartzite from the Spionkop Ridge occurrence (site RM16; sample 8265) show goethite and jarosite, with traces of cerussite, barite, rutile, zircon and galena, in a matrix of quartz, microcline/orthoclase, amorphous silica-rich material,

**Table 3. Selected results from stratabound, sediment-hosted Pb-Zn-Cu sulphide occurrences within the Belt-Purcell Supergroup of southwestern Alberta. The data obtained by in situ PXRF analysis are shown for comparison with the whole-rock laboratory data. Anomalous concentrations are in bold type. Thickness refers to the width of the channel sample. See Figure 1 for locations of sample sites.**

| **Location** | **Carbondale River (RM14)** | | **Spionkop Ridge (RM16)** | | **South Drywood Creek (RM06)** |
|---|---|---|---|---|---|
| **Host Formation** | **Sheppard** | | **Siyeh** | | **Siyeh** |
| **Lithology** | **Laminated dolomite and siltstone** | | **Quartzite with abundant sulphide spheres** | | **Quartzite with abundant sulphide spheres** |
| **Analysis** | **Lab** | **PXRF[1]** | **Lab** | **PXRF[1]** | **Lab** |
| Ag (ppm) | **1.0** | 87 | **5.0** | 65 | 0.5 |
| As (ppm) | **34** | 440 | **449** | 182 | **34** |
| Au (ppb) | <0.2 | <89000 | **24.0** | <54870 | <0.2 |
| Ba (ppm) | 970 | 784 | **3000** | 464 | 830 |
| Be (ppm) | 2.0 | n.d. | 0.2 | n.d. | <0.1 |
| Bi (ppm) | 0.48 | <43 | **4.01** | <20 | 0.20 |
| Br (ppm) | 1.2 | n.d. | 1.0 | n.d. | 1.5 |
| Cd (ppm) | **23** | <28 | 0.10 | <23 | 0.05 |
| Ce (ppm) | 94 | n.d. | 21 | n.d. | 14 |
| Co (ppm) | 6.3 | <333 | **44** | <243 | 21 |
| Cr (ppm) | 55 | 306 | 16 | <85 | 12 |
| Cs (ppm) | 4.0 | n.d. | 1.2 | n.d. | 0.5 |
| Cu (ppm) | **155** | 259 | **803** | 190 | **456** |
| F (ppm) | 970 | n.d. | 200 | n.d. | 220 |
| Ga (ppm) | 16 | n.d. | 4.2 | n.d. | 3.9 |
| Ge (ppm) | 0.1 | n.d. | <0.1 | n.d. | <0.1 |
| Hg (ppb) | **2667** | n.d. | **171** | n.d. | 15 |
| In (ppm) | 0.08 | n.d. | 0.07 | n.d. | 0.09 |
| Ir (ppb) | <5 | n.d. | <5 | n.d. | <5 |
| Li (ppm) | 76 | n.d. | 36 | n.d. | 32 |
| Mn (wt. %) | 0.04 | 0.11 | 0.007 | <0.01 | 0.09 |
| Mo (ppm) | 0.5 | <8.1 | **59** | 42 | 3.0 |
| Ni (ppm) | 14 | 157 | 16 | <82 | 5.6 |
| Pb (ppm) | **1955** | 7712 | **923** | 930 | 23 |
| Pd (ppb) | <0.5 | <12370 | **2.8** | <10010 | <0.5 |
| Pt (ppb) | 0.2 | n.d. | **1.5** | n.d. | <0.1 |
| Re (ppb) | 1 | n.d. | 6 | n.d. | 3 |
| S (wt. %) | 0.51 | 0.47 | 0.17 | 1.98 | 0.40 |
| Sb (ppm) | 1.6 | <53 | **6.9** | <45 | 0.7 |
| Se (ppm) | 0.4 | <10 | 2.5 | <5.6 | 0.2 |
| Sn (ppm) | 3.0 | <63 | 0.6 | <49 | 0.3 |
| Te (ppm) | 0.03 | n.d. | 0.31 | n.d. | <0.02 |
| Th (ppm) | 13 | n.d. | 3.0 | n.d. | 1.9 |
| Tl (ppm) | 0.07 | n.d. | **1.05** | n.d. | 0.30 |
| U (ppm) | 3.0 | n.d. | 1.9 | n.d. | 0.8 |
| V (ppm) | 59 | 208 | 14 | 117 | 17 |
| W (ppm) | 2.0 | <242 | 0.4 | <125 | 0.2 |
| Y (ppm) | 26 | n.d. | 8.0 | n.d. | 10 |
| Zn (ppm) | **3564** | 2349 | 24 | <18 | 20 |
| Thickness | 2.0 | | 0.03 | | 0.2 |

[1] in situ analysis with portable X-ray fluorescence analyzer

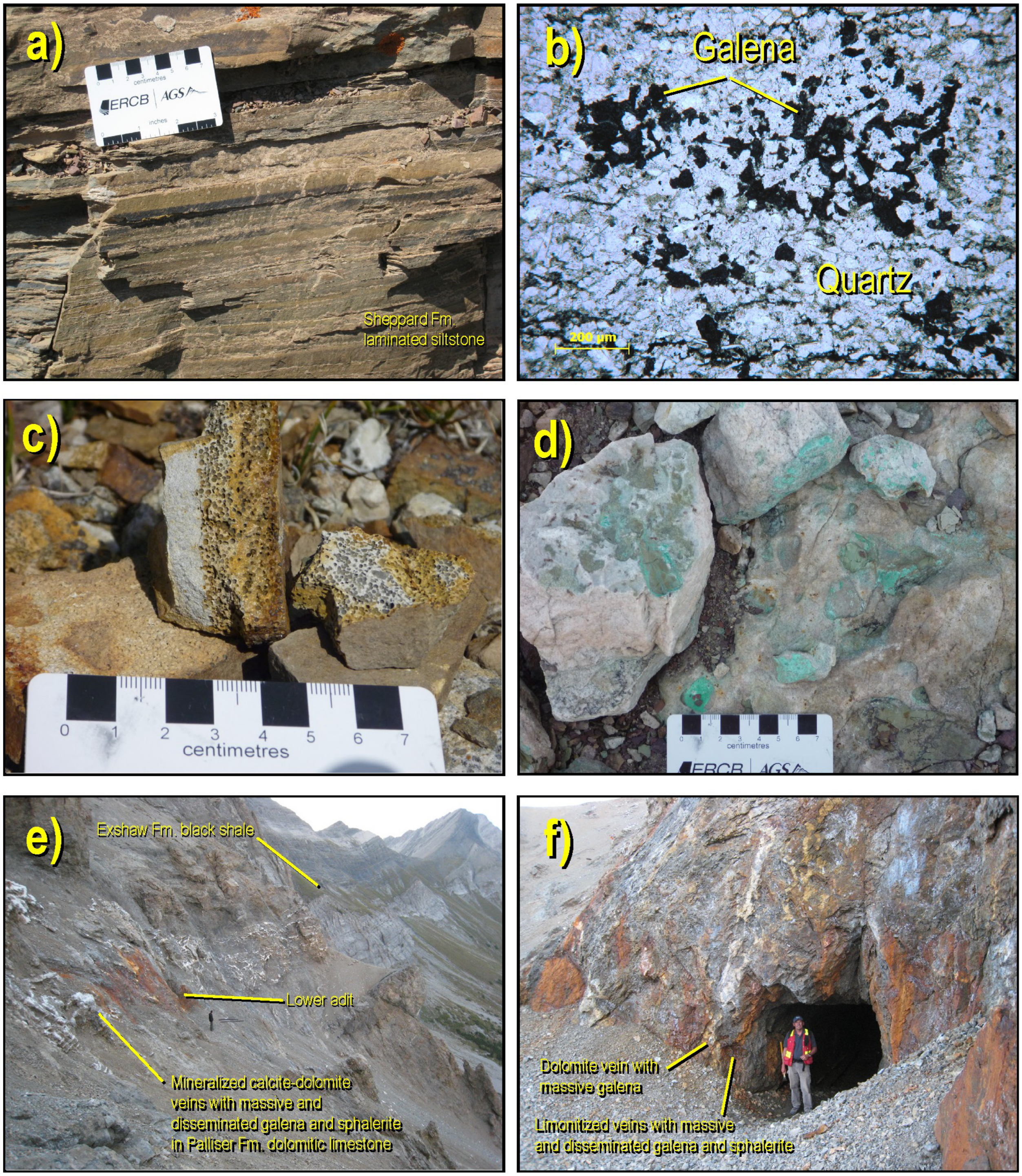


**Figure 9. Stratabound, sediment-hosted and vein metallic-mineral occurrences in southwestern Alberta: outcrop (a) and photomicrograph (b) of Sheppard Formation siltstone hosting Pb-Zn mineralization at Carbondale River (site RM14); c) quartzite with abundant sulphide spheres at the base of the Siyeh Formation on Spionkop Ridge (site RM16); d) malachite-stained, Cu-sulphide–rich intraformational argillite pebbles in quartz arenite cycles of the Grinnell Formation on Spionkop Ridge (site RM17); e) Oldman River Mississippi Valley–type (MVT) Pb-Zn occurrence in brecciated dolomitized limestone of the Upper Devonian Palliser Formation on the east flank of Mount Gass (site RM20); and f) mineralized zone at the lower (northern) adit shown in photo (e).**

poorly crystalline to amorphous clay compositionally similar to illite/saponite, albite, chlorite, muscovite/illite and biotite (Appendices 8 and 9). The whole-rock geochemistry of this sample is characterized by anomalous concentrations of Pb, Cu, Ag, Au, Mo, Co, Ba, As, Sb, Bi, Tl and Hg, with traces of Pd and Pt (Table 3). However, stratigraphically the same sulphide-rich quartzite bed at South Drywood Creek (site RM06) contains anomalous concentrations of Cu and As but low concentrations of other metals.

The stratabound, sediment-hosted Pb-Zn-Cu sulphides, associated with elevated concentrations of Ag±Au±Co±Mo±Cd±As±Sb±Bi±Hg±Tl, within the Siyeh and Sheppard formations of the Belt-Purcell Supergroup in the Clark Range area perhaps represent syngenetic, sedimentary-exhalative (SEDEX) mineralization (Olson et al., 1994). The SEDEX mineralization might have formed by accumulation of sulphides from vent-distal metalliferous brine pools (generally <250°C) in an anoxic environment on the seafloor or just below the sediment surface due to hydrothermal activity controlled by active extensional faults within the rift basin (Lydon, 2007). Figure 10 illustrates a genetic model for vent-distal SEDEX deposits formed from bottom-hugging brines (after Goodfellow and Lydon, 2007).

The Sullivan Pb-Zn-Ag-Au-Cd-Sb-Cu-Bi-Sn past-producer in adjacent southeastern British Columbia is a world-class SEDEX deposit within the turbiditic sequence in the central part of the Belt-Purcell rift, whereas the Sheep Creek Cu-Co-Pb-Zn deposit in Montana lies at the margin of the basin (Lydon, 2007). The occurrence of SEDEX-type mineralization within the Siyeh and Sheppard formations in the Clark Range area indicates that discharge of metalliferous fluids continued at the rift margin during deposition of the late Belt-Purcell rift-cover sequence (Olson et al., 1994).

## 6.3 Stratabound, Sediment-Hosted Cu-Ag-Pb Sulphides of the Belt-Purcell Supergroup

Table 4 lists selected geochemical results from stratabound, sediment-hosted Cu-Ag-Pb sulphide occurrences within the Belt-Purcell Supergroup of southwestern Alberta. This type of mineralization was first discovered on the northern side of Yarrow Creek (site RM21), just north of Waterton Lakes National Park during 1910–1920 (Figure 1; Morton, 1971; Goble, 1972a).

During subsequent exploration, numerous occurrences of stratabound laminae, stringers (up to 0.03 by 2.0 cm) and finely disseminated bornite, covellite, chalcocite, chalcopyrite (±tennantite±sphalerite±galena±pyrrhotite±pyrite±digenite±djurleite±idaite±wittichenite±magnetite±hematite) and secondary malachite and/or azurite were found at several stratigraphic levels within the Belt-Purcell Supergroup of the Clark Range (Figure 2). These include

- multiple quartz arenite beds within redbed cycles of the upper Appekunny Formation and throughout the Grinnell Formation at Middle Kootenay Pass (site RM01) and Spionkop Ridge (site RM17);
- black argillite at the base of the Siyeh Formation on South Drywood Creek (site RM06) and a 3.0–4.6 m section of the upper Siyeh Formation on Spionkop Ridge (near site RM16);
- two beds (1.2–2.4 m thick) of siliceous dolomite to siltstone of the upper Sheppard Formation, traced on Spionkop and Barnaby ridges (sites RM07 and 16);
- at least three beds (0.6–3.7 m thick) of silty to argillaceous dolomite of the lower Gateway Formation and two silty dolomite to dolomitic argillite beds (0.03–1.8 m thick) of the upper Gateway Formation on Barnaby Ridge (near site RM07) and in the North Kootenay Pass (near site RM14); and
- a 0.01–0.61 m thick section of dolomite, dolomitic argillite, siltstone and oolitic sandstone of the Roosville Formation at Jutland Mountain and La Coulotte Peak (site RM19; Duncan, 1970; Halferdahl, 1971; Van Dyck, 1971; Goble, 1973; Morton et al., 1974; Collins and Smith, 1977).

The cupriferous quartz arenite cycles form either stacks of more than 25 thin, lenticular mineralized beds (0.03–0.15 m thick) or 0.8–5.2 m thick mineralized zones throughout the Grinnell Formation (Duncan, 1970; Halferdahl, 1971; Goble, 1972a, b; Collins and Smith, 1977). The individual mineralized cycles extend for tens to hundreds of metres along strike, with each cycle typically consisting of the following six units (Collins and Smith, 1977), from bottom to top:

1) red argillite containing scattered, well-rounded quartz grains and up to 5% finely disseminated hematite, with mudcracks and salt hoppers
2) greyish-green argillite, with gradual transition from the underlying red argillite and upward increase in sand content
3) white to greenish-grey, moderately sorted, coarse-grained, crossbedded cupriferous quartzite or sandstone, with some interbedded intraformational conglomerate containing rounded green argillite pebbles
4) a thin (up to 6 mm) green argillite seam or parting
5) white, medium- to coarse-grained quartzite with a rippled upper surface
6) green silty argillite with a flat upper surface

Interstitial chalcocite, bornite, covellite, tennantite, pyrite and traces of chalcopyrite occur as discrete grains (up to 1 mm in diameter) and intergrowths with silica cement, mainly in the quartz arenite (unit 3). Very fine grained Cu-sulphides are often concentrated on the green argillite pebbles (Figure 9d). Secondary Cu minerals include azurite and malachite (Duncan, 1970; Halferdahl, 1971; Van Dyck, 1971; Goble, 1973a; Morton et al., 1974; Collins and Smith, 1977).

Goble (1972b) reported 0.03%–2.86% Cu, 0.05%–0.10% Zn and trace–2.06 ppm Ag for an 8.5–19.8 m section of the upper Appekunny Formation containing disseminated pyrite and chalcopyrite in quartzite beds at Yarrow Creek (site RM21). On Spionkop Ridge (site RM17), assays for cupriferous quartzite indicated 0.18%–0.62% Cu across 1.3–2.0 m intervals in outcrop and up to 1.09% Cu and 7.54 ppm Ag across a 0.5 m interval from a drillhole (Duncan, 1970; Halferdahl, 1971).

Several cupriferous quartzite beds within a 61 m thick section of the upper Grinnell Formation north of Yarrow Creek (site RM21) returned values of 0.04%–7.20% Cu, trace–68.57 ppm Ag (up to 2036 ppm Ag near basaltic dike at Yarrow Creek), trace–514 ppb Au and traces of Pb (Halferdahl, 1971; Goble,

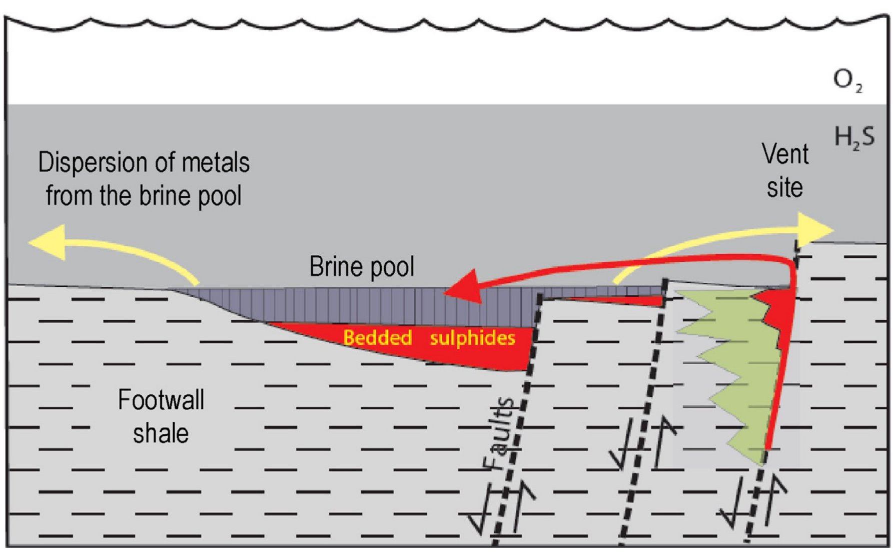


**Figure 10. Genetic model for vent-distal SEDEX deposits formed by the reaction of metals in hydrothermal fluids discharged into seawater as bottom-hugging, basinal saline brines with biogenic $H_2S$ in the ambient, anoxic water column (after Goodfellow and Lydon, 2007).**

**Table 4. Selected results from stratabound, sediment-hosted Cu-Ag-Pb sulphide occurrences within the Belt-Purcell Supergroup of southwestern Alberta. The data obtained by in situ PXRF analysis are shown for comparison with the whole-rock laboratory data. Anomalous concentrations are in bold type. Thickness refers to either the true thickness of the formation, or the width of a channel sample (in red type). See Figure 1 for locations of sample sites.**

| Location | Yarrow Creek (RM21) | | Middle Kootenay Pass (RM01 and RM08) | | South Drywood Creek (RM06) | | Barnaby Ridge, southwest flank (RM07) | Spionkop Ridge (RM16 and RM17) | | | La Coulotte Peak (RM19) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Host Formation | Appekunny | | Grinnell | Appekunny | Grinnell | Siyeh | Grinnell | Siyeh | Grinnell | | Roosville | |
| Lithology | Siltstone | | Quartz arenite | Argillite pebble conglomerate | Argillite pebble conglomerate | Siltstone | Argillite pebble conglomerate | Siltstone | Quartz arenite | | Interbedded dolomitic siltstone and sandstone | |
| Analysis | Lab | PXRF[1] | Lab | Lab | Lab | Lab | Lab | Lab | Lab | PXRF[1] | Lab | PXRF[1] |
| Ag (ppm) | **0.7** | <71 | **8.8** | 0.6 | 0.1 | 0.1 | 0.1 | 0.2 | **9.1** | 179 | **0.9** | <126 |
| As (ppm) | 7.0 | 63 | **33** | 3.0 | 14 | 9.3 | 7.0 | **49** | **44** | <49 | 3.8 | 130 |
| Au (ppb) | <0.2 | <43490 | **7.0** | 0.5 | <0.2 | 1.2 | 0.9 | 0.5 | 5.0 | <131070 | 0.4 | <89500 |
| Ba (ppm) | 420 | 565 | 1528 | 870 | 360 | 733 | 150 | 1200 | 550 | 2271 | **26400** | 17837 |
| Be (ppm) | 2.0 | n.d. | 0.2 | 0.4 | <0.1 | 2.3 | 0.4 | 2.0 | <0.1 | n.d. | 3.0 | n.d. |
| Bi (ppm) | 0.33 | <21 | **24** | 0.22 | 0.40 | 0.17 | 0.09 | 0.11 | **230** | 2511 | **2.7** | 95 |
| Br (ppm) | <0.5 | n.d. | 1.9 | 3.0 | 2.3 | 1.4 | 0.9 | 1.9 | 1.2 | n.d. | <0.5 | n.d. |
| Cd (ppm) | 0.12 | <26 | 0.05 | 0.20 | 0.03 | 0.07 | 0.03 | 0.02 | <0.01 | <50 | 0.20 | <39 |
| Ce (ppm) | 60 | n.d. | 17 | 43 | 43 | 89 | 89 | 64 | 6.1 | n.d. | 50 | n.d. |
| Co (ppm) | 4.9 | <460 | 1.9 | 23 | 5.0 | 6.0 | 6.4 | 11 | 1.1 | <137 | 7.0 | <472 |
| Cr (ppm) | 41 | 227 | 15 | 21 | 12 | 44 | 18 | 34 | 27 | <99 | 31 | <218 |
| Cs (ppm) | 5.4 | n.d. | 0.2 | 1.2 | 0.5 | 10 | 2.3 | 7.0 | 0.4 | n.d. | 4.0 | n.d. |
| Cu (ppm) | **92** | 355 | **11700** | **223** | **1444** | **1785** | **577** | **1170** | **8288** | 204323 | **706** | 41013 |
| F (ppm) | 600 | n.d. | 1130 | 300 | 540 | 1387 | 660 | 1000 | 150 | n.d. | 680 | n.d. |
| Ga (ppm) | 13 | n.d. | 1.0 | 4.5 | 5.4 | 17 | 9.8 | 14 | 2.5 | n.d. | 16 | n.d. |
| Ge (ppm) | <0.1 | n.d. | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | n.d. | <0.1 | n.d. |
| Hg (ppb) | 34 | n.d. | 71 | 7 | 13 | 10 | 10 | 23 | 23 | n.d. | 20 | n.d. |
| In (ppm) | <0.02 | n.d. | 0.03 | 0.17 | 0.04 | 0.05 | 0.08 | 0.04 | <0.02 | n.d. | 0.07 | n.d. |
| Ir (ppb) | <5 | n.d. | <5 | <5 | <5 | <5 | <5 | <5 | <5 | n.d. | <5 | n.d. |
| Li (ppm) | 45 | n.d. | 18 | 38 | 44 | **97** | 78 | 92 | 7.8 | n.d. | 56 | n.d. |
| Mn (wt. %) | 0.007 | <0.02 | 0.02 | 0.14 | 0.05 | 0.01 | 0.06 | 0.03 | 0.007 | <0.02 | 0.07 | 0.12 |
| Mo (ppm) | 1.5 | <8.2 | **58** | 2.0 | 1.1 | 0.8 | 0.4 | 3.0 | 0.8 | <17 | 0.5 | 29 |
| Ni (ppm) | 23 | 148 | 4.3 | 14 | 5.5 | 16 | 12 | 13 | 2.0 | <143 | 12 | <103 |
| Pb (ppm) | **118** | <29 | 4 | 13 | 7.0 | 9.0 | **74** | **84** | 3.0 | <95 | **214** | 3645 |
| Pd (ppb) | <0.5 | <11240 | <0.5 | <0.5 | <0.5 | 1.7 | <0.5 | <0.5 | <0.5 | <22660 | <0.5 | <21550 |
| Pt (ppb) | <0.1 | n.d. | **3.0** | 0.3 | <0.1 | 0.9 | <0.1 | 0.2 | 0.6 | n.d. | 0.4 | n.d. |
| Re (ppb) | <1 | n.d. | 5 | 2 | 3 | <1 | 2 | **7** | <1 | n.d. | <1 | n.d. |
| S (wt. %) | 0.05 | 0.39 | 0.20 | 1.40 | 0.11 | 0.06 | <0.02 | 0.20 | 0.06 | 4.76 | 0.57 | 0.26 |
| Sb (ppm) | 0.7 | <53 | 0.3 | 0.7 | 0.5 | 1.1 | 0.5 | 1.0 | 0.2 | <96 | 1.3 | <78 |
| Se (ppm) | 0.1 | <4.6 | 0.9 | 0.6 | 0.2 | 0.4 | 0.2 | 0.1 | 0.8 | <29 | 1.4 | 47 |
| Sn (ppm) | 2.0 | <59 | 0.2 | 0.6 | 0.6 | 2.5 | 1.5 | 2.0 | 0.4 | <113 | 4.6 | <106 |
| Te (ppm) | <0.02 | n.d. | 0.10 | 0.05 | <0.02 | 0.04 | 0.04 | <0.02 | 0.05 | n.d. | 0.08 | n.d. |
| Th (ppm) | 9.1 | n.d. | 1.8 | 3.3 | 3.5 | 11 | 5.2 | 8.5 | 2.3 | n.d. | 19 | n.d. |
| Tl (ppm) | 0.10 | n.d. | 0.03 | <0.02 | 0.30 | 0.19 | 0.06 | **0.62** | <0.02 | n.d. | 0.07 | n.d. |
| U (ppm) | 2.8 | n.d. | 8.9 | 1.1 | 6.8 | 3.2 | 2.5 | 2.5 | 26 | n.d. | 9.1 | n.d. |
| V (ppm) | 47 | 133 | 11 | 21 | 19 | 64 | 25 | 53 | 133 | 285 | 47 | 1799 |
| W (ppm) | 1.0 | <120 | <0.1 | 0.3 | 0.6 | 3.3 | 1.3 | 2.0 | 0.2 | <258 | 1.7 | <191 |
| Y (ppm) | 18 | n.d. | 23 | 15 | 11 | 29 | 22 | 20 | 11 | n.d. | 77 | n.d. |
| Zn (ppm) | 69 | <25 | 6.0 | 27 | 44 | 65 | 45 | 51 | 5.0 | <238 | 41 | 346 |
| Thickness (m) | 0.3 | | 0.03 | 0.2 | 0.33 | 0.15 | 0.2 | 0.05 | 3.7 | | 0.04 | |

[1] in situ analysis with portable X-ray fluorescence analyzer

1972a, b, 1973, 1974a). The lowest of these beds, the 'YS' bed (1.5–3.7 m thick), was traced for more than 4.8 km along strike from north of Yarrow Creek (site RM21) to just south of Spionkop Creek (near site RM10).Goble (1972a, b, 1974a) estimated that the 'YS' bed could contain 2.2 million tonnes grading 2.0%–2.25% Cu and 5.14–8.57 ppm Ag, or 15–18 million tonnes grading 1.25%–1.75% Cu and 6.86–10.29 ppm Ag. Morton et al. (1974) reported grades of 0.5%–5.71% Cu and 2.1–20.2 ppm Ag for the stratabound, sediment-hosted Cu-Ag occurrences, with considerably enriched concentrations in proximity to the basaltic sills and/or normal faults.

Our field examinations and mineralogical and geochemical analyses confirm the presence of previously reported stratabound, sediment-hosted Cu-sulphide mineralization at several stratigraphic levels within the Belt-Purcell Supergroup in the Clark Range of southwestern Alberta (Table 2). Quantitative MLA results for cupriferous quartz arenites of the Grinnell Formation at Middle Kootenay Pass (site RM01; sample 8175) and Spionkop Ridge (site RM17; sample 8267) indicate accessory apatite, Cu-sulphate, barite, Cu-oxide/carbonate, covellite, goethite and jarosite (±carbonate±zircon±rutile) in a matrix of mainly quartz with trace amounts of muscovite/illite, poorly crystalline illite-smectite, amorphous silica-rich material, K-feldspar, biotite and chlorite±albite (Appendix 9). The SEM-EDS observations show replacement of covellite/digenite by Cu-sulphate, Cu-oxide/carbonate and/or Cu-goethite, and the presence of tenorite, Cu-Bi-arsenate and Cu-phosphate associated with apatite, barite and clay attached to quartz.

The whole-rock geochemical results indicate anomalous concentrations of Cu, Ag, Bi and As (±Mo±Au±Pt±Re) for these two occurrences (Table 4). Beds of argillite-pebble conglomerate and quartzite (0.2–0.3 m thick) in the upper Grinnell Formation contain erratic chalcopyrite±bornite streaks (0.02 by 1.5 cm) associated with green argillite pebbles. Samples from these beds on South Drywood Creek (site RM06) and on the southwest flank of Barnaby Ridge (site RM07) indicate high concentrations of Cu, coupled with an elevated concentration of Pb at the latter occurrence.

A 0.2 m thick bed of pyrite-rich, oxidized, argillite-pebble conglomerate and quartzite of the Appekunny Formation at Middle Kootenay Pass (site RM08) contains an anomalous concentration of Cu and slightly elevated concentration of Ag, whereas oxidized laminated siltstone near the top of this formation at Yarrow Creek (site RM21) shows a slightly anomalous concentration of Pb, coupled with Cu and Ag (Table 4).

On South Drywood Creek (site RM06) and Spionkop Ridge (site RM16), black siltstone of the lowermost Siyeh Formation contains very fine grained, disseminated Cu mineralization. This is marked by malachite staining on the weathered surface, which shows high concentrations of Cu (±Pb±As±Re±Tl) across 0.05–0.15 m thick sections.

On La Coulotte Peak (site RM19), a 0.04 m thick section of thinly interbedded dolomitic siltstone and sandstone in the Roosville Formation contains oxidized sulphide blebs up to 1 cm in diameter (Figure 11). Whole-rock and in situ geochemical analyses of this bed indicate anomalous concentrations of Cu, Pb, Ba, Bi and Ag (Table 4), consistent with historical data for this occurrence (Halferdahl, 1971). It is noteworthy that a 2 m thick basaltic sill intrudes the Roosville Formation about 1.5 m stratigraphically above the sulphide-bearing interval.

Several hypotheses have been proposed to explain the origin of the stratabound, sediment-hosted Cu-sulphide mineralization in the Belt-Purcell basin of southwestern Alberta. Duncan (1970) suggested that the stratabound Cu mineralization in the Belt-Purcell strata could be syngenetic to epigenetic or hydrothermal in origin, similar to the Kupferschiefer deposits in Germany, the White Pine deposit in Michigan or the Dzhezkazgan deposits in Kazakhstan. However, Halferdahl (1971) considered the Cu mineralization hosted by the Grinnell Formation to be mainly fault controlled and possibly sedimentary in origin for the siltstone-hosted Cu occurrences, but different from the Kupferschiefer-type deposits.

Goble (1973) and Morton et al. (1974) suggested that local enrichment of Cu-Ag mineralization in redbed sequences along normal fault zones and contacts with mafic intrusions could be due to short-range hydrothermal mobilization and redeposition of initially exhalative, syngenetic and diagenetic, stratabound metals within the Belt-Purcell rift basin.

Collins and Smith (1977) proposed a model in which Cu-sulphide mineralization is controlled by repeated redox cycles during deposition or contemporaneous with cementation of fluvial to lacustrine, cupriferous quartz arenites of the Grinnell Formation deposited by intermittent sheet floods on a floodplain surface in an arid to semiarid environment. Based on the textural relationships of silica cement and sulphides in the quartz arenite units, Collins and Smith (1977) suggested that the highly mobile Cu, complexed in solution under the prolonged oxidizing conditions during deposition of the argillites, could have precipitated syngenetically in the organically induced reducing environment during deposition and diagenesis of the quartz arenites.

Recently, Lydon (2007) interpreted the redbed-type Cu-Ag deposits of the Belt-Purcell basin to be the result of migration of warm (~120°C), oxic, saline fluid along bedding or vertical fluid-escape structures during the earliest stages of the rift-sag phase. The epigenetic sulphides were precipitated in pore space between quartz grains under reducing conditions before any major compaction of the sediment.

Morton et al. (1974) pointed out that the stratigraphic positions, host lithology and relative grades of the stratabound, redbed-type Cu-Ag sulphide occurrences in the Clark Range of southwestern Alberta correlate remarkably well with the Cu-Ag deposits in the Revett, Spokane, Helena Dolomite and Mount Shields formations of Montana and Idaho. Examples of the redbed-type Cu-Ag deposits hosted by sandstones of the Revett Formation, a stratigraphic equivalent of the Grinnell Formation of southwestern Alberta, include the Spar Lake (Troy), Rock Creek and Montanore deposits of northwestern Montana (Lydon, 2007).

Our observations and new results confirm laterally extensive, stratigraphically controlled Cu-Ag sulphide mineralization within redbed cycles of the Appekunny and Grinnell formations. Therefore, we agree with previous conclusions that the stratabound, sediment-hosted Cu-sulphide occurrences in the Clark Range


**Figure 11. Close-up of the Roosville Formation laminated dolomitic siltstone containing oxidized sulphide blebs on La Coulotte Peak (site RM19).**

of southwestern Alberta might have originated due to a large-scale synsedimentary deposition of metals in the Belt-Purcell rift basin (Morton et al., 1974; Olson et al., 1994).

### 6.4 Stratabound, Polymetallic Zn-Ni-Mo Mineralization of the Devonian–Mississippian Exshaw Formation Black Shale

Table 5 lists selected geochemical results from black shale, argillaceous siltstone and bentonite of the Devonian–Mississippian Exshaw Formation on the east flank of Mount Gass (site RM20) in southwestern Alberta (Figure 1). Geldsetzer et al. (1987) completed a regional study of the Devonian–Mississippian Exshaw Formation black shale of southwestern Alberta and reported elevated concentrations of up to 0.4% V, 775 ppm Zn, 155 ppm Ni, 33 ppm Sb and 4.0 ppm Ag for the basal Exshaw black shale.

Richards et al. (1994) described the type section of the Exshaw Formation at Jura Creek. Here the lower Exshaw Formation consists of planar-laminated black shale with abundant phosphate nodules, calcareous to cherty concretions, disseminated vaesite, sphalerite and pyrite, and yellowish-grey marine tuff seams (2.0–5.5 cm thick). A 1–6 cm thick basal layer of the formation comprises conglomeratic sandstone containing abraded bone fragments and fish scales. This basal layer was interpreted to represent a reworked tuff or submarine lag deposit. The whole-rock analyses for the lower Exshaw Formation indicate up to 2.19% Zn, 0.48% Ni, 560 ppm Mo, 240 ppm Cu, 128 ppm Y and 47 ppm U (Richards et al., 1994).

We examined the 6 m thick Devonian–Mississippian Exshaw Formation, exposed on the east flank of Mount Gass (site RM20; Figure 12a). The Exshaw Formation comprises very fissile black shale with an oxidized grey bentonite layer (0.05 m thick) lying about 0.05 m above its contact with carbonates of the Upper Devonian Palliser Formation (Figure 12b). The fissile black shale grades into argillaceous siltstone interbedded with laminated black shale stratigraphically higher in the Exshaw Formation (Figure 12c). This is conformably overlain by buff dolomitic siltstone of the Mississippian Banff Formation.

Quantitative mineral liberation analyses for the basal black shale of the Exshaw Formation (sample 8296) indicate the presence of accessory apatite, Ca-Fe-Al–phosphate, globular Fe-Zn–oxide, pyrite and cerussite. The rock is composed mainly of poorly crystalline clay (compositionally similar to illite-smectite), muscovite/illite, amorphous silica-rich material and quartz. Minor to accessory phases include calcite, K-feldspar, chlorite, albite, biotite, goethite, jarosite, rutile and zircon (Appendices 8 and 9). The SEM-EDS observations show apatite particles mantled by Ca-Fe-Al–phosphate, pyrite replacement by goethite, and Fe-Zn-oxide spherules (about 10–12 µm in diameter) within a poorly crystalline phosphate–silica–illite/clay matrix. However, in contrast to the Jura Creek occurrence, vaesite and sphalerite were not found in the analyzed sample from the east flank of Mount Gass.

Our whole-rock and in situ PXRF geochemical results indicate elevated concentrations of V, Ni, Re, Mo, Sb and Se for the upper and middle Exshaw Formation black shale and argillaceous siltstone (Table 5). The higher in situ S concentrations may indicate heterogeneous distribution of sulphides and/or sulphates in these rocks. The basal 0.05 m section of the Exshaw Formation black shale (sample 8296) shows anomalously high concentrations of Zn, Ni, Mo, Cu, Co, Cd, U and As, coupled with elevated concentrations of Sb, Hg, F, Li and Y (Table 5). Compared with this basal black shale, the grey bentonite layer (sample 8297; Figure 12b) contains slightly lower concentrations of Zn and Ni, coupled with pronounced enrichment in Hg, F, Th and Tl, and weakly anomalous concentrations of Cd and Bi (Table 5).

The stratabound, black-shale polymetallic mineralization is interpreted to represent a basin-wide exhalative accumulation of massive to semimassive, rhythmically laminated, clastic or nodular sulphides. These sulphides are associated with phosphorites, chert, barite and bentonite horizons within organic-rich,

**Table 5. Selected results from black shale, argillaceous siltstone and bentonite of the Devonian–Mississippian Exshaw Formation at Mount Gass (site RM20), southwestern Alberta. The Exshaw Formation is about 6 m thick at this site and contains a 0.05 m thick bentonite layer approximately 0.05 m above the contact with the underlying Upper Devonian Palliser Formation. The in situ PXRF data are shown for comparison with the whole-rock laboratory data. Anomalous concentrations are in bold type. See Figure 1 for locations of sample sites.**

| Sample No. | 8294 | | 8295 | | 8296 | 8297 |
|---|---|---|---|---|---|---|
| Lithology | Laminated black shale, 1 m below the Exshaw-Banff contact | | Black argillaceous siltstone, 3 m below the Exshaw-Banff contact | | Fissile, rusty black shale, 0–0.05 m interval above the Exshaw-Palliser contact | Grey, rusty bentonite, 0.05–0.10 m interval above the Exshaw-Palliser contact |
| Analysis | Lab | PXRF[1] (± 2σ error) | Lab | PXRF[1] (± 2σ error) | Lab | Lab |
| Ag (ppm) | 0.80 | <59 | 0.40 | <50 | 0.18 | 0.12 |
| As (ppm) | 16 | 72 ± 7.1 | 18 | <6.9 | **81** | 24 |
| Au (ppb) | 5.0 | <49930 | 6.0 | <37820 | 5.7 | 2.1 |
| Ba (ppm) | 250 | 392 ± 86 | 131 | <140 | 280 | 330 |
| Be (ppm) | 1.0 | n.d. | 1.0 | n.d. | 7.0 | 3.0 |
| Bi (ppm) | 0.20 | <12 | 0.20 | <8.4 | 0.27 | **1.22** |
| Br (ppm) | 0.9 | n.d. | 1.0 | n.d. | 1.7 | <0.5 |
| Cd (ppm) | 0.40 | <22 | 0.15 | <21 | **47** | **4.9** |
| Ce (ppm) | 31 | n.d. | 24 | n.d. | 72 | 58 |
| Co (ppm) | 0.9 | <272 | 1.6 | <102 | **96** | 2.2 |
| Cr (ppm) | 68 | 121 ± 57 | 55 | <59 | 84 | 7.0 |
| Cs (ppm) | 6.0 | n.d. | 4.0 | n.d. | 9.3 | 12 |
| Cu (ppm) | 12 | <37 | 12 | <33 | **143** | 27 |
| F (ppm) | 520 | n.d. | 570 | n.d. | **3897** | **5130** |
| Ga (ppm) | 7.9 | n.d. | 6.8 | n.d. | 22 | 24 |
| Ge (ppm) | <0.10 | n.d. | <0.10 | n.d. | 0.17 | <0.1 |
| Hg (ppb) | 98 | n.d. | 101 | n.d. | **208** | **300** |
| In (ppm) | <0.02 | n.d. | <0.02 | n.d. | 0.02 | 0.06 |
| Ir (ppb) | <5 | n.d. | <5 | n.d. | <5 | <5 |
| Li (ppm) | 26 | n.d. | 23 | n.d. | **106** | 86 |
| Mn (ppm) | 24 | <142 | 17 | <116 | 419 | 6.0 |
| Mo (ppm) | 47 | 93 ± 5.6 | **66** | <7.3 | **119** | 18 |
| Ni (ppm) | **160** | 99 ± 44 | **170** | <81 | **1409** | **130** |
| Pb (ppm) | 26 | <15 | 27 | <12 | 29 | 51 |
| Pd (ppb) | 2.6 | <9460 | 1.7 | <8330 | 0.9 | <0.5 |
| Pt (ppb) | 2.2 | n.d. | 2.0 | n.d. | 2.1 | 0.9 |
| Re (ppb) | **182** | n.d. | **155** | n.d. | 38 | 10 |
| S (wt. %) | 0.10 | 3.05 ± 0.05 | 0.30 | 0.80 ± 0.03 | 0.09 | 0.54 |
| Sb (ppm) | **28** | 49 ± 23 | **19** | <36 | **21** | 9.1 |
| Se (ppm) | **17** | 19 ± 4.5 | **13** | <7.0 | 9.5 | 11 |
| Sn (ppm) | 1.3 | <48 | 0.9 | <40 | 7.3 | 6.0 |
| Te (ppm) | 0.13 | n.d. | 0.13 | n.d. | 0.07 | 0.18 |
| Th (ppm) | 4.7 | n.d. | 3.5 | n.d. | 9.8 | **30** |
| Tl (ppm) | 0.84 | n.d. | 1.12 | n.d. | 3.90 | **13.1** |
| U (ppm) | 13 | n.d. | 9.4 | n.d. | **86** | 17 |
| V (ppm) | **2024** | 3000 ± 92 | **1413** | 1845 ± 48 | 150 | 54 |
| W (ppm) | 1.0 | <116 | 0.5 | <99 | 1.6 | <0.1 |
| Y (ppm) | 12 | n.d. | 8.0 | n.d. | **114** | 70 |
| Zn (ppm) | 47 | 51 ± 12 | 50 | <19 | **3568** | **589** |

[1] in situ analysis with portable X-ray fluorescence analyzer

transgressive shale sequences and formed in anoxic basins of a passive continental margin or rifts (e.g., Lefebure and Coveney, 1995; Lott et al., 1999). The best-mineralized zones mark seafloor hydrothermal discharge centres controlled by synrift normal faults (Olson et al., 1994).

The stratigraphy and observed geochemical variations across the Exshaw Formation in southwestern Alberta suggest that anoxic precipitation of metals peaked during the earliest stage of the Upper Devonian–Mississippian. This stage was characterized by a marine transgression across the carbonate platform flanking the epicratonic basins that extended west along the rifted passive continental margin of ancestral North America (e.g., Nelson and Colpron, 2007). It is interesting to note that this metallogenic event is closely associated with the deposition of marine bentonites of the lower Exshaw Formation (Richards et al., 1994), and is coincident with the initiation of alkaline, ultramafic, kimberlite and carbonatite magmatism (ca. 360 Ma) along the Rocky Mountain Trench–Kechika Fault in British Columbia. This suggests an extensional regime, possibly due to lithospheric thinning of the passive continental margin during the Late Devonian–Mississippian transition (Pell, 1994; Rukhlov and Bell, 2010).

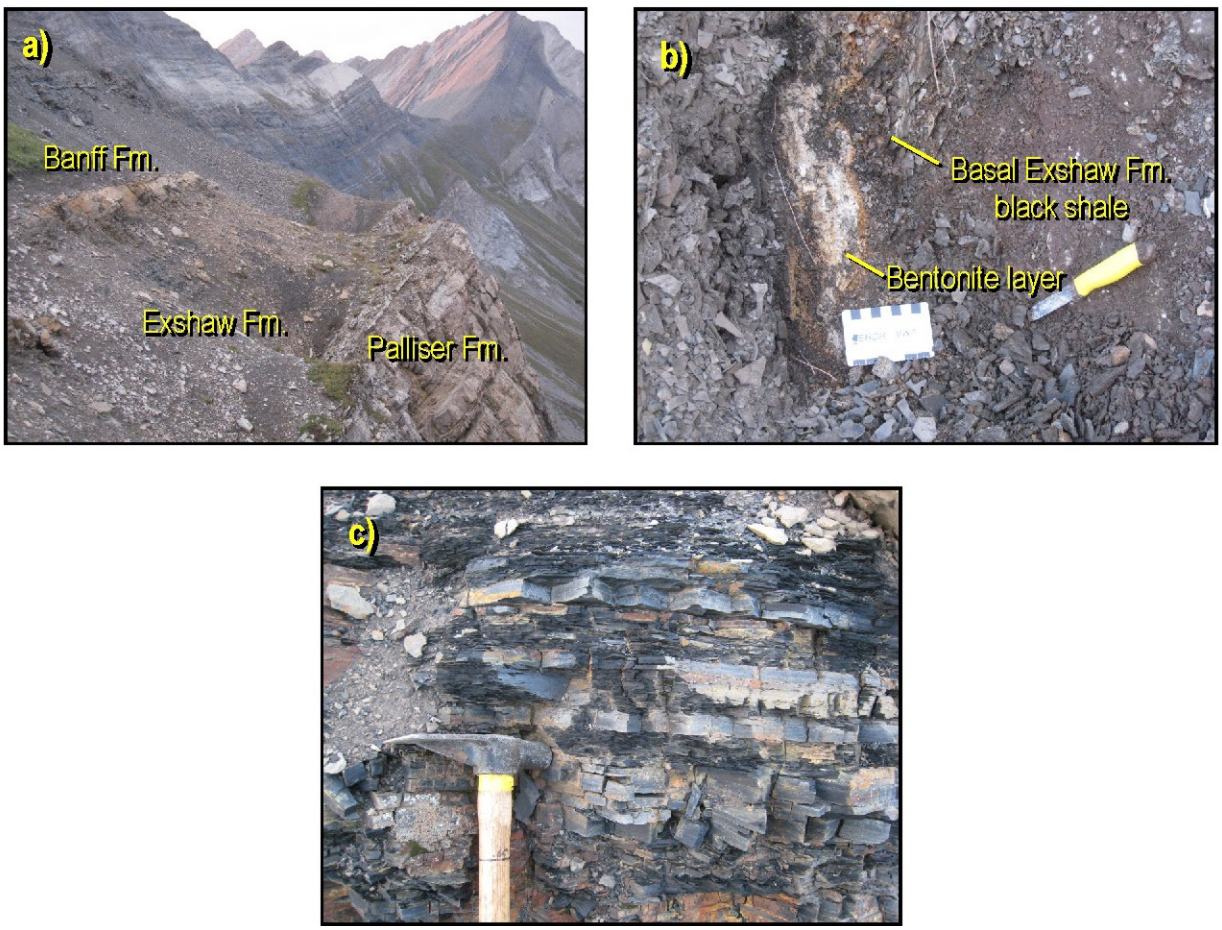


**Figure 12. Devonian–Mississippian Exshaw Formation exposed on the east flank of Mount Gass near the headwaters of the Oldman River, southwestern Alberta: a) northwesterly view of the outcrop, showing the Exshaw Formation underlain by carbonate strata of the Upper Devonian Palliser Formation and overlain by buff dolomitic siltstone of the Mississippian Banff Formation; b) close-up of a rusty-weathering, grey bentonite layer about 0.05 m stratigraphically above the base of the Exshaw Formation; and c) close-up of black argillaceous siltstone interbedded with laminated black shale of the upper 3 m section of the Exshaw Formation.**

## 6.5 Porphyry to Epithermal Au–Ag±Cu±Mo±W±Pb±Zn Mineralization Related to Cretaceous Alkaline Intrusions and Crowsnest Formation Volcanic Rocks

Table 6 lists selected geochemical results from Cretaceous alkali trachyte intrusions, adjacent sedimentary rocks, and volcanic rocks of the Crowsnest Formation of southwestern Alberta. In 1935, sulphide mineralization associated with a 41 m thick dike, composed of silicified alkali syenite breccia with up to 70.6 ppm Au, was discovered within the Belt-Purcell strata on the ridge between Commerce Peak and Sunkist Ridge in southeastern British Columbia, about 2.4 km south of the Alberta border (Morton, 1971; Goble, 1972a).

Follow-up exploration during the 1960s and 1970s discovered disseminated pyrite-pyrrhotite (±chalcopyrite) mineralization (up to 3%–5% sulphides), tetrahedrite- and azurite-bearing quartz veins, and gossan-like and andradite-carbonate contact-metasomatic zones associated with the Cretaceous alkaline sills and dikes. These intrusions cut the Mesoproterozoic Belt-Purcell Supergroup and Middle Cambrian Flathead Formation strata along the Continental Divide in southwestern Alberta and adjacent British Columbia (sites RM03, 04, 09 and 19). Assays from some of these occurrences yielded up to 1.37 ppm Au, 32.7 ppm Ag, 1.75% Cu and 200 ppm Zn (Halferdahl, 1971; Goble, 1972a, 1974b, c; Morton, 1971; Morton et al., 1974).

Regional lithogeochemical studies carried out by several exploration companies and the government in the Crowsnest Pass area reported up to 10–50 ppb Au, along with weakly elevated concentrations of Ag, Cu, Zn, Pb, Mo, W, V, As, Bi and Sb, associated with pyrite and minor galena and chalcopyrite in volcaniclastic rocks of the Crowsnest Formation. However, economic mineralization was not found (Williams, 1989; Willliamson et al., 1993; Cantin et al., 1995; Leckie and Craw, 1995; Waskett-Myers and Graf, 1995; Peterson et al., 1997). Olson et al. (1994) suggested that the Au-Ag-As-Sb-Hg geochemical anomalies associated with Paleozoic calcareous siltstone and carbonate strata in the area extending from northwest of Blairmore to the Livingstone Range (Figure 1) could indicate epithermal or Carlin-type, disseminated sulphide mineralization related to the Cretaceous alkaline magmatism.

Our observations in the field and mineralogical and geochemical results confirm the presence of intrusion-related sulphide mineralization associated with enrichment in precious and base metals, within both the alkali trachyte and phonolite dikes and the adjacent country rocks. Quantitative mineralogical results indicate the presence of minor to trace goethite, rutile, hematite, jarosite, apatite and other phosphates, and Mn-oxides in an altered aegirine-augite trachyte sill (about 3 m thick) on Jutland Brook (site RM03). These minerals are associated with abundant orthoclase, illite and poorly crystalline to amorphous illite/smectite–like alteration products after K-feldspar and vesicular volcanic glass (?), with dehydration cracks. Other minor to trace constituents include chlorite, biotite, amorphous silica, quartz, albite and plagioclase (Appendices 8 and 9). The crossbedded quartzite and quartzose pebble conglomerate of the Middle Cambrian Flathead Formation in a 0.1 m section immediately above this intrusion contains minor or accessory K-feldspar, amorphous silica, goethite, illite, jarosite, chlorite, biotite, rutile and zircon in a quartz matrix (about 90 vol. %). Our microscopic observations, the SEM-EDS results and the modal mineralogy of the trachyte sill and sedimentary host rocks all suggest strong argillic alteration and oxidation, with some silicification and propylitic alteration. Whole-rock geochemical data indicate anomalous concentrations of Zn, Mn, W, As, Sb and Hg in the altered trachyte, and even higher concentrations of W, As, Sb and Hg, coupled with elevated concentrations of Au, Ag, Th and Pb but low Zn content, in the adjacent Flathead Formation strata (Table 6).

On La Coulotte Ridge (sites RM04 and RM09), a swarm of Cretaceous aegirine-augite (±analcime±melanite) alkali trachyte sills and dikes (up to 7.2 m thick) intrudes siltstones of the Roosville Formation (Figures 4a–d). The host siltstone adjacent to the intrusions shows malachite staining, indicating the presence of fine-grained disseminated Cu mineralization. The sills display variable degrees of alteration, ranging from relatively fresh to strongly carbonatized, propylitized and/or argillically altered

**Table 6. Selected results from Cretaceous alkaline intrusions, adjacent sedimentary rocks, and volcaniclastic rocks of the Crowsnest Formation of southwestern Alberta. Anomalous concentrations are in bold. Thickness refers to either the thickness of the formation or intrusion, or the width of the channel sample (in red type). Figure 1 shows the locations of sample sites.**

| Location | Jutland Brook (RM03) | | La Coulotte Ridge (RM04 and 09) | | La Coulotte Peak (RM19) | | Coleman (RM11) | Star Creek (RM12) |
|---|---|---|---|---|---|---|---|---|
| Host Formation | Cretaceous sill | Flathead | Cretaceous sills and dikes | Roosville | Cretaceous sill | Roosville | Crowsnest | Crowsnest |
| Lithology | Altered trachyte | Quartzite adjacent to sill | Altered trachytes | Siltstone adjacent to sill | Altered trachyte | Siltstone adjacent to sill | Tuffaceous sandstone, conglomerate | Garnet-analcime phonolite |
| Analysis | Lab | Lab | Lab | Lab | Lab | Lab | Lab | Lab |
| Ag (ppm) | 0.1 | **4.5** | 0.2 | **1.6** | 0.04 | 0.2 | 0.5 | 0.2 |
| As (ppm) | **19** | **95** | 10 | 7.2 | 6.2 | **15** | 6.9 | 6.4 |
| Au (ppb) | <0.2 | **20.0** | 3.0 | **61.0** | 2.0 | 0.4 | **7.0** | 2.8 |
| Ba (ppm) | 1506 | 170 | 3000 | 440 | 2000 | 2100 | **3541** | **3803** |
| Be (ppm) | 3.0 | 1.0 | 3.0 | 5.0 | 2.0 | 3.0 | 3.0 | 8.0 |
| Bi (ppm) | 0.06 | 0.05 | 0.50 | **28** | 0.15 | **0.95** | 0.20 | 0.60 |
| Br (ppm) | <0.5 | <0.5 | 1.3 | <0.5 | 0.6 | <0.5 | 1.1 | 1.0 |
| Cd (ppm) | 0.8 | 0.2 | 0.4 | 0.2 | 0.4 | 0.3 | 0.3 | 0.4 |
| Ce (ppm) | 90 | 120 | 120 | 120 | 75 | 73 | 100 | 170 |
| Co (ppm) | 14 | 1.9 | 7.8 | 13 | 11 | 15 | 4.1 | 17 |
| Cr (ppm) | 14 | 27 | 11 | 61 | 12 | 30 | 13 | 24 |
| Cs (ppm) | 10 | 0.9 | 14 | 12 | 9.0 | 9.0 | 2.0 | 14 |
| Cu (ppm) | 8 | 5 | 25 | **493** | 11 | 22 | 9 | 92 |
| F (ppm) | 920 | 230 | 1120 | **1590** | 840 | 1140 | 200 | 550 |
| Ga (ppm) | 25 | 4.1 | 24 | 28 | 21 | 16 | 21 | 27 |
| Ge (ppm) | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 |
| Hg (ppb) | **450** | **995** | 10 | 12 | <5 | 9 | 13 | <5 |
| In (ppm) | 0.05 | <0.02 | 0.03 | 0.03 | 0.06 | <0.02 | 0.02 | 0.04 |
| Ir (ppb) | **9** | <5 | <5 | <5 | <5 | <5 | <5 | **7** |
| Li (ppm) | 12 | 6.3 | **106** | 62 | 26 | 35 | 24 | 33 |
| Mn (wt. %) | **0.22** | 0.01 | 0.16 | 0.02 | 0.14 | 0.07 | **1.72** | 0.15 |
| Mo (ppm) | 0.7 | 1.1 | **6.2** | **69** | 0.9 | 4.0 | 0.4 | 1.0 |
| Ni (ppm) | 23 | 4.3 | 5.2 | 25 | 9.1 | 15 | 2.8 | 10 |
| Pb (ppm) | 33 | **91** | 30 | **129** | 28 | **78** | 19 | 31 |
| Pd (ppb) | <0.5 | <0.5 | **10** | <0.5 | <0.5 | <0.5 | **23** | 1.4 |
| Pt (ppb) | 0.1 | 3.0 | **3.0** | 0.2 | 0.2 | <0.1 | 0.8 | 0.5 |
| Re (ppb) | 2 | <1 | **15** | **16** | <1 | 2 | 2 | <1 |
| S (wt. %) | 0.04 | 0.06 | 0.14 | <0.02 | 0.06 | 0.17 | 0.02 | <0.02 |
| Sb (ppm) | **6.0** | **11** | 1.1 | 1.2 | 2.0 | 1.2 | 0.7 | 0.8 |
| Se (ppm) | 0.2 | 0.2 | 0.7 | 0.6 | 0.3 | 0.4 | 0.2 | 0.2 |
| Sn (ppm) | 1.3 | 0.5 | 1.0 | 5.0 | 1.0 | 3.4 | 2.0 | 3.0 |
| Te (ppm) | 0.03 | <0.02 | <0.02 | **0.56** | <0.02 | 0.02 | 0.03 | 0.10 |
| Th (ppm) | 7.7 | **38** | 10 | 18 | 6.5 | 12 | 11 | 22 |
| Tl (ppm) | 0.40 | 0.34 | 0.11 | 0.40 | 0.08 | 0.17 | 0.30 | 0.30 |
| U (ppm) | 3.3 | 7.5 | 3.5 | 5.6 | 3.8 | 4.2 | 5.7 | 4.8 |
| V (ppm) | 74 | 113 | 79 | 96 | 106 | 38 | 151 | **256** |
| W (ppm) | **29** | **70** | 2.0 | 4.0 | 2.0 | 2.1 | 1.1 | 7.4 |
| Y (ppm) | 28 | 51 | 28 | 46 | 34 | 31 | 35 | 24 |
| Zn (ppm) | **348** | 65 | **170** | 100 | 130 | 60 | 87 | 120 |
| Thickness (m) | 3.0 | 0.1 | 7.2 | 0.1 | 3.0 | 0.1 | >3.0 | 25 |

rocks. Whole-rock geochemical data indicate elevated concentrations of Zn, Mo, Re, Pd, Pt and Li in altered trachytes, whereas the adjacent Roosville Formation siltstones show anomalous concentrations of Au, Ag, Cu, Pb, Mo, Bi and Te, coupled with elevated concentrations of Re, F and Sn (Table 6). Based on the quantitative XRD and MLA results, the host siltstone from a 0.1 m section immediately below the trachyte sill is composed mainly of poorly crystalline to amorphous clay (compositionally similar to illite/smectite), illite, quartz, amorphous silica-rich material, albite, chlorite and minor to trace K-feldspar, biotite, rutile, apatite, goethite, galena and zircon (Appendices 8 and 9). In addition, the SEM-EDS observations show the presence of disseminated Bi-oxide grains (~20 µm in diameter), associated with Cu-goethite spots (~70 µm in diameter), apatite and Cu-oxide veinlets (~4 µm wide) in the K-feldspar–quartz–illite/smectite matrix of the Roosville Formation siltstone.

A similar alkali trachyte sill (3 m thick) at La Coulotte Peak (site RM19) shows strong carbonatization, limonitization and propylitic alteration. The host Roosville Formation siltstone adjacent to the sill is silicified, brecciated and limonitized, with oxidized lenses and veinlets. However, the whole-rock geochemical analyses indicate low concentrations of metals in this sill, and only slightly elevated concentrations of Pb, As and Bi in the adjacent host siltstone.

Our whole-rock geochemical results for volcaniclastic rocks of the Crowsnest Formation at Coleman (site RM11) and near Star Creek (site RM12) indicate up to 3803 ppm Ba and 1.72% Mn, coupled with elevated concentrations of V, Pd, Ir and Au (Table 6). These new whole-rock geochemical data agree with previous results, indicating generally low concentrations of metals in alkaline volcanic rocks of the Crowsnest Formation (Peterson et al., 1997).

The previous data and our new data and observations indicate that alteration assemblages, sulphide mineralization and geochemical signatures associated with Cretaceous alkaline intrusions of southwestern Alberta and adjacent British Columbia are similar to alkaline porphyry and epithermal deposits elsewhere (Skupinski and Legun, 1989; Brown and Cameron, 1999). The documented mineralization styles include both sediment- and intrusion-hosted, disseminated and fracture-controlled pyrite (±chalcopyrite±galena±sphalerite±magnetite) and manto-like sphalerite replacement zones in carbonates. These sulphides are associated with minor to abundant barite-fluorite veins, quartz stockwork and variable degrees of silicification, carbonatization, oxidation, albitization, propylitization and argillic alteration (Skupinski and Legun, 1989; Brown and Cameron, 1999). The Cretaceous alkaline magmatism and the related Au-Ag (±Cu±Mo±W±Pb±Zn) sulphide mineralization mark a district-scale metallogenic event associated with the Cordilleran orogeny.

## 6.6 Vein Pb-Zn-Ag-Cu Sulphides

Table 7 lists selected geochemical results from quartz-carbonate veins cutting sedimentary strata and igneous rocks of southwestern Alberta. During the late 1800s to early 1900s, small-scale production of metals from quartz-carbonate veins cutting Precambrian and Paleozoic strata and containing galena, sphalerite, chalcopyrite, bornite, chalcocite, enargite, cuprite and secondary azurite and malachite took place in southwestern Alberta (e.g., Dawson, 1886; Hedley, 1954; Evans et al., 1968; La Casse and Roebuck, 1978). Little information is available on these historical prospects and occurrences, the majority of which lie within the limits of Banff National Park (Olson et al., 1994; Rukhlov, 2011).

The Oldman River (Bearspaw) Pb-Zn occurrence (site RM20; Figure 1) was discovered in 1912 and subsequently developed on the east flank of Mount Gass, near the headwaters of the Oldman River (Hedley, 1954; Holter, 1973). The Oldman River occurrence comprises an intense network of irregular, flat-lying and vertically oriented calcite-dolomite and oxidized sulphide veins crosscutting an ~15 m thick section of dolomitized limestone in the upper Late Devonian Palliser Formation (Figures 9e, f). The brecciated, dolomitized limestone and dolomitic veins contain disseminated and massive galena, sphalerite, pyrite and minor Cu-sulphides, and are interpreted to represent the MVT mineralization (Holter, 1973; Sangster, 1995, 1996; Graf, 1997; Pană, 2006).

Salat (1988) estimated that the Oldman River MVT mineralized zone could contain 2.0–2.5 million tonnes grading 6% Zn, 1% Pb, 500 ppm Cd and 34.3 ppm Ag. Graf (1997) reported petrographic descriptions and geochemical analyses indicating up to 29.4% Pb, 26.0% Zn, 670 ppm Cd, 390 ppm Cu, 310 ppm Ge, 210 ppm Ag, and 60 ppm Co for the mineralized rocks from the Oldman River Pb-Zn occurrence.

Goble (1972a, 1973) described disseminated and fracture-filling galena, sphalerite and chalcopyrite associated with quartz-carbonate stockwork and veins cutting brecciated argillaceous limestones of the lower Siyeh Formation along a northwest-trending fault zone between the south arm of Spionkop Ridge and Spionkop Creek (site RM10). Assays from the mineralized veins and limestones indicated up to 5.0% Pb, 1.3% Cu, 0.48% Zn, 17.14 ppm Ag and 343 ppb Au (Goble, 1972a, b, 1973, 1974a).

The new quantitative XRD and MLA results (Appendices 8 and 9) show that the mineralized veins (samples 8287 and 8290) at the Oldman River MVT Pb-Zn occurrence (site RM20) are composed mainly of dolomite, smithsonite, sphalerite and galena, with minor to accessory pyrite, goethite, Fe-sulphate, cerussite, K-feldspar, calcite, quartz, kaolinite and rutile (±covellite±poorly crystalline to amorphous smectite). Some of the sphalerite is Fe rich. Whole-rock geochemical analyses of these mineralized dolomitic veins indicate up to 17.8% Pb, 13.1% Zn and 73.1 ppm Ag, coupled with anomalous concentrations of Cd, Cu, Ge, Hg, Sb, Se, Pd and In (Table 7). These new mineralogical and geochemical results confirm the previous reports on this Pb-Zn occurrence.

Whole-rock geochemical analysis of a brecciated calcareous mudstone of the Siyeh Formation, crosscut by chlorite-calcite stockwork (0.01 m thick veins) containing sphalerite and chalcopyrite, on Spionkop Creek (site RM10) returned elevated concentrations of Cu, As and Bi (Table 7). Our observations confirm the presence of disseminated and vein-hosted sulphide mineralization at this occurrence. However, the analyzed sample returned lower metal concentrations.

Whole-rock geochemical results for mineralized quartz-carbonate veinlets (<0.01 m thick) with galena, sphalerite and chalcopyrite, cutting the upper quenched margin of the Proterozoic basaltic sill in the upper Appekunny Formation redbed cycles on Yarrow Creek (site RM21), indicate anomalous concentrations of Pb, Cu, Zn, Ag, As, Bi and Li. However, a chlorite-calcite-quartz vein (0.2 m thick) in a high-angle chloritized shear zone within the Proterozoic olivine basalt intrusion on Coppermine Creek (site RM13) contains background concentrations of analyzed metals except slightly elevated Mn and In (Table 7).

The vein sulphide mineralization within the Mesoproterozoic Belt-Purcell Supergroup of the Clark Range area may be related to synrift extensional faulting, magmatism and hydrothermal activity, similar to the world-class Coeur d'Alene (Idaho) and St. Eugene and Vine (southeastern British Columbia) Pb-Zn-Cu-Ag-Au deposits (e.g., Lydon, 2007).

The Oldman River vein Pb-Zn sulphide occurrence in brecciated and dolomitized limestones of the Upper Devonian Palliser Formation may represent MVT mineralization controlled by extensional faults in permeable carbonates of the shallow-water platform flanking the Paleozoic shale basins to the west, along the rifted passive continental margin (e.g., Sangster, 1995, 1996; Hutchinson, 1996; Nelson et al., 2002; Goodfellow, 2007). Thus, the MVT Pb-Zn deposits of Yukon, British Columbia and possibly southwestern Alberta could be cogenetic with the SEDEX Pb-Zn-Cu and polymetallic black-shale Zn-Ni-Mo deposits formed by discharge of metalliferous fluids and mixing with ambient anoxic water at the seafloor in the adjacent rifted basin (Goodfellow and Lydon, 2007). Alternatively, some of the vein Pb-Zn

**Table 7. Selected results from quartz-carbonate veins cutting sedimentary and magmatic rocks in southwestern Alberta. The in situ PXRF data are shown for comparison with the whole-rock laboratory data. Anomalous concentrations are in bold type. Thickness refers to either the true thickness of the formation or intrusion, or the width of a channel sample (in red type). See Figure 1 for the locations of sample sites.**

| Location | Copper Mine Creek (RM13) | Mount Gass, Oldman prospect (RM20) | | Spionkop Creek (RM10) | Yarrow Creek (RM21) | |
|---|---|---|---|---|---|---|
| Host Formation | Proterozoic olivine basalt sill | Palliser | | Siyeh | Proterozoic biotite-olivine basalt sill | |
| Lithology | Chlorite-calcite-quartz vein in shear zone | Calcite-galena-sphalerite-dolomite veins in dolomitic limestone | | Sphalerite-chalcopyrite-chlorite-calcite veins in calcareous mudstone | Sulphide-quartz-calcite veins in the upper quenched margin | |
| Analysis | Lab | Lab | PXRF[1] | Lab | Lab | PXRF[1] |
| Ag (ppm) | 0.005 | **73.1** | <77 | 0.2 | **2.1** | <75 |
| As (ppm) | 3.0 | 5.9 | <35 | **56** | **30** | <76 |
| Au (ppb) | 0.2 | 4.0 | <64960 | 3.0 | <0.2 | <81500 |
| Ba (ppm) | 17 | 15 | <219 | 187 | 1000 | 905 |
| Be (ppm) | <0.1 | 0.5 | n.d. | 0.2 | 3.0 | n.d. |
| Bi (ppm) | <0.02 | 0.25 | <17 | **0.86** | **5.4** | <36 |
| Br (ppm) | 2.4 | 2.6 | n.d. | 0.9 | 1.0 | n.d. |
| Cd (ppm) | 0.03 | **411** | 83 | 0.30 | 0.8 | <28 |
| Ce (ppm) | 36 | 3.9 | n.d. | 52 | 68 | n.d. |
| Co (ppm) | 2.5 | 36 | <250 | 14 | 23 | <436 |
| Cr (ppm) | 8.0 | 9.0 | <110 | 9.0 | 55 | <136 |
| Cs (ppm) | 0.05 | 0.10 | n.d. | 2.0 | 5.0 | n.d. |
| Cu (ppm) | 42 | **231** | <62 | **190** | **1967** | 998 |
| F (ppm) | 50 | 60 | n.d. | 880 | 1280 | n.d. |
| Ga (ppm) | 3.0 | 24 | n.d. | 4.0 | 24 | n.d. |
| Ge (ppm) | <0.1 | **65** | n.d. | <0.1 | 0.1 | n.d. |
| Hg (ppb) | 5 | **4368** | n.d. | 98 | 5 | n.d. |
| In (ppm) | **0.24** | **0.50** | n.d. | 0.04 | 0.18 | n.d. |
| Ir (ppb) | <5 | <5 | n.d. | <5 | <5 | n.d. |
| Li (ppm) | 25 | 1.1 | n.d. | 35 | **311** | n.d. |
| Mn (wt. %) | **0.25** | 0.14 | 0.15 | 0.04 | 0.17 | 0.14 |
| Mo (ppm) | 0.14 | 0.60 | <10 | 1.2 | 1.8 | <9.0 |
| Ni (ppm) | 5.5 | 30 | <99 | 15 | 45 | <104 |
| Pb (ppm) | 2.0 | **177800** | 504 | 50 | **7018** | 2968 |
| Pd (ppb) | <0.5 | **26** | <13160 | <0.5 | <0.5 | <12740 |
| Pt (ppb) | <0.1 | 0.2 | n.d. | <0.1 | <0.1 | n.d. |
| Re (ppb) | <1 | 1.0 | n.d. | <1 | <1 | n.d. |
| S (wt. %) | <0.02 | 6.36 | 2.19 | 0.18 | 0.23 | <0.08 |
| Sb (ppm) | 0.02 | **12.8** | <58 | 2.1 | 0.4 | <55 |
| Se (ppm) | 0.1 | **6.4** | <9.3 | 0.5 | 0.6 | <9.1 |
| Sn (ppm) | 0.2 | 5.3 | <65 | 0.6 | 1.4 | <61 |
| Te (ppm) | <0.02 | <0.02 | n.d. | 0.18 | <0.02 | n.d. |
| Th (ppm) | <0.1 | 0.5 | n.d. | 5.0 | 4.1 | n.d. |
| Tl (ppm) | 0.02 | 0.23 | n.d. | 0.31 | <0.02 | n.d. |
| U (ppm) | <0.1 | 0.7 | n.d. | 1.7 | 2.2 | n.d. |
| V (ppm) | 11 | 23 | <59 | 16 | 189 | 432 |
| W (ppm) | <0.1 | 5.6 | <792 | 0.4 | 3.0 | <188 |
| Y (ppm) | 12 | 3.0 | n.d. | 16 | 42 | n.d. |
| Zn (ppm) | 67 | **131100** | 35580 | 86 | **450** | 370 |
| Thickness (m) | 0.2 | 15 | | 0.01 | <0.01 | |

sulphide mineralization associated with zones of brecciation and dolomitization may be related to the Laramide tectonics and/or postorogenic collapse faults, which could have controlled upwelling of the mineralizing hydrothermal fluids through the strained successions of the Rocky Mountain foreland fold-and-thrust belt in southwestern Alberta (Pană, 2006; Paradis et al., 2007).

# 7 Conclusions

The diverse styles of metallic mineralization observed in the Rocky Mountain foreland fold-and-thrust belt of the Canadian Cordillera in southwestern Alberta reflect at least three metallogenic intervals related to different tectonic settings during about 1.5 billion years of evolution in that portion of the Western Canada Sedimentary Basin:

- The Mesoproterozoic, perhaps mantle plume–induced, Belt-Purcell intracontinental rifting, accompanied by voluminous, high-Fe, tholeiitic- to alkali-basalt magmatism and seafloor hydrothermal fluid discharge, resulted in accumulation of magmatic-hydrothermal and stratabound, syngenetic to diagenetic (SEDEX- and redbed-type), base- and precious-metal sulphides.
- The Devonian–Mississippian extension of the continental margin, manifested by alkaline, carbonatite and kimberlite magmatism in British Columbia, marine bentonites and seafloor hydrothermal venting, produced SEDEX Pb-Zn-Cu sulphide deposits and polymetallic black shales (e.g., Exshaw Formation) in anoxic transgressive basins, and possibly cogenetic MVT Pb-Zn sulphide deposits controlled by permeable fault zones in the adjacent shallow-water carbonate platforms to the east.
- The Cretaceous alkaline intrusion–related, porphyry to epithermal Au-Ag (±Cu±Mo±W±Pb±Zn) sulphide mineralization is associated with the Cordilleran orogeny, whereas some of the vein Pb-Zn sulphide occurrences (Oldman River?) may be controlled by postorogenic collapse faults that could have channelled hydrothermal fluids upwelling through the strained successions of the Rocky Mountain foreland fold-and-thrust belt.

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# Appendix 1 – Sample Locations and Descriptions

## Legend

| | |
|---|---|
| Count: | Number of samples |
| Sample: | AGS sample number |
| Lab-wt_kg: | Weight of sample (in kilograms) submitted to lab |
| QC: | Quality-control samples: dup, duplicate; trip, triplicate; std, standard |
| Site: | Sample site |
| Month: | Month sample collected |
| Year: | Year sample collected |
| Zn_UTM: | UTM zone |
| E_UTM83: | UTM easting (NAD83 datum; from field GPS) |
| N_UTM83: | UTM northing (NAD83 datum; from field GPS) |
| Elev_m: | Approximate elevation (in metres above sea level; from field GPS) |
| Area: | General map area |
| Location: | Local geographic location |
| Formation: | Geological formation or equivalent |
| Lithology: | Lithology of sample |
| Remarks: | Descriptive comments |
| Dup. | Duplicate |
| Std. | Standard |
| SW | Southwest |

| Count | Sample | Lab-wt_kg | QC | Site | Month | Year | Zn_UTM | E_UTM83 | N_UTM83 | Elev_m | Area | Location | Formation | Lithology | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8175 | 0.48 | | RM01 | Aug | 2008 | 11 | 689039 | 5459435 | 2060 | Clark Range | Middle Kootenay Pass | Grinnell | Quartzite | White, malachite in intraformational green argillite pebbles |
| 2 | 8176 | 0.59 | | RM01 | Aug | 2008 | 11 | 688726 | 5459460 | 2003 | Clark Range | Middle Kootenay Pass | Proterozoic intrusions | Olivine basalt | Sill, middle portion, glomeroporphyritic |
| 3 | 8177 | 0.43 | | RM01 | Aug | 2008 | 11 | 688725 | 5459478 | 2014 | Clark Range | Middle Kootenay Pass | Proterozoic intrusions | Olivine basalt | Sill, upper quenched margin, glomeroporphyritic |
| 4 | 8178 | 0.68 | | RM01 | Aug | 2008 | 11 | 688731 | 5459443 | 1985 | Clark Range | Middle Kootenay Pass | Grinnell | Argillite/sandstone | Black and green, laminated, immediately below sill contact |
| 5 | 8179 | 0.37 | | RM01 | Aug | 2008 | 11 | 688726 | 5459444 | 1985 | Clark Range | Middle Kootenay Pass | Proterozoic intrusions | Olivine basalt | Sill, sheared, chloritized, lower margin |
| 6 | 8180 | 0.44 | | RM08 | Aug | 2008 | 11 | 688265 | 5459651 | 2086 | Clark Range | Middle Kootenay Pass | Appekunny | Quartzite | Green argillite pebbles, rusty spots |
| 7 | 8181 | 0.40 | | RM08 | Aug | 2008 | 11 | 688566 | 5459653 | 2086 | Clark Range | Middle Kootenay Pass | Appekunny | Quartzite | Green argillite pebbles, abundant pyrite (up to 1 cm crystals) |
| 8 | 8182 | 0.44 | | RM02 | Aug | 2008 | 11 | 702879 | 5451445 | 2052 | Clark Range | Font Creek | Proterozoic intrusions | Olivine basalt | Sill, glomeroporphyritic |
| 9 | 8183 | 0.03 | Std. | | Sept | 2008 | | | | | | | | Diabase | CCRMP TDB-1 certified reference material, ~30 g |
| 10 | 8185 | 0.03 | Std. | | Sept | 2008 | | | | | | | | Diabase | CCRMP TDB-1 certified reference material, ~30 g |
| 11 | 8186 | 0.48 | 8203 dup. | RM06 | Aug | 2008 | 11 | 714689 | 5459127 | 1716 | Clark Range | South Drywood Creek | Siyeh | Siltstone | Duplicate to 8203 |
| 12 | 8187 | 0.47 | 8204 dup. | RM07 | Aug | 2008 | 11 | 690113 | 5463038 | 1586 | Clark Range | SW flank of Barnaby Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Duplicate to 8204 |
| 13 | 8188 | 0.03 | Std. | | Sept | 2008 | | | | | | | | Diabase | CCRMP TDB-1 certified reference material, ~30 g |
| 14 | 8189 | 0.60 | | RM02 | Aug | 2008 | 11 | 702860 | 5451464 | 2051 | Clark Range | Font Creek | Proterozoic intrusions | Quartz diabase | Sill |
| 15 | 8190 | 0.55 | | RM02 | Aug | 2008 | 11 | 702878 | 5451462 | 2049 | Clark Range | Font Creek | Proterozoic intrusions | Olivine basalt | Sill, quenched margin, glomeroporphyritic |
| 16 | 8191 | 0.58 | | RM03 | Aug | 2008 | 11 | 699614 | 5451005 | 2152 | Clark Range | Jutland Brook | Cretaceous intrusions | Cpx-sanidine trachyte | Sill, upper margin, propylitic alteration, limonitization |
| 17 | 8192 | 0.58 | | RM03 | Aug | 2008 | 11 | 699604 | 5451007 | 2154 | Clark Range | Jutland Brook | Flathead | Quartzite | Crossbedded, pebble conglomerate, immediately above sill |
| 18 | 8193 | 0.31 | | RM03 | Aug | 2008 | 11 | 699610 | 5451002 | 2153 | Clark Range | Jutland Brook | Cretaceous intrusions | Cpx-sanidine trachyte | Sill, upper margin, strong propylitic alteration and limonitization |
| 19 | 8194 | 0.40 | | RM03 | Aug | 2008 | 11 | 699608 | 5451009 | 2151 | Clark Range | Jutland Brook | Cretaceous intrusions | Cpx-sanidine trachyte | Sill, middle portion, strong propylitic alteration and limonitization |
| 20 | 8195 | 0.55 | | RM04 | Aug | 2008 | 11 | 697134 | 5452029 | 2137 | Clark Range | La Coulotte Ridge | Cretaceous intrusions | Cpx-sanidine trachyte | Sill, lower margin, propylitic alteration, analcime-bearing (?) |
| 21 | 8196 | 0.31 | | RM04 | Aug | 2008 | 11 | 697136 | 5452022 | 2137 | Clark Range | La Coulotte Ridge | Roosville | Siltstone | Green, malachite stains, immediately below sill |
| 22 | 8197 | 0.48 | | RM04 | Aug | 2008 | 11 | 697128 | 5452018 | 2139 | Clark Range | La Coulotte Ridge | Cretaceous intrusions | Cpx trachyte | Sill, middle portion, propylitic alteration, carbonatization |
| 23 | 8198 | 0.30 | | RM04 | Aug | 2008 | 11 | 697122 | 5452015 | 2142 | Clark Range | La Coulotte Ridge | Cretaceous intrusions | Cpx trachyte | Sill, upper margin, propylitic alteration, carbonatization |
| 24 | 8199 | 0.58 | | RM04 | Aug | 2008 | 11 | 697123 | 5452011 | 2142 | Clark Range | La Coulotte Ridge | Roosville | Siltstone | Green, traces of malachite, 0–10 cm above the sill |
| 25 | 8200 | 0.97 | | RM05 | Aug | 2008 | 11 | 710662 | 5461052 | 1696 | Clark Range | Drywood Creek | Purcell Lava | Basalt | Lava flow, chloritized, amygdaloidal, hyalophytic, 1%–3% chalcopyrite; float |
| 26 | 8201 | 0.37 | | RM06 | Aug | 2008 | 11 | 714686 | 5459123 | 1716 | Clark Range | South Drywood Creek | Grinnell | Quartzite | White, green argillite pebbles, chalcopyrite and bornite (1.5 cm streaks) |
| 27 | 8202 | 0.38 | | RM06 | Aug | 2008 | 11 | 714687 | 5459125 | 1716 | Clark Range | South Drywood Creek | Siyeh | Pyritic ooidal quartzite | Rusty weathering, abundant pyrite spherules <1 mm in diameter |
| 28 | 8203 | 0.44 | | RM06 | Aug | 2008 | 11 | 714689 | 5459127 | 1716 | Clark Range | South Drywood Creek | Siyeh | Siltstone | Dark grey, malachite staining, ~1 m stratigraphically above 8202 |
| 29 | 8204 | 0.55 | | RM07 | Aug | 2008 | 11 | 690113 | 5463038 | 1586 | Clark Range | SW flank of Barnaby Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Sill, upper quenched margin, amygdaloidal, glomeroporphyritc |
| 30 | 8205 | 0.54 | | RM07 | Aug | 2008 | 11 | 690113 | 5463036 | 1586 | Clark Range | SW flank of Barnaby Ridge | Grinnell | Quartzite | White, crossbedded, 0–10 cm above sill |
| 31 | 8206 | 0.96 | | RM07 | Aug | 2008 | 11 | 690108 | 5463038 | 1584 | Clark Range | SW flank of Barnaby Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Sill, middle portion, amygdaloidal, glomeroporphyritc |
| 32 | 8207 | 0.63 | | RM07 | Aug | 2008 | 11 | 690104 | 5463035 | 1582 | Clark Range | SW flank of Barnaby Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Sill, lower margin, amygdaloidal, glomeroporphyritc |
| 33 | 8208 | 0.71 | | RM07 | Aug | 2008 | 11 | 690102 | 5463034 | 1582 | Clark Range | SW flank of Barnaby Ridge | Grinnell | Quartzite | White, crossbedded, 0–10 cm below sill |
| 34 | 8209 | 0.69 | | RM07 | Aug | 2008 | 11 | 690129 | 5463038 | 1593 | Clark Range | SW flank of Barnaby Ridge | Grinnell | Quartzite | White, green argillite pebbles, 1 cm long chalcopyrite streaks |
| 35 | 8210 | 0.39 | | RM08 | Aug | 2008 | 11 | 688586 | 5459653 | 2086 | Clark Range | Middle Kootenay Pass | Appekunny | Quartzite | Rusty, pyrite-rich, intraformational green argillite pebbles |
| 36 | 8211 | 0.10 | | RM08 | Aug | 2008 | 11 | 688606 | 5459653 | 2086 | Clark Range | Middle Kootenay Pass | Appekunny | Quartzite | Rusty, pyrite-rich, intraformational green argillite pebbles |
| 37 | 8212 | 0.41 | | RM08 | Aug | 2008 | 11 | 688626 | 5459653 | 2086 | Clark Range | Middle Kootenay Pass | Appekunny | Quartzite | Very rusty, pyrite-rich, intraformational green argillite pebbles |
| 38 | 8213 | 0.30 | | RM08 | Aug | 2008 | 11 | 688646 | 5459653 | 2086 | Clark Range | Middle Kootenay Pass | Appekunny | Quartzite | White, rare rusty vugs |
| 39 | 8214 | 0.35 | | RM09 | Aug | 2008 | 11 | 697419 | 5452219 | 1988 | Clark Range | La Coulotte Ridge | Cretaceous intrusions | Garnet-Cpx trachyte | Sill, pink, analcime-bearing, weak phyllic-argillic alteration |
| 40 | 8215 | 0.23 | | RM09 | Aug | 2008 | 11 | 697410 | 5452200 | 1988 | Clark Range | La Coulotte Ridge | Cretaceous intrusions | Cpx-sanidine trachyte | Sill, brown, strong propylitic alteration and carbonatization |
| 41 | 8216 | 0.45 | | RM09 | Aug | 2008 | 11 | 697405 | 5452190 | 1988 | Clark Range | La Coulotte Ridge | Cretaceous intrusions | Garnet-Cpx trachyte | Sill, grey, analcime-bearing |
| 42 | 8217 | 0.52 | | RM09 | Aug | 2008 | 11 | 697395 | 5452180 | 1988 | Clark Range | La Coulotte Ridge | Cretaceous intrusions | Garnet-Cpx trachyte | Sill, brown, strong propylitic alteration |
| 43 | 8218 | 0.12 | | RM10 | Aug | 2008 | 11 | 715215 | 5456054 | 1774 | Clark Range | Spionkop Creek | Siyeh | Grey calcareous mudrock | Laminated, ooidal, calcite-chlorite veins, sphalerite-chalcopyrite streaks |
| 44 | 8220 | 0.42 | 8203 trip | RM06 | Aug | 2008 | 11 | 714689 | 5459127 | 1716 | Clark Range | South Drywood Creek | Siyeh | Siltstone | Triplicate to 8203 |
| 45 | 8221 | 0.50 | 8204 trip | RM07 | Aug | 2008 | 11 | 690113 | 5463038 | 1586 | Clark Range | SW flank of Barnaby Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Triplicate to 8204 |
| 46 | 8222 | 0.49 | | RM11 | Apr | 2008 | 11 | 682285 | 5500537 | 1322 | Crowsnest Pass | Coleman, Hwy. 3 roadcut | Crowsnest | Tuffaceous sandstone | Epiclastic, abundant melanitic garnet |
| 47 | 8223 | 0.17 | | RM11 | Apr | 2008 | 11 | 682287 | 5500537 | 1322 | Crowsnest Pass | Coleman, Hwy. 3 roadcut | Crowsnest | Cpx-garnet-sanidine trachyte | Pebble from tuffaceous conglomerate |
| 48 | 8224 | 0.94 | | RM11 | Apr | 2008 | 11 | 682289 | 5500537 | 1322 | Crowsnest Pass | Coleman, Hwy. 3 roadcut | Crowsnest | Tuffaceous sandstone | Epiclastic, abundant melanitic garnet |
| 49 | 8225 | 0.58 | | RM12 | Apr | 2008 | 11 | 677845 | 5500212 | 1402 | Crowsnest Pass | Star Creek | Crowsnest | Garnet-Cpx-analcime phonolite | Sanidine phenocrysts up to 4 cm-long, secondary calcite veins |
| 50 | 8226 | 0.17 | | RM12 | Apr | 2008 | 11 | 677805 | 5500212 | 1402 | Crowsnest Pass | Star Creek | Crowsnest | Garnet-Cpx-analcime phonolite | Green breccia, sanidine-calcite blebs and veinlets |

| Count | Sample | Lab-wt_kg | QC | Site | Month | Year | Zn_UTM | E_UTM83 | N_UTM83 | Elev_m | Area | Location | Formation | Lithology | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 8227 | 0.22 | | RM12 | Apr | 2008 | 11 | 678241 | 5500087 | 1417 | Crowsnest Pass | Star Creek | Crowsnest | Tephriphonolite | Red breccia |
| 52 | 8228 | 0.28 | | RM12 | Apr | 2008 | 11 | 678238 | 5500092 | 1417 | Crowsnest Pass | Star Creek | Crowsnest | Garnet-Cpx-analcime phonolite | Abundant red-brown analcime phenocrysts up to 1.5 cm |
| 53 | 8246 | 0.57 | | RM13 | Aug | 2009 | 12 | 283874 | 5443815 | 1521 | Waterton | Coppermine Creek | Proterozoic intrusions | Quartz-calcite vein | 20 cm thick, within mafic sill, trace chalcopyrite |
| 54 | 8247 | 0.44 | | RM13 | Aug | 2009 | 12 | 283880 | 5443809 | 1529 | Waterton | Coppermine Creek | Proterozoic intrusions | Olivine basalt | Sill, middle portion, sheared, hyalophytic, chloritized |
| 55 | 8248 | 0.48 | | RM13 | Aug | 2009 | 12 | 283909 | 5443764 | 1881 | Waterton | Coppermine Creek | Proterozoic intrusions | Basalt | Sill, lower margin, hyalophytic |
| 56 | 8249 | 0.56 | | RM13 | Aug | 2009 | 12 | 283920 | 5443761 | 1553 | Waterton | Coppermine Creek | Grinnell | Quartzite | White, green argillite pebbles, 1–2% Fe-sulphides, malachite |
| 57 | 8250 | 0.36 | | RM13 | Aug | 2009 | 12 | 283920 | 5443760 | 1552 | Waterton | Coppermine Creek | Proterozoic intrusions | Olivine basalt | Sill, upper margin, hyalophytic, carbonatized |
| 58 | 8251 | 0.31 | | RM14 | Aug | 2009 | 11 | 676387 | 5474707 | 1881 | Clark Range | Carbondale River | Sheppard/Purcell Lava | Dolomitic siltstone/olivine basalt | Upper contact of Purcell Lava, amygdule-filling chalcopyrite |
| 59 | 8252 | 0.54 | | RM14 | Aug | 2009 | 11 | 676375 | 5474692 | 1883 | Clark Range | Carbondale River | Sheppard | Siltstone | Grey, thinly laminated, fine-grained disseminated galena, sphalerite |
| 60 | 8253 | 0.41 | | RM14 | Aug | 2009 | 11 | 676375 | 5474689 | 1883 | Clark Range | Carbondale River | Sheppard | Siltstone/sandstone | Grey, thinly laminated, interstitial galena |
| 61 | 8254 | 0.90 | | RM14 | Aug | 2009 | 11 | 676336 | 5474690 | 1887 | Clark Range | Carbondale River | Sheppard | Dolomite/dolomitic sandstone | Composite sample from 2 m thick section, as 8252 and 8253 |
| 62 | 8255 | 0.30 | | RM14 | Aug | 2009 | 11 | 676267 | 5474691 | 1894 | Clark Range | Carbondale River | Gateway | Sandstone | Red, quartzose, hematite cement and coatings in vugs |
| 63 | 8256 | 0.35 | | RM15 | Aug | 2009 | 12 | 282344 | 5452096 | 1869 | Clark Range | Cloudy Ridge | Siyeh | Calcareous mudstone | Grey, rusty concretions, XRF detects metal mineralization |
| 64 | 8257 | 0.49 | | RM15 | Aug | 2009 | 12 | 282008 | 5451952 | 1932 | Clark Range | Cloudy Ridge | Proterozoic intrusions | Olivine basalt | Sill, upper margin, glomeroporhyritic, sulphides |
| 65 | 8258 | 0.43 | | RM15 | Aug | 2009 | 12 | 282007 | 5451949 | 1932 | Clark Range | Cloudy Ridge | Siyeh | Calcareous siltstone | Red, 0–10 cm above gabbro sill |
| 66 | 8259 | 0.42 | | RM15 | Aug | 2009 | 12 | 282000 | 5451964 | 1933 | Clark Range | Cloudy Ridge | Siyeh | Limestone | Bleached, thinly laminated, 0–10 cm below gabbro sill |
| 67 | 8260 | 0.54 | | RM15 | Aug | 2009 | 12 | 282000 | 5451964 | 1934 | Clark Range | Cloudy Ridge | Proterozoic intrusions | Olivine basalt | Sill, lower quenched margin, glomeroporphyritic |
| 68 | 8261 | 0.56 | | RM15 | Aug | 2009 | 12 | 282006 | 5451969 | 1938 | Clark Range | Cloudy Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Sill, middle portion, white-pink calcite veins, glomeroporphyritic |
| 69 | 8262 | 0.32 | | RM15 | Aug | 2009 | 12 | 282072 | 5451951 | 1957 | Clark Range | Cloudy Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Sill, near the upper margin, glomeroporphyritic |
| 70 | 8263 | 0.44 | | RM16 | Aug | 2009 | 11 | 717877 | 5456456 | 1956 | Clark Range | Spionkop Ridge | Siyeh | Siltstone | Grey, about 5 m thick bed with malachite staining |
| 71 | 8264 | 0.59 | | RM16 | Aug | 2009 | 11 | 717875 | 5456454 | 1955 | Clark Range | Spionkop Ridge | Siyeh | Siltstone | 1 m below rusty-weathering sandstone, malachite stains |
| 72 | 8265 | 0.42 | | RM16 | Aug | 2009 | 11 | 717867 | 5456890 | 2010 | Clark Range | Spionkop Ridge | Siyeh | Pyritic ooidal quartzite | Rusty-weathering, 3 cm thick bed, ~60% pyrite spherules |
| 73 | 8266 | 0.46 | | RM17 | Aug | 2009 | 11 | 718024 | 5457141 | 2046 | Clark Range | Spionkop Ridge | Grinnell | Quartzite | White, malachite in intraformational green argillite pebbles |
| 74 | 8267 | 0.49 | 8266 dup | RM17 | Aug | 2009 | 11 | 718024 | 5457141 | 2046 | Clark Range | Spionkop Ridge | Grinnell | Quartzite | White, malachite in intraformational green argillite pebbles |
| 75 | 8268 | 0.46 | | RM17 | Aug | 2009 | 11 | 718061 | 5457205 | 2030 | Clark Range | Spionkop Ridge | Proterozoic intrusions | Basalt | Sill, hyalophytic, malachite stains along fractures |
| 76 | 8269 | 0.63 | | RM18 | Aug | 2009 | 11 | 709544 | 5461663 | 2320 | Clark Range | Pincher Ridge | Proterozoic intrusions | Olivine basalt | Sill, upper quenched margin, amygdaloidal, 1–3% Fe-sulphides |
| 77 | 8270 | 0.54 | | RM18 | Aug | 2009 | 11 | 709544 | 5461663 | 2321 | Clark Range | Pincher Ridge | Gateway | Sandstone | Thinly bedded, green and pink, 0–10 cm above sill |
| 78 | 8271 | 0.48 | | RM18 | Aug | 2009 | 11 | 709555 | 5461677 | 2322 | Clark Range | Pincher Ridge | Gateway | Sandstone | Massive, greenish-grey, immediately below sill |
| 79 | 8272 | 0.38 | | RM18 | Aug | 2009 | 11 | 709544 | 5461663 | 2323 | Clark Range | Pincher Ridge | Proterozoic intrusions | Olivine basalt | Sill, lower quenched margin, amygdaloidal |
| 80 | 8273 | 0.47 | | RM18 | Aug | 2009 | 11 | 709545 | 5461668 | 2321 | Clark Range | Pincher Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Sill, green and red, middle portion, altered |
| 81 | 8274 | 0.49 | | RM18 | Aug | 2009 | 11 | 709545 | 5461668 | 2321 | Clark Range | Pincher Ridge | Proterozoic intrusions | Olivine-hornblende basalt | Sill, green and red, middle portion, altered |
| 82 | 8275 | 0.33 | | RM19 | Aug | 2009 | 11 | 695519 | 5453659 | 2260 | Clark Range | La Coulotte Peak | Proterozoic intrusions | Quartz-hornblende basalt | Sill, lower quenched margin, olivine-phyric |
| 83 | 8276 | 0.39 | | RM19 | Aug | 2009 | 11 | 695520 | 5453660 | 2259 | Clark Range | La Coulotte Peak | Roosville | Dolomitic sandstone/siltstone | Green, laminated, 5–10 cm below sill |
| 84 | 8277 | 0.40 | | RM19 | Aug | 2009 | 11 | 695520 | 5453660 | 2260 | Clark Range | La Coulotte Peak | Proterozoic intrusions | Quartz vein | Cuts gabbro sill near the lower margin |
| 85 | 8278 | 0.55 | | RM19 | Aug | 2009 | 11 | 695515 | 5453656 | 2263 | Clark Range | La Coulotte Peak | Proterozoic intrusions | Olivine-hornblende basalt | Sill, middle portion, glomeroporphyritic |
| 86 | 8279 | 0.39 | | RM19 | Aug | 2009 | 11 | 695516 | 5453649 | 2265 | Clark Range | La Coulotte Peak | Proterozoic intrusions | Olivine basalt | Sill, upper quenched margin, amygdaloidal |
| 87 | 8280 | 0.42 | | RM19 | Aug | 2009 | 11 | 695515 | 5453646 | 2265 | Clark Range | La Coulotte Peak | Roosville | Siltstone | Green, welded, silicified, sheared (slickensides), 0–5 cm above sill |
| 88 | 8281 | 0.41 | | RM19 | Aug | 2009 | 11 | 695519 | 5453622 | 2275 | Clark Range | La Coulotte Peak | Roosville | Siltstone | Green, silicified, rusty lenses and veinlets, 0–5 cm below alkaline sill |
| 89 | 8282 | 0.41 | | RM19 | Aug | 2009 | 11 | 695519 | 5453623 | 2275 | Clark Range | La Coulotte Peak | Cretaceous intrusions | Cpx trachyte | Sill, lower margin, strong propylitic alteration and limonitization |
| 90 | 8283 | 0.34 | | RM19 | Aug | 2009 | 11 | 695520 | 5453622 | 2278 | Clark Range | La Coulotte Peak | Cretaceous intrusions | Cpx trachyte | Sill, middle portion, propylitic alteration and carbonatization |
| 91 | 8284 | 0.46 | | RM19 | Aug | 2009 | 11 | 695521 | 5453617 | 2280 | Clark Range | La Coulotte Peak | Roosville | Siltstone | Green, silicified, brecciated, limonitized, 0–15 cm above alkaline sill |
| 92 | 8285 | 0.41 | | RM19 | Aug | 2009 | 11 | 695523 | 5453617 | 2280 | Clark Range | La Coulotte Peak | Cretaceous intrusions | Cpx trachyte | Sill, upper margin, strong propylitic alteration and limonitization |
| 93 | 8286 | 0.42 | | RM19 | Aug | 2009 | 11 | 695522 | 5453667 | 2264 | Clark Range | La Coulotte Peak | Roosville | Dolomitic siltstone/argillite | Green-grey, thinly interbedded, laminated, 1.5m below mafic sill |
| 94 | 8287 | 0.74 | | RM20 | Aug | 2009 | 11 | 662953 | 5555447 | 2368 | Oldman River | Mount Gass/Oldman | Palliser | Dolomite vein | Grey, limonitized, abundant sphalerite |
| 95 | 8288 | 0.35 | | RM20 | Aug | 2009 | 11 | 662951 | 5555434 | 2379 | Oldman River | Mount Gass/Oldman | Palliser | Dolomite breccia | Brown |
| 96 | 8289 | 0.47 | | RM20 | Aug | 2009 | 11 | 662958 | 5555446 | 2387 | Oldman River | Mount Gass/Oldman | Palliser | Dolomite-calcite vein | White, network of irregular veins brecciating grey dolomite |
| 97 | 8290 | 0.55 | | RM20 | Aug | 2009 | 11 | 662958 | 5555447 | 2387 | Oldman River | Mount Gass/Oldman | Palliser | Massive galena vein | Limonitized, postdates dolomite stockwork |
| 98 | 8291 | 0.61 | 8290 dup | RM20 | Aug | 2009 | 11 | 662958 | 5555447 | 2387 | Oldman River | Mount Gass/Oldman | Palliser | Massive galena vein | Limonitized, postdates dolomite stockwork |
| 99 | 8292 | 0.30 | | RM21 | Sept | 2009 | 12 | 282046 | 5453748 | 1607 | Clark Range | Yarrow Creek | Appekunny | Siltstone | Green-grey, rusty films, XRF detects copper mineralization |
| 100 | 8293 | 0.32 | | RM21 | Sept | 2009 | 12 | 281988 | 5453932 | 1711 | Clark Range | Yarrow Creek | Proterozoic intrusions | Calcite-sulphide vein | Chalcopyrite, sphalerite and malachite, upper margin of gabbro sill |
| 101 | 8294 | 0.47 | | RM20 | Aug | 2009 | 11 | 662828 | 5555499 | 2437 | Oldman River | Mount Gass | Exshaw | Black shale | Laminated, 1m below overlying Banff Fm., 455 cps |

| Count | Sample | Lab-wt_kg | QC | Site | Month | Year | Zn_UTM | E_UTM83 | N_UTM83 | Elev_m | Area | Location | Formation | Lithology | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102 | 8295 | 0.43 | | RM20 | Aug | 2009 | 11 | 662829 | 5555499 | 2434 | Oldman River | Mount Gass | Exshaw | Black argillaceous siltstone | 3 m below the overlying Banff Fm., 412 cps |
| 103 | 8296 | 0.32 | | RM20 | Aug | 2009 | 11 | 662836 | 5555476 | 2431 | Oldman River | Mount Gass | Exshaw | Black shale | Very fissile, rusty, 0–5 cm above the underlying Palliser Fm., abundant roots |
| 104 | 8297 | 0.36 | | RM20 | Aug | 2009 | 11 | 662836 | 5555476 | 2432 | Oldman River | Mount Gass | Exshaw | Bentonite | Grey, rusty, 5–10 cm interval above the underlying Palliser Fm., 505 cps |
| 105 | 8298 | 0.36 | | RM21 | Sept | 2009 | 12 | 281934 | 5453864 | 1655 | Clark Range | Yarrow Creek | Appekunny | Quartzite | White, green argillite pebbles, 0–10 cm below gabbro sill |
| 106 | 8299 | 0.36 | | RM21 | Sept | 2009 | 12 | 281934 | 5453864 | 1655 | Clark Range | Yarrow Creek | Proterozoic intrusions | Olivine basalt | Sill, lower margin, glomeroporphyritic, hyalophytic, chloritized fault |
| 107 | 8300 | 0.52 | | RM21 | Sept | 2009 | 12 | 281933 | 5453901 | 1665 | Clark Range | Yarrow Creek | Proterozoic intrusions | Biotite-olivine basalt | Sill, middle portion, ophytic |
| 108 | 8301 | 0.52 | | RM21 | Sept | 2009 | 12 | 281930 | 5453947 | 1684 | Clark Range | Yarrow Creek | Proterozoic intrusions | Biotite-olivine basalt | Sill, middle portion, ophytic, stellar plagioclase phenocryst aggregates |
| 109 | 8302 | 0.35 | 8253 dup | RM14 | Aug | 2009 | 11 | 676375 | 5474689 | 1883 | Clark Range | Carbondale River | Sheppard | Siltstone | Duplicate to 8253 |
| 110 | 8303 | 0.29 | 8253 trip | RM14 | Aug | 2009 | 11 | 676375 | 5474689 | 1883 | Clark Range | Carbondale River | Sheppard | Siltstone | Triplicate to 8253 |
| 111 | 8304 | 0.34 | 8296 dup | RM20 | Aug | 2009 | 11 | 662836 | 5555476 | 2431 | Oldman River | Mount Gass | Exshaw | Black shale | Duplicate to 8296 |
| 112 | 8305 | 0.32 | 8296 trip | RM20 | Aug | 2009 | 11 | 662836 | 5555476 | 2431 | Oldman River | Mount Gass | Exshaw | Black shale | Triplicate to 8296 |
| 113 | 8306 | 0.07 | Std | | Sept | 2008 | | | | | | | | Diabase | CCRMP TDB-1 certified reference material, 71.9 g |
| 114 | 8307 | 0.07 | Std | | Sept | 2008 | | | | | | | | Diabase | CCRMP TDB-1 certified reference material, 71.3 g |
| 115 | 8308 | 0.07 | Std | | Sept | 2008 | | | | | | | | Diabase | CCRMP TDB-1 certified reference material, 67.3 g |

# Appendix 2 – Whole-Rock Analytical Methods, Acme Analytical Laboratories Ltd.

| Method | Description |
|---|---|
| 3B03 | Lead-collection fire-assay fusion of 15 g sample split, followed by dilute $HNO_3$ digestion of the Ag dore bead and inductively coupled plasma–mass spectrometry (ICP-MS) analysis of the solution for Au, Pt and Pd. |
| 4A | A 0.2 g sample split is weighed into a graphite crucible and fused with $LiBO_2$ flux in a muffle furnace for 15 minutes at 1050°C. The molten mixture is then poured into 100 mL of 5% $HNO_3$. The solution is shaken for 2 hours, then an aliquot is poured into a polypropylene test tube and analyzed using inductively coupled plasma–emission spectrometry (ICP-ES) for $SiO_2$, $Al_2O_3$, $Fe_2O_3$, MgO, CaO, $Na_2O$, $K_2O$, $TiO_2$, $P_2O_5$, MnO, $Cr_2O_3$, Ni and Sc. In addition, loss-on-ignition (LOI) is determined gravimetrically after ignition of a 1 g sample split at 1000°C, and total C and S are analyzed on a 0.1 g sample split using a Leco carbon-sulphur analyzer. |
| 4B | The same fusion and $HNO_3$ digestion as the 4A method, followed by ICP-MS analysis of the solution for 31 elements (Ba, Be, Co, Cs, Ga, Hf, Nb, Rb, Sn, Sr, Ta, Th, U, V, W, Zr, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu). The determinations are considered total. |
| 1DX | As a supplement to the 4B group, a 0.5 g sample split is leached for one hour in 95°C aqua regia ($HCl-HNO_3-H_2O$ mixture), with an aqua regia/sample ratio of 6 mL/g, then diluted to a 20 mL/g final ratio and analyzed in solution by ICP-MS for 14 elements (Mo, Cu, Pb, Zn, Ni, As, Cd, Sb, Bi, Ag, Au, Hg, Tl and Se). Some minerals will not dissolve completely in aqua regia, resulting in partial concentrations for some elements. Solubility of Au can be limited in refractory and graphitic samples. |
| 1F04 | The same aqua regia leaching as the 1DX procedure, followed by ICP-ES and ICP-MS analyses. ICP-ES values may be reported if concentrations exceed laboratory-determined crossover values; otherwise, ICP-MS results are reported for 53 elements (Mo, Cu, Pb, Zn, Ag, Ni, Co, Mn, Fe, As, U, Au, Th, Sr, Cd, Sb, Bi, V, Ca, P, La, Cr, Mg, Ba, Ti, B, Al, Na, K, W, Sc, Tl, S, Hg, Se, Te, Ga, Cs, Ge, Hf, Nb, Rb, Sn, Ta, Zr, Y, Ce, In, Re, Be, Li, Pd and Pt). Similar to the 1DX method, only partial concentrations are determined for some elements due to incomplete digestion of the sample. |
| 1EX | A 0.25 g sample split is weighed into a Teflon test tube. A 10 mL aliquot of the 2:2:1:1 $H_2O-HF-HClO_4-HNO_3$ mixture is added and the sample is heated until fuming on a hot plate and taken to dryness. A 7.5 mL aliquot of 50% HCl is then added to the residue and heated in a hot-water bath (~95°C) for 30 minutes. After cooling, the solution is transferred to a polypropylene test tube, made up to a 10 mL volume with 5% HCl and analyzed by ICP-ES and ICP-MS for 41 elements (Mo, Cu, Pb, Zn, Ag, Ni, Co, Mn, Fe, As, U, Au, Th, Sr, Cd, Sb, Bi, V, Ca, P, La, Cr, Mg, Ba, Ti, Al, Na, K, W, Zr, Ce, Sn, Y, Nb, Ta, Be, Sc, Li, S, Rb and Hf). The four-acid digestion is only partial for some Cr and Ba minerals and some oxides of Al, Hf, Mn, Sn, Ta and Zr. Volatilization during fuming may result in some loss of As, Sb and Au. |
| 5A | Instrumental neutron activation analysis (INAA) involves irradiation of a 5–30 g sample split in a nuclear reactor, followed by the gamma-ray analysis at Becquerel Laboratories Ltd. for total determination of 35 elements (Sb, As, Ba, Br, Ca, Ce, Cs, Cr, Co, Eu, Au, Hf, Ir, Fe, La, Lu, Hg, Mo, Nd, Ni, Rb, Sm, Sc, Se, Ag, Na, Sr, Ta, Tb, Th, Sn, W, U, Yb and Zn). The Mo results are affected by the interference from Mo produced by U fission. Other interferences may result in higher minimum detection limits for some elements. |
| 2A | A 0.2 g sample split is fused with NaOH, followed by fluorine analysis by specific-ion electrode. |
| 7PF | A 0.25 g sample split is fused with $Na_2O_2$, followed by ICP-ES analysis for percentage-level concentrations of 10 elements (B, Cr, Cu, Fe, Nb, Ni, Sn, Ta, W and Zn). |
| 7TD | Hot four-acid digestion of a 0.5–0.1 g sample split, followed by ICP-ES analysis for percentage-level Pb concentration. |

## Appendix 3 – Sample Crushing and Quality Control for Whole-Rock Geochemical Analyses

Each rock sample was crushed, split and a 250 g portion pulverized to 200 mesh using a mild steel mill (Acme preparation method code R200–250). The mill was washed with glass between each pulverization to minimize cross-contamination by mineralized samples.

The laboratory performed analyses of several certified reference materials, random duplicate splits of pulverized samples, grinder wash glass samples and blanks. The analyses of wash glass and blanks were used to monitor contamination during sample preparation and analysis. For internal data-quality control, we analyzed six aliquots of the Canadian Certified Reference Materials Project (CCRMP) TDB-1 certified reference material. The six aliquots (30–72 g) of the TDB-1 were weighed into plastic vials at the AGS and inserted in sample sets before the samples were sent to the laboratory.

We estimated precision or reproducibility of the analyses in terms of average relative percentage difference (RPD), based on multiple duplicate-sample pairs (e.g., Ziegler and Combs, 1997; Zimmerman et al., 2001). The RPD for a duplicate pair is defined as

RPD = 100 x [absolute value (C1 – C2)] / CX,

where (C1 – C2) is the concentration difference between duplicate results and CX is the average of the two results. The duplicate pairs include triplicate sample splits prepared by the AGS before pulverization and duplicate analyses of pulverized samples by Acme. Column heads in Appendix 4 indicate the total number of duplicate pairs (RPD count) used to calculate the average RPD values for each element. Lower average RPD value indicates higher analytical precision.

Accuracy of the analyses was estimated in terms of average percentage recovery (APR; Ziegler and Combs, 1997), based on the analyses of the CCRMP TDB-1 certified reference material. The APR is defined as

APR = 100 x CM / CA,

where CM is the average measured concentration in TDB-1 based on our results, and CA is the expected concentration in TDB-1 reported in the CCRMP Certificate of Analysis.

However, the accuracy estimate has an uncertainty that depends on both the precision of our analyses of TDB-1 and the error of the expected concentration reported in the CCRMP Certificate of Analysis. We estimated the 95.5% confidence-level precision of our analyses of TDB-1 in terms of relative standard deviation multiplied by a factor of two (2RSD) using

2RSD = (SD / CM) x 200,

where SD is the standard deviation and CM is the average measured concentration in TDB-1, based on our analyses.

If the error of the expected concentration in TDB-1 is reported in the CCRMP Certificate of Analysis, it is combined with the 2RSD according to

APR error = $\sqrt{(2RSD^2 + EA^2)}$,

where APR error (%) is the total relative uncertainty of the accuracy estimate (APR), 2RSD is the two times relative standard deviation or 95.5% confidence-level precision (%) of our TDB-1 results, and EA is the relative error (%) of the expected concentration in TDB-1 reported in the CCRMP Certificate of

Analysis. Therefore, if the error of the expected concentration in TDB-1 is not provided in the Certificate of Analysis, the total APR error simply equals the 95.5% confidence-level precision of our TDB-1 analyses (i.e., 2RSD). In this case, the APR error should be regarded as the minimum uncertainty of the accuracy estimate because it does not include the analytical uncertainty of the expected concentration.

Average percentage recovery (APR) values of about 100% within the uncertainty (i.e., ± APR error %) indicate an accurate result. It should be emphasized that the APR error (i.e., the measure of the uncertainty of the accuracy estimate) applies only to the TDB-1 results, whereas the average RPD value based on duplicate pairs for many different samples characterizes analytical precision or reproducibility of the method applied to all of the samples.

The calculated RPD, APR and APR error values for each element are listed in the column heads in Appendix 4, with the minimum APR error values (i.e., APR error = 2RSD) highlighted. When more than 50% of the TDB-1 results returned ‘<MDL’, the APR is assigned a '<MDL' value.

## Appendix 4 – Whole-Rock Geochemical Data

### Legend

| | |
|---|---|
| Element: | Element analyzed |
| Method: | Analytical method code (Acme Analytical Laboratories Ltd.) |
| Units: | Units of measure: ppm, parts per million; ppb, parts per billion; %, per cent |
| MDL: | Minimum detection limit |
| RPD %: | Average relative percentage difference between duplicate pairs |
| RPD count: | Number of duplicate pairs used to calculate the RPD values |
| APR %: | Average percentage recovery relative to the CCRMP TDB-1 certified reference material |
| APR error %: | Relative 95.5% confidence-level uncertainty (%) of the APR values |
| Sample: | AGS sample number |
| <: | Less than the minimum detection limit |
| >: | Above than the maximum detection limit |
| NA: | Not analyzed |

**Note:** Average percentage recovery (APR) values are based on six samples of the CCRMP TDB-1 certified reference material analyzed with other samples by Acme Analytical Laboratories Ltd. The APR error values are based on two times relative standard deviation (2RSD) of the CCRMP TDB-1 results quadratically combined with the relative error of expected concentration in this reference material. When the error of expected concentration is not reported in the CCRMP TDB-1 Certificate of Analysis, minimum APR error values (equal to the 2RSD) are highlighted. Elements not reported in the TDB-1 Certificate of Analysis are denoted with 'NA'. See Appendix 3 for details on calculating the RPD, APR and APR error values.

## Appendix 4A

| Element | Au | Pt | Pd |
|---|---|---|---|
| Method | 3B03 | 3B03 | 3B03 |
| Units | ppb | ppb | ppb |
| MDL | 1 | 0.1 | 0.5 |
| RPD % | 30.8 | 16.7 | 17.0 |
| RPD count | 9 | 19 | 16 |
| APR % | 74.1 | 78.7 | 88.6 |
| APR error % | 38.4 | 27.7 | 29.4 |
| Sample | | | |
| 8175 | 6 | 1.7 | <0.5 |
| 8176 | <1 | 1.4 | <0.5 |
| 8177 | <1 | 1.4 | <0.5 |
| 8178 | <1 | 0.2 | <0.5 |
| 8179 | <1 | 1.6 | <0.5 |
| 8180 | <1 | <0.1 | <0.5 |
| 8181 | <1 | 0.3 | <0.5 |
| 8182 | <1 | <0.1 | <0.5 |
| 8183 | 5 | 5.5 | 23.7 |
| 8185 | <1 | 4.1 | 16.7 |
| 8186 | 2 | 0.9 | 1.7 |
| 8187 | 2 | <0.1 | <0.5 |
| 8188 | <1 | 4.3 | 15.4 |
| 8189 | 2 | <0.1 | <0.5 |
| 8190 | 2 | <0.1 | <0.5 |
| 8191 | <1 | 0.1 | <0.5 |
| 8192 | 20 | 0.2 | <0.5 |
| 8193 | <1 | 0.1 | <0.5 |
| 8194 | <1 | <0.1 | <0.5 |
| 8195 | <1 | <0.1 | <0.5 |
| 8196 | 55 | <0.1 | <0.5 |
| 8197 | <1 | <0.1 | <0.5 |
| 8198 | <1 | <0.1 | <0.5 |
| 8199 | <1 | 0.2 | <0.5 |
| 8200 | <1 | <0.1 | <0.5 |
| 8201 | <1 | <0.1 | <0.5 |
| 8202 | <1 | <0.1 | <0.5 |
| 8203 | <1 | <0.1 | <0.5 |
| 8204 | <1 | <0.1 | <0.5 |
| 8205 | <1 | <0.1 | <0.5 |
| 8206 | <1 | 0.4 | 3.7 |
| 8207 | <1 | 0.2 | <0.5 |
| 8208 | <1 | <0.1 | <0.5 |
| 8209 | <1 | <0.1 | <0.5 |
| 8210 | <1 | 0.2 | <0.5 |
| 8211 | <1 | <0.1 | <0.5 |
| 8212 | <1 | <0.1 | <0.5 |
| 8213 | <1 | <0.1 | <0.5 |
| 8214 | <1 | <0.1 | <0.5 |
| 8215 | 3 | <0.1 | <0.5 |
| 8216 | <1 | <0.1 | <0.5 |
| 8217 | <1 | <0.1 | <0.5 |
| 8218 | 3 | <0.1 | <0.5 |
| 8220 | <1 | <0.1 | <0.5 |
| 8221 | <1 | <0.1 | <0.5 |
| 8222 | <1 | <0.1 | <0.5 |
| 8223 | <1 | <0.1 | <0.5 |
| 8224 | 7 | 0.8 | 1.4 |
| 8225 | <1 | <0.1 | <0.5 |
| 8226 | <1 | 0.5 | 1.4 |
| 8227 | <1 | 0.2 | <0.5 |
| 8228 | <1 | <0.1 | <0.5 |
| 8246 | <1 | <0.1 | <0.5 |
| 8247 | <1 | <0.1 | <0.5 |
| 8248 | <1 | <0.1 | <0.5 |
| 8249 | <1 | <0.1 | <0.5 |
| 8250 | 3 | 0.6 | <0.5 |
| 8251 | 3 | 0.6 | <0.5 |

| Element | Au | Pt | Pd |
|---|---|---|---|
| Method | 3B03 | 3B03 | 3B03 |
| Units | ppb | ppb | ppb |
| MDL | 1 | 0.1 | 0.5 |
| RPD % | 30.8 | 16.7 | 17.0 |
| RPD count | 9 | 19 | 16 |
| APR % | 74.1 | 78.7 | 88.6 |
| APR error % | 38.4 | 27.7 | 29.4 |
| Sample | | | |
| 8252 | <1 | <0.1 | <0.5 |
| 8253 | <1 | 0.2 | <0.5 |
| 8254 | <1 | <0.1 | <0.5 |
| 8255 | <1 | <0.1 | <0.5 |
| 8256 | <1 | <0.1 | 0.5 |
| 8257 | <1 | 0.9 | <0.5 |
| 8258 | <1 | 0.9 | <0.5 |
| 8259 | <1 | <0.1 | <0.5 |
| 8260 | <1 | 1.1 | <0.5 |
| 8261 | <1 | 1.7 | 0.6 |
| 8262 | <1 | <0.1 | <0.5 |
| 8263 | <1 | 0.2 | <0.5 |
| 8264 | <1 | <0.1 | <0.5 |
| 8265 | 21 | 1.5 | 2.8 |
| 8266 | 3 | 0.3 | <0.5 |
| 8267 | 2 | 0.6 | <0.5 |
| 8268 | 51 | 0.3 | 0.5 |
| 8269 | <1 | <0.1 | <0.5 |
| 8270 | <1 | <0.1 | <0.5 |
| 8271 | <1 | <0.1 | <0.5 |
| 8272 | <1 | <0.1 | <0.5 |
| 8273 | <1 | <0.1 | <0.5 |
| 8274 | <1 | <0.1 | <0.5 |
| 8275 | 1 | 8.8 | 6.1 |
| 8276 | <1 | 0.2 | <0.5 |
| 8277 | <1 | 1.5 | 0.7 |
| 8278 | <1 | 6.2 | 3.5 |
| 8279 | <1 | 10.8 | 4.8 |
| 8280 | <1 | 0.1 | <0.5 |
| 8281 | <1 | <0.1 | <0.5 |
| 8282 | <1 | <0.1 | <0.5 |
| 8283 | <1 | 0.2 | <0.5 |
| 8284 | <1 | <0.1 | <0.5 |
| 8285 | <1 | <0.1 | <0.5 |
| 8286 | <1 | 0.4 | <0.5 |
| 8287 | 4 | 0.2 | <0.5 |
| 8288 | <1 | <0.1 | <0.5 |
| 8289 | <1 | <0.1 | <0.5 |
| 8290 | <1 | <0.1 | <0.5 |
| 8291 | 2 | 0.1 | <0.5 |
| 8292 | <1 | <0.1 | <0.5 |
| 8293 | <1 | <0.1 | <0.5 |
| 8294 | 5 | 2.2 | 2.6 |
| 8295 | 5 | 2.0 | 1.7 |
| 8296 | 4 | 2.2 | 1.0 |
| 8297 | 2 | 0.9 | <0.5 |
| 8298 | <1 | <0.1 | <0.5 |
| 8299 | <1 | 0.1 | <0.5 |
| 8300 | <1 | 0.2 | <0.5 |
| 8301 | <1 | 0.2 | <0.5 |
| 8302 | <1 | 0.2 | <0.5 |
| 8303 | <1 | 0.2 | <0.5 |
| 8304 | 2 | 1.9 | 0.8 |
| 8305 | 3 | 2.1 | 0.9 |
| 8306 | 4 | 4.1 | 20.1 |
| 8307 | 4 | 4.8 | 20.5 |
| 8308 | 6 | 4.7 | 23.0 |

Appendix 4B

| Element | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | $P_2O_5$ | MnO | $Cr_2O_3$ | Ni | Sc | LOI | Sum | Ba | Be | Co | Cs | Ga | Hf | Nb | Rb | Sn | Sr | Ta | Th | U | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B |
| Units | % | % | % | % | % | % | % | % | % | % | % | ppm | ppm | % | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| MDL | 0.01 | 0.01 | 0.04 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.002 | 20 | 1 | 0.1 | 0.01 | 1 | 1 | 0.2 | 0.1 | 0.5 | 0.1 | 0.1 | 0.1 | 1 | 0.5 | 0.1 | 0.2 | 0.1 | 8 |
| RPD % | 0.7 | 1.2 | 1.3 | 1.7 | 7.5 | 2.6 | 2.3 | 1.0 | 5.9 | 6.4 | 3.5 | 3.6 | 4.1 | 11.9 | | 5.1 | 16.1 | 10.4 | 6.0 | 3.6 | 7.5 | 5.0 | 4.8 | 20.7 | 5.6 | 14.7 | 8.8 | 7.5 | 4.9 |
| RPD count | 25 | 25 | 25 | 24 | 25 | 25 | 25 | 25 | 25 | 21 | 24 | 16 | 24 | 25 | | 25 | 19 | 25 | 25 | 25 | 25 | 25 | 25 | 24 | 25 | 23 | 25 | 25 | 25 |
| APR % | 99.1 | 101.5 | 96.1 | 100.0 | 102.3 | 97.6 | 96.6 | 101.0 | 122.8 | 94.1 | 98.1 | 99.6 | 104.2 | 161.1 | | 94.3 | 66.7 | 97.0 | NA | 100.5 | 93.3 | 115.3 | 92.4 | 125.0 | 101.0 | 95.8 | 98.1 | 100.0 | 104.5 |
| APR error % | 1.2 | 4.3 | 4.6 | 6.3 | 7.5 | 6.2 | 9.7 | 7.2 | 25.5 | 6.4 | 7.2 | 8.5 | 8.8 | 71.3 | | 13.4 | 0.0 | 11.7 | | 15.9 | 21.2 | 14.7 | 10.1 | 66.5 | 13.5 | 28.4 | 13.6 | 20.5 | 10.5 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8175 | 91.17 | 0.59 | 0.86 | 0.24 | 2.11 | 0.04 | 0.20 | 0.03 | 1.44 | 0.03 | <0.002 | <20 | <1 | 1.6 | 98.34 | 1441 | <1 | 1.6 | 0.2 | 1.0 | 0.8 | 0.6 | 6.7 | <1 | 42.2 | <0.1 | 1.5 | 8.7 | 11 |
| 8176 | 48.04 | 11.75 | 12.41 | 7.29 | 8.98 | 3.02 | 1.06 | 3.91 | 0.50 | 0.16 | 0.045 | 145 | 26 | 2.4 | 99.63 | 344 | 2 | 40.9 | 0.5 | 20.5 | 8.1 | 31.3 | 26.4 | 3 | 467.1 | 2.0 | 5.1 | 1.5 | 352 |
| 8177 | 49.02 | 12.27 | 12.77 | 7.01 | 8.22 | 2.45 | 1.14 | 4.06 | 0.52 | 0.19 | 0.044 | 136 | 27 | 1.9 | 99.58 | 530 | 3 | 43.4 | 1.8 | 22.2 | 8.4 | 34.1 | 35.4 | 3 | 621.3 | 2.1 | 5.5 | 1.6 | 381 |
| 8178 | 69.27 | 12.67 | 5.65 | 3.55 | 0.77 | 0.29 | 3.49 | 0.48 | 0.31 | 0.03 | 0.005 | 22 | 10 | 3.2 | 99.73 | 1152 | 2 | 11.0 | 5.6 | 16.1 | 8.6 | 12.8 | 122.6 | 3 | 89.2 | 0.9 | 12.9 | 4.3 | 45 |
| 8179 | 49.01 | 11.70 | 11.78 | 6.07 | 9.87 | 3.39 | 0.45 | 3.62 | 0.44 | 0.14 | 0.042 | 131 | 24 | 3.0 | 99.58 | 141 | 2 | 37.3 | 0.3 | 21.4 | 7.2 | 29.3 | 12.1 | 2 | 1353.0 | 1.6 | 4.5 | 1.4 | 340 |
| 8180 | 88.90 | 3.36 | 2.55 | 1.54 | 0.61 | 0.05 | 0.69 | 0.09 | 0.05 | 0.06 | 0.002 | <20 | 3 | 2.0 | 99.93 | 443 | <1 | 2.0 | 1.2 | 4.3 | 1.3 | 2.1 | 25.9 | <1 | 21.5 | 0.1 | 2.2 | 0.6 | 12 |
| 8181 | 84.16 | 2.78 | 7.29 | 1.74 | 0.37 | 0.03 | 0.26 | 0.10 | 0.04 | 0.17 | <0.002 | <20 | 3 | 2.9 | 99.87 | 813 | <1 | 18.7 | 0.5 | 3.7 | 1.3 | 2.2 | 10.6 | <1 | 17.0 | 0.2 | 2.8 | 0.8 | 14 |
| 8182 | 48.04 | 10.66 | 13.29 | 8.95 | 8.70 | 2.31 | 1.29 | 2.94 | 0.37 | 0.21 | 0.041 | 162 | 39 | 2.8 | 99.61 | 544 | 3 | 59.6 | 0.6 | 20.5 | 8.1 | 23.9 | 28.0 | 2 | 320.4 | 1.5 | 3.6 | 0.7 | 343 |
| 8183 | 50.08 | 13.60 | 14.03 | 5.85 | 9.65 | 2.24 | 0.91 | 2.35 | 0.22 | 0.19 | 0.037 | 95 | 38 | 0.5 | 99.68 | 239 | 1 | 46.4 | 0.5 | 22.6 | 5.2 | 12.6 | 21.9 | 3 | 240.3 | 0.7 | 2.7 | 1.1 | 510 |
| 8185 | 50.15 | 13.56 | 14.03 | 5.82 | 9.71 | 2.26 | 0.91 | 2.37 | 0.22 | 0.19 | 0.036 | 88 | 38 | 0.4 | 99.67 | 240 | <1 | 46.8 | 0.5 | 22.0 | 5.1 | 13.3 | 21.8 | 3 | 240.7 | 0.8 | 2.6 | 1.0 | 511 |
| 8186 | 68.53 | 13.44 | 3.68 | 4.06 | 0.26 | 0.67 | 4.65 | 0.50 | 0.13 | 0.01 | 0.006 | <20 | 12 | 3.6 | 99.58 | 669 | 2 | 5.5 | 9.3 | 17.4 | 5.5 | 11.6 | 159.7 | 3 | 38.7 | 0.8 | 10.2 | 3.0 | 66 |
| 8187 | 48.00 | 11.01 | 13.72 | 7.99 | 8.35 | 3.04 | 0.60 | 3.16 | 0.40 | 0.16 | 0.051 | 135 | 33 | 3.1 | 99.60 | 720 | 1 | 61.0 | 0.6 | 21.1 | 8.4 | 25.0 | 12.8 | 2 | 316.2 | 1.5 | 4.5 | 0.9 | 354 |
| 8188 | 49.80 | 13.73 | 13.98 | 5.93 | 9.89 | 2.26 | 0.91 | 2.37 | 0.23 | 0.20 | 0.037 | 91 | 38 | 0.3 | 99.67 | 241 | 1 | 47.2 | 0.4 | 22.3 | 4.8 | 13.2 | 21.3 | 3 | 241.9 | 0.8 | 2.8 | 0.9 | 519 |
| 8189 | 51.42 | 14.80 | 11.96 | 3.68 | 4.45 | 4.46 | 2.44 | 3.08 | 0.61 | 0.18 | <0.002 | <20 | 18 | 2.5 | 99.62 | 1033 | 2 | 33.7 | 0.7 | 25.8 | 11.5 | 40.0 | 52.3 | 3 | 382.3 | 2.5 | 6.8 | 1.3 | 276 |
| 8190 | 47.65 | 12.30 | 13.35 | 6.73 | 8.64 | 2.76 | 1.07 | 3.27 | 0.45 | 0.17 | 0.024 | 104 | 30 | 3.2 | 99.64 | 370 | 1 | 55.4 | 1.7 | 22.8 | 8.4 | 28.8 | 24.9 | 2 | 404.1 | 1.7 | 5.2 | 1.0 | 358 |
| 8191 | 56.72 | 19.85 | 6.08 | 0.26 | 0.09 | 0.23 | 13.31 | 0.53 | 0.11 | 0.03 | 0.002 | <20 | 5 | 2.6 | 99.87 | 268 | 3 | 2.5 | 5.8 | 25.0 | 5.1 | 15.8 | 305.5 | 1 | 61.9 | 0.7 | 7.7 | 2.7 | 74 |
| 8192 | 89.03 | 2.93 | 3.50 | 0.10 | 0.08 | 0.03 | 1.62 | 1.04 | 0.09 | 0.01 | 0.004 | <20 | 4 | 1.2 | 99.61 | 120 | <1 | 1.9 | 0.9 | 4.1 | 58.7 | 30.3 | 42.0 | <1 | 98.3 | 1.1 | 37.7 | 7.5 | 113 |
| 8193 | 58.34 | 19.30 | 5.48 | 0.24 | 0.37 | 1.34 | 11.50 | 0.50 | 0.13 | 0.28 | <0.002 | <20 | 5 | 2.3 | 99.81 | 671 | 3 | 12.5 | 9.3 | 23.8 | 5.2 | 14.1 | 282.1 | 1 | 160.6 | 0.6 | 6.1 | 3.0 | 70 |
| 8194 | 54.85 | 17.95 | 4.67 | 0.40 | 5.68 | 5.07 | 3.57 | 0.46 | 0.14 | 0.16 | <0.002 | <20 | 4 | 6.8 | 99.73 | 1471 | 2 | 5.0 | 6.9 | 22.3 | 4.3 | 12.7 | 87.3 | 1 | 378.1 | 0.6 | 5.9 | 2.8 | 66 |
| 8195 | 58.35 | 18.03 | 4.25 | 1.53 | 3.64 | 4.81 | 3.65 | 0.47 | 0.21 | 0.13 | <0.002 | <20 | 5 | 4.7 | 99.75 | 936 | 1 | 7.4 | 3.1 | 23.4 | 4.8 | 13.7 | 92.8 | 1 | 453.6 | 0.6 | 6.4 | 2.5 | 70 |
| 8196 | 62.33 | 18.06 | 4.34 | 3.16 | 0.24 | 1.03 | 5.68 | 0.65 | 0.08 | 0.02 | 0.008 | 23 | 17 | 4.1 | 99.73 | 383 | 5 | 13.3 | 11.3 | 27.7 | 7.4 | 17.5 | 239.5 | 5 | 40.4 | 1.2 | 17.4 | 5.6 | 96 |
| 8197 | 58.89 | 17.99 | 4.68 | 0.99 | 3.33 | 6.49 | 2.89 | 0.43 | 0.19 | 0.14 | <0.002 | <20 | 5 | 3.7 | 99.73 | 996 | 2 | 4.9 | 2.1 | 22.4 | 4.8 | 13.5 | 63.2 | 1 | 688.7 | 0.6 | 6.1 | 2.4 | 64 |
| 8198 | 57.27 | 17.83 | 4.54 | 1.13 | 4.60 | 4.98 | 3.14 | 0.46 | 0.20 | 0.15 | <0.002 | <20 | 5 | 5.5 | 99.75 | 1069 | 2 | 5.0 | 3.5 | 23.9 | 4.3 | 14.1 | 90.3 | 1 | 363.4 | 0.9 | 5.8 | 2.4 | 68 |
| 8199 | 66.27 | 15.38 | 4.29 | 3.41 | 0.29 | 1.47 | 4.49 | 0.58 | 0.09 | 0.03 | 0.007 | 25 | 13 | 3.5 | 99.78 | 416 | 3 | 10.6 | 10.5 | 22.2 | 6.6 | 15.2 | 205.1 | 4 | 44.6 | 1.2 | 15.0 | 4.4 | 78 |
| 8200 | 46.73 | 14.39 | 14.76 | 6.64 | 3.37 | 3.06 | 2.50 | 3.63 | 0.72 | 0.09 | 0.004 | 28 | 26 | 3.8 | 99.65 | 826 | <1 | 43.0 | 0.5 | 25.2 | 7.4 | 33.2 | 37.7 | 2 | 40.2 | 1.9 | 3.1 | 0.4 | 175 |
| 8201 | 83.08 | 3.99 | 2.51 | 3.65 | 1.59 | 0.06 | 1.25 | 0.09 | 0.06 | 0.06 | <0.002 | <20 | 2 | 3.4 | 99.73 | 334 | <1 | 4.5 | 0.5 | 5.4 | 1.3 | 2.6 | 24.6 | <1 | 12.1 | 0.2 | 3.5 | 6.5 | 14 |
| 8202 | 82.91 | 3.73 | 2.03 | 2.05 | 2.47 | 0.23 | 2.41 | 0.09 | 0.02 | 0.11 | <0.002 | <20 | 2 | 3.8 | 99.83 | 743 | <1 | 19.1 | 0.5 | 3.9 | 1.7 | 1.6 | 41.7 | <1 | 27.4 | 0.1 | 1.9 | 0.8 | 8 |
| 8203 | 69.02 | 13.11 | 3.71 | 3.93 | 0.24 | 0.66 | 4.56 | 0.49 | 0.12 | 0.01 | 0.006 | <20 | 11 | 3.7 | 99.60 | 628 | 3 | 5.8 | 9.1 | 16.9 | 5.7 | 10.9 | 153.1 | 2 | 32.6 | 0.8 | 11.3 | 3.2 | 61 |
| 8204 | 48.14 | 11.12 | 13.63 | 8.01 | 8.38 | 2.99 | 0.63 | 3.15 | 0.38 | 0.17 | 0.049 | 130 | 33 | 3.0 | 99.63 | 571 | 1 | 55.8 | 0.7 | 19.4 | 7.8 | 23.5 | 13.3 | 2 | 298.0 | 1.6 | 4.6 | 0.9 | 330 |
| 8205 | 75.85 | 7.58 | 4.17 | 4.17 | 1.58 | 0.68 | 2.64 | 0.53 | 0.08 | 0.06 | 0.009 | 22 | 8 | 2.4 | 99.72 | 1522 | <1 | 12.5 | 1.0 | 9.5 | 3.4 | 7.6 | 50.3 | 2 | 106.0 | 0.5 | 6.3 | 1.5 | 58 |
| 8206 | 47.71 | 10.51 | 13.72 | 8.93 | 9.02 | 2.30 | 1.61 | 3.01 | 0.35 | 0.19 | 0.065 | 159 | 35 | 2.2 | 99.58 | 849 | 1 | 60.2 | 0.5 | 19.7 | 6.7 | 21.7 | 31.6 | 2 | 365.1 | 1.5 | 4.4 | 0.9 | 328 |
| 8207 | 48.10 | 10.35 | 13.70 | 9.14 | 8.70 | 2.26 | 1.56 | 2.97 | 0.35 | 0.19 | 0.069 | 167 | 36 | 2.2 | 99.58 | 773 | 1 | 63.5 | 0.6 | 19.5 | 7.0 | 22.0 | 31.3 | 2 | 352.2 | 1.4 | 3.9 | 0.7 | 343 |
| 8208 | 96.31 | 0.86 | 1.20 | 0.55 | 0.20 | 0.03 | 0.31 | 0.04 | 0.07 | <0.01 | 0.003 | <20 | <1 | 0.4 | 99.98 | 354 | <1 | 1.8 | 0.1 | 1.0 | 1.1 | 0.7 | 5.3 | <1 | 9.5 | <0.1 | 1.7 | 0.5 | <8 |
| 8209 | 79.39 | 6.75 | 3.40 | 4.07 | 0.80 | 0.03 | 1.59 | 0.13 | 0.06 | 0.07 | 0.002 | <20 | 5 | 3.5 | 99.83 | 143 | <1 | 5.6 | 2.3 | 9.8 | 2.3 | 3.7 | 51.9 | 1 | 5.3 | 0.3 | 4.8 | 2.5 | 25 |
| 8210 | 83.70 | 3.40 | 7.27 | 1.95 | 0.11 | 0.03 | 0.39 | 0.11 | 0.04 | 0.14 | 0.002 | <20 | 3 | 2.8 | 99.89 | 512 | <1 | 22.5 | 0.9 | 4.5 | 1.7 | 2.9 | 15.3 | <1 | 10.7 | 0.2 | 3.3 | 0.9 | 16 |
| 8211 | 96.76 | 0.61 | 1.94 | 0.28 | 0.06 | 0.02 | 0.11 | 0.02 | <0.01 | 0.02 | 0.003 | <20 | <1 | 0.2 | 100.03 | 57 | <1 | 2.2 | 0.2 | 0.9 | 0.8 | 0.6 | 3.9 | <1 | 3.6 | <0.1 | 1.2 | 0.4 | <8 |
| 8212 | 90.67 | 2.25 | 3.83 | 1.45 | 0.04 | 0.02 | 0.19 | 0.07 | 0.03 | 0.10 | 0.002 | <20 | 2 | 1.3 | 99.97 | 204 | <1 | 7.8 | 0.4 | 2.8 | 1.1 | 1.8 | 7.1 | <1 | 7.4 | 0.1 | 2.0 | 0.6 | 10 |
| 8213 | 95.36 | 1.17 | 1.81 | 0.33 | 0.02 | 0.04 | 0.28 | 0.03 | 0.03 | 0.03 | <0.002 | <20 | 1 | 0.9 | 99.99 | 248 | <1 | 0.8 | 0.4 | 1.1 | 0.9 | 0.8 | 9.9 | <1 | 7.9 | <0.1 | 1.2 | 0.4 | <8 |
| 8214 | 54.60 | 19.80 | 4.83 | 0.85 | 4.06 | 5.26 | 5.74 | 0.52 | 0.09 | 0.15 | <0.002 | <20 | 2 | 3.4 | 99.35 | 2791 | 2 | 5.0 | 13.7 | 22.4 | 4.3 | 16.1 | 120.0 | 1 | 2095.4 | 0.7 | 8.2 | 3.3 | 79 |
| 8215 | 57.95 | 18.24 | 4.73 | 0.96 | 3.62 | 5.56 | 2.77 | 0.44 | 0.21 | 0.19 | <0.002 | <20 | 5 | 5.0 | 99.67 | 1801 | 2 | 4.7 | 2.7 | 20.9 | 4.4 | 12.6 | 71.7 | <1 | 516.2 | 0.6 | 6.1 | 2.1 | 62 |
| 8216 | 54.52 | 19.57 | 4.75 | 0.59 | 4.91 | 5.98 | 5.11 | 0.52 | 0.10 | 0.15 | <0.002 | <20 | 2 | 3.2 | 99.41 | 2695 | 3 | 4.8 | 6.8 | 22.2 | 3.8 | 15.3 | 113.4 | <1 | 1802.9 | 0.7 | 8.3 | 2.9 | 79 |

Appendix 4B

| Element | W | Zr | Y | La | Ce | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | TOT/C | TOT/S | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 2A Leco | 2A Leco | 2A |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm |
| MDL | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 0.02 | 0.3 | 0.05 | 0.02 | 0.05 | 0.01 | 0.05 | 0.02 | 0.03 | 0.01 | 0.05 | 0.01 | 0.02 | 0.02 | 10 |
| RPD % | 13.6 | 3.8 | 3.6 | 4.0 | 4.5 | 3.4 | 3.7 | 3.8 | 4.5 | 5.2 | 3.3 | 3.0 | 5.7 | 6.4 | 5.7 | 3.3 | 4.3 | 10.3 | 31.8 | 4.4 |
| RPD count | 17 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 23 | 23 | 27 |
| APR % | <MDL | 104.0 | 96.9 | 93.3 | 93.6 | 88.3 | 103.8 | 99.3 | 93.2 | 91.1 | 92.1 | 78.8 | 99.7 | 89.0 | 87.5 | 92.3 | 91.7 | NA | 80.0 | 95.0 |
| APR error % | | 16.8 | 14.3 | 14.1 | 11.0 | 8.3 | 10.4 | 10.7 | 10.6 | 9.1 | 11.0 | 14.1 | 32.0 | 2.8 | 17.8 | 12.9 | 12.3 | | 45.6 | 25.8 |
| Sample | | | | | | | | | | | | | | | | | | | | |
| 8175 | <0.5 | 29.0 | 22.5 | 5.9 | 14.6 | 2.33 | 15.2 | 10.14 | 1.76 | 11.68 | 1.49 | 5.83 | 0.80 | 1.75 | 0.20 | 1.09 | 0.13 | 0.15 | 0.12 | 1130 |
| 8176 | 0.6 | 304.7 | 28.9 | 33.6 | 82.0 | 11.29 | 50.5 | 10.09 | 2.91 | 8.49 | 1.22 | 6.03 | 1.08 | 2.72 | 0.37 | 2.23 | 0.30 | 0.15 | 0.09 | 830 |
| 8177 | 0.7 | 328.8 | 30.7 | 36.8 | 90.8 | 12.49 | 54.9 | 10.86 | 3.24 | 9.41 | 1.32 | 6.93 | 1.22 | 3.06 | 0.43 | 2.52 | 0.34 | 0.05 | 0.09 | 840 |
| 8178 | 1.8 | 325.1 | 78.2 | 37.0 | 82.9 | 9.96 | 39.6 | 8.94 | 1.95 | 12.15 | 2.42 | 13.74 | 2.76 | 7.52 | 1.02 | 5.91 | 0.84 | 0.12 | <0.02 | 890 |
| 8179 | 0.6 | 279.1 | 26.1 | 31.7 | 76.4 | 10.41 | 48.1 | 9.30 | 2.93 | 8.06 | 1.16 | 5.76 | 1.03 | 2.66 | 0.35 | 2.05 | 0.28 | 0.38 | <0.02 | 930 |
| 8180 | <0.5 | 45.8 | 10.7 | 17.1 | 39.4 | 4.84 | 20.6 | 3.69 | 0.63 | 2.84 | 0.41 | 2.10 | 0.35 | 0.97 | 0.14 | 0.83 | 0.12 | 0.20 | <0.02 | 220 |
| 8181 | <0.5 | 43.1 | 15.1 | 9.1 | 20.4 | 2.64 | 11.5 | 3.01 | 0.77 | 3.63 | 0.59 | 2.81 | 0.52 | 1.25 | 0.19 | 1.02 | 0.16 | 0.11 | 1.26 | 160 |
| 8182 | 0.5 | 268.8 | 30.1 | 32.1 | 76.9 | 10.68 | 45.9 | 9.66 | 2.82 | 8.33 | 1.23 | 6.05 | 1.11 | 2.79 | 0.39 | 2.08 | 0.33 | 0.15 | 0.05 | 690 |
| 8183 | <0.5 | 171.5 | 35.8 | 16.4 | 39.5 | 5.48 | 25.0 | 6.33 | 2.02 | 6.57 | 1.14 | 6.49 | 1.30 | 3.52 | 0.54 | 3.12 | 0.48 | 0.03 | 0.03 | 400 |
| 8185 | <0.5 | 170.4 | 36.5 | 16.0 | 38.7 | 5.51 | 24.4 | 6.16 | 2.04 | 6.63 | 1.13 | 6.36 | 1.35 | 3.58 | 0.54 | 3.15 | 0.49 | 0.03 | 0.03 | 400 |
| 8186 | 2.2 | 178.8 | 29.4 | 36.5 | 85.1 | 10.60 | 40.8 | 7.34 | 1.13 | 5.78 | 0.90 | 4.93 | 1.01 | 2.77 | 0.46 | 2.92 | 0.47 | <0.02 | 0.05 | 1280 |
| 8187 | 0.7 | 290.8 | 32.7 | 32.9 | 80.1 | 11.18 | 48.5 | 10.24 | 3.05 | 8.89 | 1.32 | 6.93 | 1.26 | 3.09 | 0.42 | 2.38 | 0.34 | 0.16 | 0.20 | 960 |
| 8188 | <0.5 | 168.6 | 36.5 | 16.6 | 38.9 | 5.48 | 24.7 | 6.19 | 2.04 | 6.66 | 1.15 | 6.53 | 1.37 | 3.65 | 0.54 | 3.10 | 0.48 | 0.03 | 0.02 | 460 |
| 8189 | 0.6 | 426.8 | 40.1 | 53.7 | 124.8 | 16.82 | 70.9 | 13.76 | 3.95 | 11.04 | 1.59 | 8.24 | 1.46 | 3.63 | 0.51 | 2.92 | 0.44 | 0.12 | 0.05 | 910 |
| 8190 | 0.5 | 320.9 | 33.2 | 39.2 | 92.2 | 12.81 | 53.4 | 10.90 | 3.17 | 9.13 | 1.35 | 6.75 | 1.20 | 3.06 | 0.43 | 2.40 | 0.34 | 0.34 | 0.20 | 910 |
| 8191 | 28.1 | 181.4 | 28.0 | 42.1 | 86.8 | 10.83 | 42.2 | 7.48 | 2.11 | 5.84 | 0.89 | 4.59 | 0.91 | 2.47 | 0.38 | 2.28 | 0.38 | 0.05 | 0.03 | 720 |
| 8192 | 69.7 | 2293.6 | 51.4 | 51.2 | 115.4 | 13.18 | 53.0 | 10.55 | 1.72 | 8.39 | 1.46 | 8.01 | 1.64 | 4.65 | 0.78 | 4.92 | 0.88 | 0.03 | 0.06 | 230 |
| 8193 | 16.6 | 185.3 | 25.1 | 34.9 | 83.0 | 9.43 | 37.3 | 7.77 | 2.17 | 6.24 | 0.88 | 4.66 | 0.88 | 2.40 | 0.37 | 2.23 | 0.35 | <0.02 | <0.02 | 870 |
| 8194 | 1.0 | 169.2 | 23.9 | 38.5 | 80.6 | 10.07 | 40.0 | 6.97 | 2.14 | 5.54 | 0.81 | 4.21 | 0.84 | 2.17 | 0.35 | 2.12 | 0.33 | 1.27 | 0.02 | 920 |
| 8195 | 1.5 | 177.4 | 25.9 | 37.2 | 72.8 | 8.95 | 34.8 | 6.06 | 1.74 | 4.99 | 0.78 | 4.41 | 0.87 | 2.43 | 0.37 | 2.37 | 0.36 | 0.77 | 0.05 | 800 |
| 8196 | 2.9 | 247.6 | 45.5 | 61.5 | 118.2 | 13.73 | 48.1 | 8.49 | 1.42 | 6.95 | 1.20 | 7.21 | 1.63 | 4.93 | 0.82 | 4.96 | 0.79 | 0.02 | <0.02 | 1590 |
| 8197 | 1.0 | 179.0 | 22.3 | 38.9 | 76.6 | 9.01 | 32.7 | 5.75 | 1.78 | 4.45 | 0.68 | 3.65 | 0.75 | 1.99 | 0.34 | 2.03 | 0.33 | 0.66 | 0.14 | 650 |
| 8198 | 0.5 | 178.8 | 22.8 | 38.1 | 75.6 | 9.04 | 34.8 | 5.92 | 1.87 | 4.60 | 0.70 | 3.95 | 0.76 | 2.14 | 0.35 | 2.14 | 0.35 | 0.97 | 0.10 | 650 |
| 8199 | 3.2 | 213.7 | 35.7 | 46.4 | 90.5 | 10.46 | 37.7 | 6.73 | 1.12 | 5.69 | 0.99 | 5.92 | 1.21 | 3.63 | 0.62 | 3.71 | 0.60 | 0.04 | <0.02 | 1270 |
| 8200 | <0.5 | 290.7 | 42.4 | 28.0 | 70.4 | 9.89 | 42.5 | 9.92 | 3.54 | 9.37 | 1.53 | 8.54 | 1.57 | 4.12 | 0.61 | 3.59 | 0.55 | 0.03 | <0.02 | 760 |
| 8201 | 0.6 | 49.6 | 11.2 | 18.8 | 41.2 | 4.55 | 15.7 | 3.12 | 0.54 | 2.52 | 0.41 | 2.07 | 0.40 | 0.98 | 0.17 | 1.03 | 0.15 | 0.66 | 0.09 | 540 |
| 8202 | <0.5 | 55.9 | 10.3 | 5.8 | 12.6 | 1.68 | 6.8 | 1.87 | 0.39 | 1.96 | 0.37 | 1.86 | 0.34 | 0.87 | 0.13 | 0.74 | 0.11 | 1.05 | 0.35 | 220 |
| 8203 | 2.4 | 176.3 | 28.2 | 34.0 | 80.1 | 9.94 | 37.9 | 7.00 | 1.09 | 5.51 | 0.88 | 4.90 | 0.98 | 2.95 | 0.48 | 2.96 | 0.48 | 0.04 | 0.03 | 1310 |
| 8204 | 0.6 | 269.6 | 30.9 | 31.0 | 75.3 | 10.62 | 46.4 | 9.92 | 2.86 | 8.48 | 1.26 | 6.53 | 1.18 | 2.87 | 0.41 | 2.22 | 0.33 | 0.17 | 0.17 | 880 |
| 8205 | 0.6 | 127.2 | 17.6 | 23.0 | 45.9 | 5.52 | 21.2 | 4.11 | 0.87 | 3.48 | 0.60 | 3.35 | 0.65 | 1.91 | 0.30 | 1.87 | 0.30 | 0.13 | 0.10 | 470 |
| 8206 | <0.5 | 254.3 | 28.8 | 29.3 | 71.9 | 9.97 | 44.3 | 9.39 | 2.78 | 8.16 | 1.25 | 6.56 | 1.10 | 2.76 | 0.39 | 2.21 | 0.32 | 0.11 | 0.12 | 650 |
| 8207 | <0.5 | 262.1 | 29.7 | 29.4 | 72.2 | 10.02 | 43.8 | 9.56 | 2.70 | 8.13 | 1.23 | 6.55 | 1.12 | 2.70 | 0.40 | 2.27 | 0.32 | 0.07 | 0.05 | 560 |
| 8208 | <0.5 | 37.1 | 5.2 | 4.2 | 9.2 | 1.17 | 5.4 | 1.34 | 0.21 | 1.33 | 0.20 | 1.05 | 0.17 | 0.45 | 0.07 | 0.37 | 0.06 | 0.05 | <0.02 | 200 |
| 8209 | 1.3 | 78.1 | 22.2 | 38.6 | 83.6 | 9.74 | 35.3 | 5.92 | 0.90 | 4.81 | 0.75 | 4.17 | 0.76 | 2.03 | 0.31 | 1.89 | 0.28 | 0.30 | <0.02 | 660 |
| 8210 | <0.5 | 61.8 | 15.2 | 10.2 | 23.5 | 2.87 | 12.1 | 2.77 | 0.63 | 3.09 | 0.54 | 2.87 | 0.50 | 1.27 | 0.19 | 1.16 | 0.17 | 0.07 | 0.77 | 300 |
| 8211 | <0.5 | 28.1 | 5.3 | 4.7 | 10.3 | 1.29 | 4.9 | 0.90 | 0.21 | 1.00 | 0.17 | 0.95 | 0.18 | 0.43 | 0.07 | 0.40 | 0.06 | <0.02 | <0.02 | 160 |
| 8212 | <0.5 | 41.8 | 10.6 | 8.0 | 18.2 | 2.21 | 9.0 | 2.35 | 0.58 | 2.56 | 0.43 | 2.22 | 0.36 | 0.92 | 0.13 | 0.76 | 0.12 | <0.02 | 0.22 | 160 |
| 8213 | <0.5 | 32.3 | 5.6 | 5.6 | 13.2 | 1.67 | 6.4 | 1.42 | 0.28 | 1.24 | 0.22 | 1.22 | 0.21 | 0.50 | 0.07 | 0.42 | 0.06 | 0.03 | <0.02 | 70 |
| 8214 | 1.8 | 199.7 | 27.9 | 53.0 | 113.2 | 14.08 | 56.0 | 9.78 | 3.23 | 7.16 | 1.00 | 5.43 | 0.92 | 2.54 | 0.39 | 2.43 | 0.36 | 0.15 | <0.02 | 810 |
| 8215 | 0.8 | 177.5 | 19.8 | 34.9 | 69.9 | 8.23 | 32.5 | 5.61 | 1.75 | 4.29 | 0.67 | 3.77 | 0.69 | 1.94 | 0.32 | 2.06 | 0.31 | 0.87 | 0.03 | 550 |
| 8216 | 1.0 | 190.6 | 25.1 | 50.4 | 107.7 | 13.49 | 52.9 | 9.37 | 3.14 | 6.76 | 0.96 | 5.04 | 0.89 | 2.46 | 0.38 | 2.30 | 0.34 | 0.07 | 0.02 | 1120 |

| Element | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | $P_2O_5$ | MnO | $Cr_2O_3$ | Ni | Sc | LOI | Sum | Ba | Be | Co | Cs | Ga | Hf | Nb | Rb | Sn | Sr | Ta | Th | U | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B |
| Units | % | % | % | % | % | % | % | % | % | % | % | ppm | ppm | % | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| MDL | 0.01 | 0.01 | 0.04 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.002 | 20 | 1 | 0.1 | 0.01 | 1 | 1 | 0.2 | 0.1 | 0.5 | 0.1 | 0.1 | 0.1 | 1 | 0.5 | 0.1 | 0.2 | 0.1 | 8 |
| RPD % | 0.7 | 1.2 | 1.3 | 1.7 | 7.5 | 2.6 | 2.3 | 1.0 | 5.9 | 6.4 | 3.5 | 3.6 | 4.1 | 11.9 | | 5.1 | 16.1 | 10.4 | 6.0 | 3.6 | 7.5 | 5.0 | 4.8 | 20.7 | 5.6 | 14.7 | 8.8 | 7.5 | 4.9 |
| RPD count | 25 | 25 | 25 | 24 | 25 | 25 | 25 | 25 | 25 | 21 | 24 | 16 | 24 | 25 | | 25 | 19 | 25 | 25 | 25 | 25 | 25 | 25 | 24 | 25 | 23 | 25 | 25 | 25 |
| APR % | 99.1 | 101.5 | 96.1 | 100.0 | 102.3 | 97.6 | 96.6 | 101.0 | 122.8 | 94.1 | 98.1 | 99.6 | 104.2 | 161.1 | | 94.3 | 66.7 | 97.0 | NA | 100.5 | 93.3 | 115.3 | 92.4 | 125.0 | 101.0 | 95.8 | 98.1 | 100.0 | 104.5 |
| APR error % | 1.2 | 4.3 | 4.6 | 6.3 | 7.5 | 6.2 | 9.7 | 7.2 | 25.5 | 6.4 | 7.2 | 8.5 | 8.8 | 71.3 | | 13.4 | 0.0 | 11.7 | | 15.9 | 21.2 | 14.7 | 10.1 | 66.5 | 13.5 | 28.4 | 13.6 | 20.5 | 10.5 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8217 | 53.47 | 19.45 | 4.73 | 0.64 | 4.48 | 3.98 | 7.20 | 0.49 | 0.07 | 0.12 | <0.002 | <20 | 1 | 4.9 | 99.51 | 2646 | 3 | 5.0 | 3.1 | 21.8 | 4.7 | 15.2 | 163.9 | 1 | 926.5 | 0.6 | 10.1 | 3.1 | 78 |
| 8218 | 13.57 | 2.92 | 1.32 | 1.96 | 42.73 | 0.33 | 0.95 | 0.09 | 0.04 | 0.05 | <0.002 | <20 | 2 | 35.9 | 99.88 | 187 | <1 | 13.6 | 1.6 | 4.0 | 1.5 | 3.5 | 32.9 | <1 | 134.8 | <0.1 | 5.0 | 1.7 | 16 |
| 8220 | 68.63 | 13.32 | 3.64 | 4.03 | 0.39 | 0.66 | 4.57 | 0.48 | 0.11 | 0.01 | 0.005 | <20 | 10 | 3.7 | 99.58 | 702 | 2 | 5.5 | 9.1 | 16.4 | 6.3 | 11.7 | 146.8 | 2 | 39.8 | 0.5 | 11.2 | 3.4 | 66 |
| 8221 | 47.57 | 11.30 | 13.61 | 8.12 | 8.58 | 2.95 | 0.69 | 3.15 | 0.38 | 0.18 | 0.049 | 123 | 32 | 3.0 | 99.59 | 787 | 2 | 60.9 | 0.7 | 21.0 | 8.2 | 24.1 | 15.7 | 3 | 325.5 | 1.2 | 6.1 | 1.0 | 344 |
| 8222 | 39.99 | 12.96 | 4.20 | 0.24 | 19.05 | 2.81 | 4.50 | 0.52 | 0.03 | 2.22 | <0.002 | <20 | 2 | 12.9 | 99.35 | 2095 | 3 | 1.5 | 1.5 | 19.0 | 7.1 | 31.6 | 96.9 | 2 | 2854.1 | 1.0 | 5.9 | 3.5 | 151 |
| 8223 | 61.28 | 19.73 | 3.17 | 0.29 | 1.54 | 5.80 | 5.74 | 0.21 | 0.02 | 0.11 | <0.002 | <20 | <1 | 1.5 | 99.36 | 2999 | 3 | 2.5 | 0.5 | 18.6 | 4.2 | 18.9 | 149.5 | 1 | 2260.4 | 1.0 | 8.0 | 2.2 | 64 |
| 8224 | 59.27 | 19.18 | 4.32 | 0.24 | 3.05 | 5.46 | 5.50 | 0.44 | 0.02 | 0.19 | <0.002 | <20 | 1 | 1.6 | 99.24 | 3272 | 2 | 3.0 | 1.5 | 21.0 | 7.0 | 37.6 | 130.1 | 2 | 2704.9 | 1.5 | 10.8 | 5.7 | 114 |
| 8225 | 55.69 | 16.89 | 7.06 | 1.00 | 2.69 | 2.30 | 9.76 | 0.92 | 0.12 | 0.15 | <0.002 | <20 | 5 | 2.7 | 99.31 | 3117 | 6 | 11.7 | 9.4 | 22.8 | 6.6 | 33.1 | 234.6 | 3 | 1904.2 | 1.3 | 14.1 | 2.0 | 232 |
| 8226 | 55.48 | 17.02 | 6.47 | 0.89 | 2.93 | 1.06 | 11.30 | 0.63 | 0.13 | 0.15 | <0.002 | <20 | 3 | 3.3 | 99.32 | 3368 | 8 | 8.8 | 5.2 | 24.8 | 5.9 | 70.9 | 480.9 | 2 | 1582.3 | 2.1 | 20.1 | 4.6 | 256 |
| 8227 | 53.03 | 15.86 | 7.28 | 0.66 | 6.03 | 2.04 | 8.88 | 0.79 | 0.36 | 0.18 | 0.002 | <20 | 6 | 4.2 | 99.33 | 2322 | 7 | 17.2 | 2.5 | 23.8 | 8.2 | 74.1 | 254.5 | 2 | 2316.6 | 3.8 | 21.2 | 4.8 | 251 |
| 8228 | 54.30 | 18.25 | 5.96 | 0.92 | 3.18 | 4.61 | 6.72 | 0.56 | 0.07 | 0.15 | <0.002 | <20 | 2 | 4.8 | 99.46 | 1924 | 6 | 11.9 | 13.9 | 27.3 | 6.8 | 44.9 | 172.4 | 2 | 1830.3 | 3.1 | 17.1 | 1.9 | 180 |
| 8246 | 47.06 | 1.08 | 1.87 | 0.85 | 26.99 | 0.03 | 0.01 | 0.06 | 0.01 | 0.30 | <0.002 | <20 | 7 | 21.7 | 99.93 | 17 | <1 | 2.4 | <0.1 | 3.0 | 0.1 | 0.6 | 0.4 | <1 | 143.7 | <0.1 | <0.2 | <0.1 | <8 |
| 8247 | 46.21 | 15.65 | 16.30 | 4.63 | 3.45 | 3.14 | 1.57 | 3.76 | 0.75 | 0.30 | 0.006 | 48 | 28 | 3.9 | 99.64 | 579 | 2 | 45.2 | 1.8 | 25.2 | 7.4 | 34.1 | 30.8 | 2 | 260.9 | 1.9 | 3.1 | 0.7 | 186 |
| 8248 | 50.70 | 14.68 | 11.49 | 7.39 | 2.59 | 3.79 | 0.34 | 2.96 | 0.58 | 0.12 | 0.006 | 43 | 24 | 5.0 | 99.67 | 99 | 1 | 31.9 | 0.6 | 21.8 | 7.1 | 27.8 | 7.8 | 2 | 65.7 | 1.6 | 4.9 | 0.8 | 150 |
| 8249 | 84.02 | 4.68 | 3.80 | 3.57 | 0.20 | 0.05 | 0.34 | 0.13 | 0.16 | 0.03 | <0.002 | <20 | 4 | 2.7 | 99.65 | 105 | <1 | 4.8 | 0.5 | 6.2 | 2.6 | 2.8 | 9.4 | <1 | 7.0 | 0.2 | 5.1 | 1.2 | 9 |
| 8250 | 45.10 | 16.80 | 5.72 | 7.25 | 5.97 | 5.08 | 0.85 | 4.11 | 0.82 | 0.18 | 0.007 | 48 | 29 | 7.4 | 99.34 | 83 | 1 | 41.2 | 0.7 | 22.8 | 8.4 | 36.9 | 21.8 | 2 | 78.4 | 2.2 | 3.5 | 0.8 | 192 |
| 8251 | 40.76 | 14.38 | 9.53 | 5.78 | 7.77 | 0.10 | 8.03 | 3.60 | 0.73 | 0.19 | 0.006 | 33 | 23 | 8.1 | 98.97 | 290 | <1 | 14.9 | 0.5 | 20.3 | 7.4 | 30.2 | 87.6 | 2 | 55.7 | 2.0 | 2.6 | 4.0 | 120 |
| 8252 | 71.92 | 12.25 | 2.37 | 2.37 | 0.14 | 0.75 | 6.14 | 0.49 | 0.11 | 0.01 | 0.006 | <20 | 9 | 3.0 | 99.52 | 503 | 2 | 1.5 | 2.6 | 15.5 | 10.7 | 10.3 | 123.0 | 2 | 41.1 | 0.8 | 12.5 | 3.0 | 49 |
| 8253 | 72.30 | 12.10 | 2.45 | 2.27 | 0.12 | 0.76 | 6.19 | 0.42 | 0.09 | <0.01 | 0.006 | <20 | 9 | 2.5 | 99.23 | 508 | 1 | 3.8 | 2.8 | 13.7 | 5.9 | 8.9 | 117.4 | 2 | 37.9 | 0.7 | 9.5 | 2.6 | 49 |
| 8254 | 63.55 | 12.97 | 3.23 | 4.03 | 2.25 | 0.66 | 6.35 | 0.52 | 0.11 | 0.05 | 0.007 | <20 | 11 | 5.9 | 99.58 | 851 | 2 | 5.8 | 3.7 | 15.8 | 7.1 | 11.0 | 131.3 | 3 | 40.9 | 0.8 | 11.0 | 3.0 | 59 |
| 8255 | 66.28 | 14.18 | 5.43 | 2.48 | 0.44 | 0.53 | 6.65 | 0.59 | 0.14 | 0.03 | 0.010 | 30 | 13 | 3.0 | 99.79 | 465 | 3 | 8.1 | 6.2 | 19.2 | 7.6 | 12.8 | 185.4 | 2 | 35.0 | 0.9 | 12.3 | 4.1 | 72 |
| 8256 | 57.12 | 10.99 | 3.18 | 7.50 | 5.34 | 0.53 | 3.59 | 0.39 | 0.11 | 0.07 | 0.005 | <20 | 9 | 10.9 | 99.77 | 354 | 2 | 6.9 | 7.4 | 13.6 | 4.0 | 9.9 | 112.0 | 2 | 30.0 | 0.7 | 9.5 | 3.3 | 41 |
| 8257 | 48.67 | 11.97 | 12.25 | 7.45 | 8.86 | 2.52 | 1.47 | 3.90 | 0.47 | 0.16 | 0.045 | 154 | 26 | 1.8 | 99.58 | 465 | 2 | 40.8 | 2.6 | 21.9 | 7.8 | 30.2 | 47.9 | 2 | 537.9 | 1.9 | 5.3 | 1.5 | 351 |
| 8258 | 51.81 | 12.28 | 9.62 | 7.27 | 6.64 | 2.34 | 2.34 | 3.03 | 0.38 | 0.13 | 0.035 | 124 | 22 | 3.7 | 99.60 | 863 | 2 | 32.4 | 3.9 | 18.9 | 6.7 | 25.4 | 68.2 | 2 | 333.1 | 1.7 | 7.1 | 2.0 | 266 |
| 8259 | 37.43 | 5.22 | 4.66 | 14.76 | 21.79 | 0.32 | 0.10 | 0.17 | 0.06 | 0.08 | <0.002 | <20 | 4 | 15.1 | 99.69 | 20 | 2 | 4.7 | 0.4 | 9.0 | 2.7 | 5.9 | 1.0 | 4 | 120.7 | 0.4 | 7.3 | 2.8 | 19 |
| 8260 | 47.68 | 11.93 | 12.57 | 8.36 | 8.56 | 2.39 | 0.73 | 3.94 | 0.48 | 0.18 | 0.049 | 168 | 27 | 2.7 | 99.61 | 213 | 2 | 45.1 | 1.8 | 21.2 | 8.3 | 30.6 | 22.9 | 2 | 421.3 | 2.0 | 5.7 | 1.3 | 374 |
| 8261 | 46.86 | 11.24 | 12.92 | 8.57 | 8.41 | 2.35 | 1.42 | 3.95 | 0.44 | 0.17 | 0.063 | 194 | 29 | 3.2 | 99.60 | 317 | 1 | 46.4 | 0.9 | 19.4 | 7.1 | 28.4 | 42.7 | 2 | 342.2 | 1.9 | 4.7 | 1.1 | 363 |
| 8262 | 47.36 | 13.39 | 13.42 | 5.26 | 7.17 | 3.56 | 1.79 | 4.45 | 0.57 | 0.17 | 0.003 | 66 | 22 | 2.5 | 99.59 | 435 | 2 | 35.9 | 0.4 | 23.9 | 9.1 | 35.3 | 38.3 | 3 | 661.4 | 2.2 | 6.6 | 1.4 | 388 |
| 8263 | 72.30 | 11.67 | 3.03 | 3.90 | 0.18 | 0.80 | 3.92 | 0.41 | 0.10 | 0.01 | 0.004 | <20 | 8 | 3.3 | 99.60 | 1027 | 1 | 4.6 | 6.5 | 13.6 | 3.5 | 8.7 | 112.4 | 2 | 31.5 | 0.6 | 8.2 | 2.3 | 53 |
| 8264 | 90.26 | 3.51 | 1.29 | 0.61 | 0.39 | 0.42 | 1.99 | 0.04 | 0.03 | 0.03 | 0.002 | <20 | <1 | 1.3 | 99.82 | 558 | <1 | 8.6 | 0.3 | 2.9 | 1.9 | 1.1 | 32.4 | <1 | 18.9 | 0.1 | 2.0 | 0.7 | <8 |
| 8265 | 81.95 | 3.43 | 7.67 | 0.38 | 0.04 | 0.20 | 1.85 | 0.09 | 0.04 | <0.01 | <0.002 | <20 | 2 | 3.8 | 99.47 | 2668 | <1 | 37.8 | 1.2 | 4.2 | 2.6 | 2.4 | 37.0 | <1 | 21.8 | 0.2 | 3.0 | 1.5 | 14 |
| 8266 | 94.74 | 1.55 | 0.70 | 0.21 | 0.08 | 0.01 | 0.60 | 0.04 | 0.08 | <0.01 | 0.004 | <20 | 1 | 1.0 | 99.06 | 216 | <1 | 0.9 | 0.4 | 2.4 | 1.1 | 1.1 | 15.2 | <1 | 4.6 | <0.1 | 2.3 | 24.6 | 125 |
| 8267 | 95.00 | 1.49 | 0.52 | 0.23 | 0.08 | 0.03 | 0.56 | 0.05 | 0.08 | <0.01 | 0.002 | <20 | 1 | 0.8 | 98.88 | 469 | <1 | 1.1 | 0.3 | 2.5 | 1.0 | 1.1 | 13.8 | <1 | 8.6 | <0.1 | 2.2 | 11.9 | 116 |
| 8268 | 42.53 | 16.12 | 3.59 | 10.40 | 4.35 | 3.48 | 1.70 | 4.10 | 0.84 | 0.34 | 0.008 | 41 | 30 | 7.8 | 95.25 | 351 | <1 | 37.7 | 0.7 | 22.9 | 8.1 | 35.7 | 38.3 | 3 | 47.5 | 2.3 | 3.8 | 1.3 | 193 |
| 8269 | 47.56 | 12.53 | 12.74 | 5.87 | 7.21 | 3.58 | 1.29 | 4.00 | 0.49 | 0.12 | 0.015 | 64 | 25 | 4.2 | 99.64 | 381 | 2 | 39.9 | 0.3 | 21.4 | 9.0 | 30.7 | 31.4 | 3 | 265.7 | 2.1 | 6.5 | 1.7 | 353 |
| 8270 | 78.70 | 9.72 | 1.99 | 1.76 | 0.36 | 0.78 | 4.19 | 0.44 | 0.11 | 0.01 | 0.006 | <20 | 7 | 1.6 | 99.70 | 1628 | <1 | 5.1 | 1.3 | 10.4 | 9.8 | 8.3 | 105.7 | 1 | 93.8 | 0.7 | 9.0 | 2.4 | 34 |
| 8271 | 84.07 | 7.00 | 1.79 | 1.60 | 0.18 | 1.07 | 2.67 | 0.30 | 0.08 | 0.01 | 0.004 | <20 | 3 | 1.0 | 99.75 | 1205 | <1 | 5.5 | 0.7 | 6.4 | 11.5 | 5.2 | 59.3 | <1 | 72.1 | 0.5 | 7.1 | 2.0 | 18 |
| 8272 | 48.71 | 12.55 | 13.00 | 6.10 | 6.81 | 3.27 | 1.64 | 4.06 | 0.49 | 0.17 | 0.015 | 68 | 25 | 2.8 | 99.58 | 816 | 2 | 40.6 | 0.5 | 22.9 | 9.1 | 31.4 | 45.0 | 3 | 373.9 | 2.2 | 6.7 | 1.6 | 375 |
| 8273 | 49.14 | 11.88 | 12.70 | 6.85 | 7.29 | 3.06 | 1.78 | 3.78 | 0.46 | 0.16 | 0.024 | 89 | 26 | 2.5 | 99.62 | 408 | 2 | 43.6 | 0.3 | 22.2 | 8.7 | 30.3 | 35.0 | 2 | 332.4 | 2.2 | 6.8 | 1.6 | 350 |
| 8274 | 48.88 | 11.99 | 12.61 | 6.81 | 7.35 | 3.32 | 1.76 | 3.84 | 0.47 | 0.16 | 0.023 | 84 | 26 | 2.4 | 99.63 | 375 | 2 | 43.5 | 0.3 | 21.5 | 8.8 | 31.2 | 31.1 | 2 | 308.3 | 2.1 | 6.4 | 1.6 | 365 |
| 8275 | 47.92 | 9.33 | 14.82 | 10.66 | 6.72 | 1.61 | 0.96 | 3.41 | 0.37 | 0.20 | 0.144 | 305 | 31 | 3.4 | 99.57 | 255 | 1 | 65.6 | 4.2 | 18.5 | 7.4 | 23.0 | 31.3 | 2 | 354.7 | 1.5 | 5.2 | 0.9 | 342 |
| 8276 | 72.57 | 11.96 | 2.89 | 2.84 | 0.93 | 2.82 | 2.62 | 0.38 | 0.09 | 0.05 | 0.005 | <20 | 8 | 2.7 | 99.82 | 463 | 2 | 2.6 | 1.9 | 14.9 | 6.2 | 11.0 | 56.7 | 3 | 112.1 | 0.8 | 9.6 | 3.0 | 36 |
| 8277 | 79.32 | 5.58 | 4.77 | 3.82 | 1.00 | 1.27 | 0.37 | 0.81 | 0.19 | 0.06 | 0.025 | 72 | 7 | 2.6 | 99.84 | 166 | <1 | 13.7 | 0.7 | 8.2 | 4.9 | 12.4 | 6.5 | <1 | 77.7 | 0.9 | 3.9 | 1.1 | 80 |

| Element | W | Zr | Y | La | Ce | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | TOT/C | TOT/S | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 2A Leco | 2A Leco | 2A |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm |
| MDL | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 0.02 | 0.3 | 0.05 | 0.02 | 0.05 | 0.01 | 0.05 | 0.02 | 0.03 | 0.01 | 0.05 | 0.01 | 0.02 | 0.02 | 10 |
| RPD % | 13.6 | 3.8 | 3.6 | 4.0 | 4.5 | 3.4 | 3.7 | 3.8 | 4.5 | 5.2 | 3.3 | 3.0 | 5.7 | 6.4 | 5.7 | 3.3 | 4.3 | 10.3 | 31.8 | 4.4 |
| RPD count | 17 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 23 | 23 | 27 |
| APR % | <MDL | 104.0 | 96.9 | 93.3 | 93.6 | 88.3 | 103.8 | 99.3 | 93.2 | 91.1 | 92.1 | 78.8 | 99.7 | 89.0 | 87.5 | 92.3 | 91.7 | NA | 80.0 | 95.0 |
| APR error % | | 16.8 | 14.3 | 14.1 | 11.0 | 8.3 | 10.4 | 10.7 | 10.6 | 9.1 | 11.0 | 14.1 | 32.0 | 2.8 | 17.8 | 12.9 | 12.3 | | 45.6 | 25.8 |
| Sample | | | | | | | | | | | | | | | | | | | | |
| 8217 | 1.3 | 196.4 | 26.5 | 56.1 | 112.6 | 14.46 | 56.0 | 9.46 | 3.20 | 7.07 | 0.98 | 4.85 | 0.87 | 2.50 | 0.35 | 2.18 | 0.35 | 0.97 | 0.03 | 1100 |
| 8218 | <0.5 | 55.5 | 15.5 | 25.5 | 52.2 | 6.25 | 22.9 | 4.13 | 0.64 | 3.22 | 0.50 | 2.57 | 0.49 | 1.49 | 0.21 | 1.34 | 0.22 | 10.25 | 0.07 | 880 |
| 8220 | 2.4 | 176.5 | 29.2 | 38.5 | 87.3 | 11.07 | 40.2 | 7.83 | 1.17 | 6.11 | 0.94 | 5.06 | 1.00 | 3.32 | 0.44 | 2.91 | 0.51 | 0.06 | 0.08 | 1570 |
| 8221 | 0.7 | 291.9 | 31.4 | 35.1 | 83.5 | 11.76 | 50.9 | 10.90 | 3.14 | 9.73 | 1.39 | 7.13 | 1.28 | 3.33 | 0.42 | 2.47 | 0.36 | 0.17 | 0.19 | 900 |
| 8222 | 0.7 | 233.9 | 35.2 | 46.3 | 96.0 | 14.60 | 65.9 | 12.09 | 3.28 | 7.92 | 1.15 | 5.69 | 1.04 | 3.31 | 0.47 | 3.19 | 0.51 | 3.75 | 0.02 | 200 |
| 8223 | 0.8 | 127.3 | 10.6 | 18.8 | 39.9 | 5.41 | 22.1 | 4.04 | 1.18 | 2.75 | 0.37 | 1.61 | 0.31 | 0.95 | 0.14 | 0.94 | 0.16 | 0.04 | <0.02 | 120 |
| 8224 | 1.1 | 264.7 | 25.0 | 52.7 | 97.3 | 13.63 | 54.0 | 8.94 | 2.50 | 6.20 | 0.86 | 4.46 | 0.79 | 2.39 | 0.38 | 2.38 | 0.40 | 0.14 | 0.02 | 180 |
| 8225 | 1.0 | 222.5 | 19.4 | 49.3 | 97.7 | 11.95 | 44.2 | 8.00 | 2.16 | 5.57 | 0.77 | 3.55 | 0.66 | 2.05 | 0.27 | 1.87 | 0.31 | 0.09 | <0.02 | 200 |
| 8226 | 7.4 | 177.5 | 12.7 | 47.2 | 82.7 | 9.18 | 33.6 | 5.09 | 1.36 | 3.54 | 0.45 | 2.15 | 0.40 | 1.14 | 0.15 | 1.04 | 0.16 | 0.38 | <0.02 | 190 |
| 8227 | 3.2 | 288.2 | 23.6 | 82.1 | 151.0 | 18.20 | 64.0 | 9.83 | 2.50 | 6.19 | 0.85 | 4.15 | 0.69 | 2.14 | 0.29 | 1.88 | 0.29 | 0.63 | <0.02 | 550 |
| 8228 | <0.5 | 247.4 | 11.0 | 50.8 | 100.5 | 11.22 | 39.2 | 5.68 | 1.36 | 3.58 | 0.43 | 2.21 | 0.35 | 1.09 | 0.14 | 1.15 | 0.16 | 0.04 | <0.02 | 150 |
| 8246 | <0.5 | 4.5 | 11.6 | 13.1 | 35.5 | 4.30 | 19.5 | 3.38 | 1.72 | 2.81 | 0.39 | 1.73 | 0.28 | 0.73 | 0.09 | 0.58 | 0.08 | 6.11 | <0.02 | 50 |
| 8247 | <0.5 | 288.7 | 45.2 | 40.9 | 94.7 | 11.42 | 49.5 | 9.66 | 2.75 | 8.60 | 1.49 | 8.04 | 1.51 | 4.45 | 0.64 | 3.90 | 0.56 | 0.07 | 0.09 | 430 |
| 8248 | 0.6 | 256.4 | 38.0 | 41.0 | 92.3 | 10.99 | 45.6 | 8.60 | 2.31 | 7.33 | 1.23 | 6.46 | 1.29 | 3.54 | 0.54 | 3.25 | 0.48 | 0.04 | <0.02 | 670 |
| 8249 | <0.5 | 81.1 | 10.3 | 2.6 | 6.7 | 0.88 | 4.1 | 1.18 | 0.23 | 1.37 | 0.26 | 1.41 | 0.31 | 1.03 | 0.16 | 1.07 | 0.15 | 0.04 | 0.04 | 290 |
| 8250 | 1.0 | 312.6 | 59.9 | 46.7 | 106.2 | 12.61 | 55.0 | 11.45 | 2.41 | 12.39 | 2.15 | 10.82 | 2.09 | 5.55 | 0.75 | 4.46 | 0.66 | 1.10 | 0.04 | 790 |
| 8251 | 1.4 | 260.7 | 40.2 | 23.2 | 57.7 | 7.31 | 33.6 | 7.90 | 2.27 | 8.30 | 1.39 | 7.31 | 1.35 | 3.96 | 0.59 | 3.54 | 0.48 | 1.61 | 0.19 | 620 |
| 8252 | 1.4 | 373.3 | 27.7 | 43.5 | 94.4 | 10.60 | 40.5 | 6.46 | 0.82 | 4.32 | 0.76 | 4.30 | 0.91 | 2.86 | 0.45 | 2.75 | 0.44 | 0.11 | 0.06 | 690 |
| 8253 | 1.1 | 188.1 | 18.6 | 27.7 | 62.6 | 6.94 | 25.7 | 4.45 | 0.61 | 2.90 | 0.52 | 2.91 | 0.62 | 1.96 | 0.32 | 2.04 | 0.30 | 0.13 | 0.45 | 690 |
| 8254 | 1.4 | 247.2 | 25.9 | 37.0 | 83.7 | 9.33 | 36.4 | 6.26 | 0.85 | 4.40 | 0.77 | 4.28 | 0.92 | 2.82 | 0.42 | 2.70 | 0.41 | 1.05 | 0.09 | 970 |
| 8255 | 1.7 | 257.1 | 30.7 | 44.6 | 93.2 | 9.87 | 37.4 | 6.81 | 1.29 | 5.47 | 0.99 | 5.04 | 1.08 | 3.19 | 0.52 | 3.18 | 0.46 | 0.11 | <0.02 | 1000 |
| 8256 | 2.0 | 148.7 | 24.5 | 25.4 | 56.9 | 6.13 | 23.5 | 4.62 | 0.63 | 3.81 | 0.70 | 4.02 | 0.81 | 2.51 | 0.41 | 2.59 | 0.38 | 2.24 | 0.04 | 1670 |
| 8257 | 0.9 | 283.8 | 29.3 | 33.4 | 89.5 | 10.89 | 47.5 | 9.82 | 2.80 | 8.17 | 1.25 | 6.21 | 1.05 | 2.77 | 0.40 | 2.29 | 0.31 | 0.02 | 0.09 | 1100 |
| 8258 | 0.8 | 247.7 | 26.5 | 35.1 | 88.0 | 10.43 | 43.2 | 8.78 | 2.24 | 6.80 | 1.08 | 5.27 | 0.99 | 2.65 | 0.41 | 2.33 | 0.33 | 0.17 | 0.03 | 1220 |
| 8259 | <0.5 | 86.2 | 22.6 | 23.7 | 53.5 | 5.64 | 21.5 | 4.38 | 0.56 | 3.68 | 0.74 | 4.38 | 0.87 | 2.43 | 0.40 | 2.55 | 0.38 | 3.59 | <0.02 | 1480 |
| 8260 | <0.5 | 295.9 | 28.7 | 34.1 | 91.7 | 11.16 | 50.1 | 10.40 | 2.98 | 8.52 | 1.32 | 6.49 | 1.07 | 2.94 | 0.40 | 2.21 | 0.31 | 0.03 | 0.14 | 920 |
| 8261 | <0.5 | 272.2 | 25.9 | 29.6 | 81.6 | 9.97 | 43.5 | 9.51 | 2.71 | 8.01 | 1.22 | 5.69 | 1.04 | 2.66 | 0.36 | 2.05 | 0.28 | 0.18 | 0.06 | 810 |
| 8262 | <0.5 | 326.9 | 33.2 | 39.6 | 103.0 | 13.10 | 55.3 | 11.55 | 3.33 | 9.55 | 1.41 | 7.00 | 1.17 | 3.04 | 0.42 | 2.27 | 0.35 | 0.17 | 0.14 | 860 |
| 8263 | 1.5 | 121.5 | 19.9 | 27.1 | 63.7 | 7.42 | 26.7 | 5.08 | 0.78 | 3.82 | 0.62 | 3.33 | 0.67 | 2.07 | 0.34 | 2.03 | 0.34 | 0.03 | 0.03 | 1000 |
| 8264 | <0.5 | 65.6 | 6.0 | 4.7 | 9.9 | 1.17 | 4.2 | 1.00 | 0.19 | 1.04 | 0.18 | 1.04 | 0.19 | 0.52 | 0.08 | 0.54 | 0.09 | 0.17 | 0.16 | 50 |
| 8265 | <0.5 | 75.3 | 8.0 | 10.4 | 20.5 | 2.30 | 8.5 | 1.66 | 0.26 | 1.41 | 0.25 | 1.27 | 0.26 | 0.76 | 0.12 | 0.74 | 0.12 | 0.08 | 0.17 | 200 |
| 8266 | <0.5 | 44.3 | 10.9 | 2.4 | 5.9 | 0.83 | 4.3 | 2.19 | 0.42 | 2.61 | 0.44 | 2.12 | 0.39 | 1.03 | 0.15 | 0.85 | 0.12 | 0.05 | 0.03 | 150 |
| 8267 | <0.5 | 38.8 | 5.8 | 2.7 | 6.1 | 0.79 | 3.7 | 1.28 | 0.22 | 1.36 | 0.22 | 1.08 | 0.21 | 0.54 | 0.09 | 0.53 | 0.08 | 0.06 | 0.06 | 60 |
| 8268 | 1.5 | 304.1 | 44.1 | 49.8 | 118.0 | 14.05 | 55.9 | 11.17 | 1.90 | 9.28 | 1.46 | 7.81 | 1.50 | 4.28 | 0.66 | 4.03 | 0.61 | 1.15 | 0.78 | 1090 |
| 8269 | 0.6 | 310.7 | 31.4 | 36.4 | 93.2 | 11.92 | 47.9 | 10.50 | 3.12 | 8.89 | 1.33 | 6.56 | 1.15 | 2.93 | 0.39 | 2.24 | 0.34 | 0.49 | 0.22 | 890 |
| 8270 | 1.0 | 369.6 | 18.3 | 13.8 | 36.9 | 3.37 | 13.0 | 2.84 | 0.66 | 2.65 | 0.50 | 2.77 | 0.61 | 1.84 | 0.31 | 2.05 | 0.32 | <0.02 | <0.02 | 320 |
| 8271 | <0.5 | 422.2 | 17.8 | 16.9 | 42.4 | 4.92 | 18.9 | 3.69 | 0.72 | 3.02 | 0.53 | 3.02 | 0.64 | 1.82 | 0.29 | 1.80 | 0.29 | <0.02 | <0.02 | 180 |
| 8272 | <0.5 | 317.8 | 32.2 | 39.1 | 98.4 | 12.71 | 51.2 | 11.03 | 3.18 | 9.19 | 1.39 | 6.81 | 1.16 | 3.03 | 0.43 | 2.37 | 0.34 | 0.15 | 0.06 | 880 |
| 8273 | <0.5 | 299.4 | 31.3 | 37.9 | 94.3 | 12.15 | 52.2 | 10.84 | 3.03 | 8.80 | 1.33 | 6.83 | 1.16 | 3.03 | 0.41 | 2.41 | 0.33 | 0.04 | 0.13 | 700 |
| 8274 | 0.5 | 301.5 | 31.8 | 37.8 | 93.6 | 12.10 | 53.2 | 10.50 | 3.04 | 9.04 | 1.35 | 6.64 | 1.16 | 3.01 | 0.42 | 2.35 | 0.33 | 0.06 | 0.07 | 720 |
| 8275 | <0.5 | 262.1 | 29.8 | 29.1 | 75.2 | 10.14 | 44.8 | 9.71 | 2.82 | 8.51 | 1.27 | 6.53 | 1.10 | 2.65 | 0.39 | 2.08 | 0.30 | 0.20 | 0.18 | 900 |
| 8276 | 0.9 | 190.3 | 32.0 | 26.4 | 57.6 | 7.30 | 28.5 | 5.74 | 1.04 | 5.32 | 0.92 | 5.62 | 1.10 | 3.37 | 0.54 | 3.40 | 0.52 | 0.26 | <0.02 | 450 |
| 8277 | <0.5 | 174.5 | 17.0 | 16.3 | 40.7 | 5.45 | 22.4 | 4.81 | 1.00 | 4.01 | 0.64 | 3.49 | 0.59 | 1.62 | 0.25 | 1.42 | 0.20 | 0.12 | <0.02 | 260 |

| Element | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | $P_2O_5$ | MnO | $Cr_2O_3$ | Ni | Sc | LOI | Sum | Ba | Be | Co | Cs | Ga | Hf | Nb | Rb | Sn | Sr | Ta | Th | U | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B |
| Units | % | % | % | % | % | % | % | % | % | % | % | ppm | ppm | % | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| MDL | 0.01 | 0.01 | 0.04 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.002 | 20 | 1 | 0.1 | 0.01 | 1 | 1 | 0.2 | 0.1 | 0.5 | 0.1 | 0.1 | 0.1 | 1 | 0.5 | 0.1 | 0.2 | 0.1 | 8 |
| RPD % | 0.7 | 1.2 | 1.3 | 1.7 | 7.5 | 2.6 | 2.3 | 1.0 | 5.9 | 6.4 | 3.5 | 3.6 | 4.1 | 11.9 | | 5.1 | 16.1 | 10.4 | 6.0 | 3.6 | 7.5 | 5.0 | 4.8 | 20.7 | 5.6 | 14.7 | 8.8 | 7.5 | 4.9 |
| RPD count | 25 | 25 | 25 | 24 | 25 | 25 | 25 | 25 | 25 | 21 | 24 | 16 | 24 | 25 | | 25 | 19 | 25 | 25 | 25 | 25 | 25 | 25 | 24 | 25 | 23 | 25 | 25 | 25 |
| APR % | 99.1 | 101.5 | 96.1 | 100.0 | 102.3 | 97.6 | 96.6 | 101.0 | 122.8 | 94.1 | 98.1 | 99.6 | 104.2 | 161.1 | | 94.3 | 66.7 | 97.0 | NA | 100.5 | 93.3 | 115.3 | 92.4 | 125.0 | 101.0 | 95.8 | 98.1 | 100.0 | 104.5 |
| APR error % | 1.2 | 4.3 | 4.6 | 6.3 | 7.5 | 6.2 | 9.7 | 7.2 | 25.5 | 6.4 | 7.2 | 8.5 | 8.8 | 71.3 | | 13.4 | 0.0 | 11.7 | | 15.9 | 21.2 | 14.7 | 10.1 | 66.5 | 13.5 | 28.4 | 13.6 | 20.5 | 10.5 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8278 | 47.06 | 8.37 | 14.40 | 11.07 | 8.51 | 1.47 | 0.90 | 3.20 | 0.31 | 0.19 | 0.153 | 268 | 36 | 3.9 | 99.56 | 485 | 1 | 63.9 | 1.7 | 16.8 | 6.4 | 20.5 | 16.2 | 2 | 209.9 | 1.3 | 4.7 | 0.8 | 333 |
| 8279 | 46.73 | 9.61 | 14.31 | 8.58 | 6.98 | 1.65 | 0.52 | 3.55 | 0.38 | 0.17 | 0.124 | 201 | 32 | 7.0 | 99.59 | 370 | 2 | 61.0 | 2.7 | 19.6 | 7.6 | 24.5 | 10.3 | 2 | 223.2 | 1.6 | 4.9 | 0.9 | 363 |
| 8280 | 58.77 | 18.97 | 3.41 | 4.27 | 1.22 | 0.76 | 7.54 | 0.33 | 0.06 | 0.05 | 0.002 | <20 | 11 | 4.2 | 99.57 | 1777 | 4 | 2.2 | 11.5 | 26.1 | 13.6 | 17.3 | 206.7 | 7 | 128.8 | 1.6 | 20.9 | 5.7 | 45 |
| 8281 | 76.32 | 11.99 | 2.64 | 1.03 | 0.14 | 0.81 | 3.86 | 0.39 | 0.09 | 0.04 | 0.004 | <20 | 7 | 2.5 | 99.85 | 362 | 3 | 8.4 | 8.0 | 15.3 | 7.1 | 10.9 | 125.8 | 3 | 24.6 | 0.8 | 11.9 | 4.2 | 36 |
| 8282 | 54.98 | 17.07 | 5.68 | 0.75 | 5.37 | 4.16 | 3.40 | 0.52 | 0.30 | 0.16 | <0.002 | <20 | 8 | 7.3 | 99.66 | 1846 | 2 | 9.5 | 7.3 | 19.4 | 3.7 | 10.2 | 83.7 | 1 | 222.7 | 0.5 | 6.3 | 3.1 | 106 |
| 8283 | 53.65 | 16.57 | 5.21 | 1.85 | 4.80 | 4.89 | 3.32 | 0.50 | 0.28 | 0.15 | <0.002 | <20 | 7 | 8.4 | 99.63 | 1831 | 2 | 8.6 | 5.1 | 19.7 | 3.5 | 9.7 | 77.9 | <1 | 387.4 | 0.4 | 6.5 | 3.3 | 102 |
| 8284 | 72.32 | 11.93 | 3.30 | 1.62 | 1.28 | 0.93 | 3.90 | 0.38 | 0.10 | 0.07 | 0.004 | <20 | 8 | 3.9 | 99.67 | 1836 | 3 | 13.4 | 7.0 | 15.5 | 7.3 | 11.6 | 123.1 | 3 | 51.8 | 0.8 | 10.7 | 4.1 | 38 |
| 8285 | 55.78 | 18.04 | 5.47 | 1.62 | 3.11 | 4.59 | 3.38 | 0.54 | 0.30 | 0.15 | <0.002 | <20 | 8 | 6.7 | 99.70 | 1356 | 2 | 7.4 | 8.6 | 20.9 | 3.8 | 10.3 | 78.9 | 1 | 153.1 | 0.5 | 5.9 | 3.0 | 103 |
| 8286 | 64.87 | 12.51 | 3.08 | 3.44 | 2.77 | 1.55 | 3.79 | 0.44 | 0.11 | 0.09 | 0.004 | <20 | 9 | 4.5 | 97.19 | 20773 | 3 | 6.3 | 4.0 | 15.9 | 12.4 | 14.5 | 97.6 | 4 | 1748.0 | 1.3 | 19.0 | 9.1 | 47 |
| 8287 | 1.04 | 0.19 | 6.84 | 13.76 | 20.03 | 0.02 | 0.13 | 0.01 | 0.01 | 0.16 | <0.002 | 30 | <1 | 33.1 | 75.31 | 10 | <1 | 34.1 | 0.1 | 22.4 | 0.1 | 0.6 | 2.9 | 5 | 78.8 | <0.1 | <0.2 | 0.3 | 23 |
| 8288 | 0.73 | 0.12 | 1.79 | 17.34 | 33.98 | 0.03 | 0.09 | <0.01 | 0.01 | 0.16 | <0.002 | <20 | <1 | 45.3 | 99.57 | 15 | <1 | 1.4 | <0.1 | 1.5 | <0.1 | 0.3 | 1.5 | <1 | 196.1 | <0.1 | 0.3 | 0.4 | <8 |
| 8289 | 0.54 | 0.09 | 1.39 | 17.53 | 33.60 | 0.02 | 0.06 | <0.01 | 0.02 | 0.16 | <0.002 | <20 | <1 | 44.9 | 98.32 | 7 | <1 | 3.8 | <0.1 | 4.6 | <0.1 | 0.2 | 1.6 | <1 | 184.3 | <0.1 | <0.2 | 0.1 | 23 |
| 8290 | 1.21 | 0.36 | 3.67 | 14.15 | 20.77 | 0.03 | 0.19 | 0.02 | <0.01 | 0.15 | <0.002 | <20 | <1 | 24.1 | 64.63 | 3 | <1 | 21.9 | <0.1 | 23.2 | 0.2 | 1.1 | 4.1 | 3 | 78.3 | <0.1 | 0.3 | 0.4 | 22 |
| 8291 | 1.93 | 0.41 | 2.76 | 14.21 | 20.50 | 0.03 | 0.23 | 0.02 | <0.01 | 0.15 | <0.002 | <20 | <1 | 26.7 | 66.90 | 11 | <1 | 13.9 | <0.1 | 9.9 | 0.1 | 0.9 | 4.8 | 2 | 85.8 | <0.1 | 0.4 | 0.4 | 21 |
| 8292 | 77.96 | 9.36 | 3.66 | 2.03 | 0.10 | 0.43 | 3.03 | 0.34 | 0.06 | <0.01 | 0.006 | 23 | 7 | 2.8 | 99.82 | 400 | 2 | 4.9 | 5.4 | 13.1 | 3.7 | 8.0 | 99.0 | 2 | 23.7 | 0.5 | 9.1 | 2.8 | 47 |
| 8293 | 35.82 | 15.28 | 11.11 | 13.63 | 5.30 | 1.29 | 0.82 | 3.65 | 0.80 | 0.20 | 0.007 | 43 | 25 | 10.7 | 98.59 | 832 | 3 | 20.4 | 3.5 | 24.4 | 7.5 | 36.0 | 19.3 | 1 | 53.5 | 2.0 | 4.1 | 2.0 | 189 |
| 8294 | 77.62 | 7.43 | 0.81 | 0.63 | 0.30 | 0.13 | 3.97 | 0.27 | 0.05 | <0.01 | 0.010 | 111 | 5 | 8.4 | 99.61 | 200 | <1 | 0.7 | 5.0 | 7.9 | 1.8 | 5.8 | 81.6 | 1 | 28.3 | 0.4 | 4.3 | 12.1 | 2017 |
| 8295 | 81.68 | 5.80 | 0.96 | 0.48 | 0.14 | 0.13 | 2.83 | 0.26 | 0.05 | <0.01 | 0.008 | 151 | 4 | 7.4 | 99.73 | 124 | 1 | 1.5 | 3.6 | 6.8 | 1.6 | 4.9 | 62.9 | <1 | 15.9 | 0.3 | 3.0 | 8.8 | 1413 |
| 8296 | 52.94 | 15.97 | 5.95 | 1.85 | 4.74 | 0.23 | 5.64 | 0.60 | 1.60 | 0.06 | 0.011 | 1324 | 15 | 9.6 | 99.32 | 274 | 5 | 93.5 | 8.7 | 21.3 | 3.7 | 16.7 | 161.9 | 3 | 96.6 | 0.8 | 9.7 | 83.9 | 151 |
| 8297 | 53.56 | 20.39 | 3.55 | 3.77 | 0.50 | 0.14 | 7.37 | 0.29 | 0.19 | <0.01 | <0.002 | 115 | 4 | 9.9 | 99.72 | 296 | 3 | 2.2 | 11.9 | 23.7 | 7.4 | 10.4 | 173.5 | 6 | 83.8 | 2.1 | 30.3 | 16.7 | 54 |
| 8298 | 93.77 | 0.72 | 0.86 | 0.87 | 1.73 | 0.02 | 0.01 | 0.03 | 0.02 | 0.02 | 0.003 | <20 | <1 | 1.9 | 99.93 | 12 | <1 | 2.9 | 0.2 | 3.3 | 0.8 | 0.5 | 0.9 | <1 | 6.2 | <0.1 | 0.9 | 0.3 | 49 |
| 8299 | 44.46 | 14.76 | 15.31 | 5.48 | 6.80 | 2.69 | 2.01 | 3.79 | 0.76 | 0.18 | 0.008 | 52 | 28 | 3.4 | 99.61 | 793 | 1 | 49.9 | 2.4 | 23.5 | 7.5 | 35.0 | 47.4 | 2 | 313.8 | 2.1 | 3.0 | 0.9 | 200 |
| 8300 | 44.76 | 14.47 | 15.36 | 5.00 | 7.46 | 2.43 | 2.57 | 3.80 | 0.73 | 0.23 | 0.011 | 67 | 27 | 2.7 | 99.58 | 974 | 2 | 41.1 | 3.7 | 23.5 | 7.2 | 34.8 | 49.0 | 2 | 343.4 | 2.1 | 3.3 | 0.7 | 215 |
| 8301 | 44.95 | 14.88 | 16.80 | 4.85 | 6.82 | 2.55 | 2.64 | 3.47 | 0.71 | 0.23 | 0.009 | 57 | 26 | 1.7 | 99.60 | 972 | 2 | 48.6 | 3.0 | 23.7 | 7.1 | 31.1 | 54.9 | 2 | 403.8 | 1.8 | 3.0 | 0.6 | 191 |
| 8302 | 72.15 | 12.17 | 2.55 | 2.21 | 0.11 | 0.75 | 6.22 | 0.42 | 0.11 | <0.01 | 0.006 | <20 | 8 | 2.7 | 99.36 | 539 | 1 | 2.5 | 2.7 | 14.3 | 5.0 | 9.3 | 125.1 | 3 | 39.8 | 0.7 | 8.3 | 2.7 | 62 |
| 8303 | 71.78 | 12.05 | 2.53 | 2.33 | 0.11 | 0.74 | 6.15 | 0.42 | 0.11 | <0.01 | 0.006 | <20 | 8 | 2.8 | 99.02 | 524 | 1 | 1.9 | 2.5 | 13.9 | 5.6 | 8.6 | 120.2 | 2 | 38.9 | 0.8 | 8.6 | 2.8 | 58 |
| 8304 | 53.32 | 16.53 | 6.12 | 1.91 | 3.69 | 0.23 | 5.79 | 0.62 | 1.78 | 0.04 | 0.012 | 1375 | 16 | 9.2 | 99.38 | 278 | 6 | 83.3 | 8.8 | 22.0 | 3.6 | 16.3 | 178.0 | 3 | 88.0 | 0.9 | 9.1 | 87.9 | 150 |
| 8305 | 53.68 | 16.49 | 5.85 | 1.91 | 3.69 | 0.23 | 5.87 | 0.62 | 1.67 | 0.05 | 0.011 | 1343 | 16 | 9.1 | 99.34 | 268 | 5 | 97.3 | 8.0 | 22.0 | 3.8 | 16.4 | 174.9 | 4 | 82.0 | 0.8 | 9.7 | 77.2 | 149 |
| 8306 | 49.39 | 13.55 | 14.57 | 5.72 | 9.70 | 2.20 | 0.88 | 2.37 | 0.23 | 0.19 | 0.035 | 91 | 37 | 0.8 | 99.66 | 215 | <1 | 42.1 | 0.5 | 19.5 | 4.5 | 11.4 | 20.5 | 2 | 218.3 | 0.8 | 2.6 | 1.1 | 466 |
| 8307 | 49.61 | 13.62 | 14.59 | 5.76 | 9.75 | 2.22 | 0.88 | 2.35 | 0.23 | 0.19 | 0.035 | 91 | 37 | 0.4 | 99.65 | 213 | 1 | 45.6 | 0.5 | 20.0 | 4.2 | 11.8 | 21.2 | 2 | 225.9 | 0.7 | 2.7 | 0.9 | 478 |
| 8308 | 49.58 | 13.62 | 14.52 | 5.75 | 9.72 | 2.24 | 0.89 | 2.34 | 0.22 | 0.19 | 0.036 | 94 | 37 | 0.5 | 99.64 | 216 | 1 | 45.3 | 0.5 | 20.2 | 4.2 | 13.8 | 20.8 | 2 | 226.7 | 0.8 | 2.5 | 1.0 | 470 |

| Element | W | Zr | Y | La | Ce | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | TOT/C | TOT/S | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 4A-4B | 2A Leco | 2A Leco | 2A |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm |
| MDL | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 0.02 | 0.3 | 0.05 | 0.02 | 0.05 | 0.01 | 0.05 | 0.02 | 0.03 | 0.01 | 0.05 | 0.01 | 0.02 | 0.02 | 10 |
| RPD % | 13.6 | 3.8 | 3.6 | 4.0 | 4.5 | 3.4 | 3.7 | 3.8 | 4.5 | 5.2 | 3.3 | 3.0 | 5.7 | 6.4 | 5.7 | 3.3 | 4.3 | 10.3 | 31.8 | 4.4 |
| RPD count | 17 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 23 | 23 | 27 |
| APR % | <MDL | 104.0 | 96.9 | 93.3 | 93.6 | 88.3 | 103.8 | 99.3 | 93.2 | 91.1 | 92.1 | 78.8 | 99.7 | 89.0 | 87.5 | 92.3 | 91.7 | NA | 80.0 | 95.0 |
| APR error % | | 16.8 | 14.3 | 14.1 | 11.0 | 8.3 | 10.4 | 10.7 | 10.6 | 9.1 | 11.0 | 14.1 | 32.0 | 2.8 | 17.8 | 12.9 | 12.3 | | 45.6 | 25.8 |
| Sample | | | | | | | | | | | | | | | | | | | | |
| 8278 | <0.5 | 230.0 | 28.4 | 26.8 | 68.4 | 9.31 | 43.3 | 9.12 | 2.63 | 7.87 | 1.17 | 6.02 | 0.97 | 2.55 | 0.36 | 2.00 | 0.28 | 0.31 | 0.11 | 480 |
| 8279 | <0.5 | 274.4 | 30.1 | 29.7 | 76.4 | 10.34 | 47.0 | 10.02 | 2.79 | 8.61 | 1.29 | 6.59 | 1.11 | 2.97 | 0.40 | 2.33 | 0.32 | 0.98 | 0.31 | 900 |
| 8280 | 0.5 | 393.2 | 59.0 | 20.7 | 53.4 | 6.44 | 25.9 | 5.50 | 1.11 | 6.43 | 1.43 | 9.59 | 2.19 | 6.85 | 1.17 | 7.11 | 1.09 | 0.25 | <0.02 | 800 |
| 8281 | 2.1 | 230.9 | 25.5 | 29.0 | 67.4 | 7.93 | 30.5 | 6.03 | 0.93 | 4.78 | 0.78 | 4.37 | 0.92 | 2.85 | 0.49 | 3.22 | 0.50 | 0.02 | 0.02 | 1140 |
| 8282 | 1.2 | 135.7 | 19.0 | 34.1 | 71.6 | 8.20 | 32.3 | 5.66 | 1.67 | 4.15 | 0.69 | 3.72 | 0.67 | 1.92 | 0.31 | 1.93 | 0.28 | 1.27 | 0.06 | 840 |
| 8283 | <0.5 | 134.6 | 17.7 | 31.2 | 66.8 | 7.67 | 30.9 | 5.39 | 1.62 | 4.02 | 0.61 | 3.50 | 0.61 | 1.76 | 0.27 | 1.78 | 0.26 | 2.07 | 0.05 | 560 |
| 8284 | 1.6 | 222.2 | 31.0 | 32.4 | 72.6 | 8.72 | 34.5 | 6.54 | 1.05 | 5.35 | 0.90 | 5.32 | 1.05 | 3.46 | 0.56 | 3.66 | 0.58 | 0.46 | 0.16 | 960 |
| 8285 | 1.1 | 140.7 | 33.7 | 42.6 | 75.3 | 10.52 | 43.6 | 8.21 | 2.29 | 7.07 | 1.08 | 5.76 | 1.01 | 2.94 | 0.44 | 2.60 | 0.39 | 1.09 | 0.04 | 740 |
| 8286 | 1.7 | 398.9 | 77.2 | 22.1 | 50.0 | 5.73 | 22.7 | 5.62 | 1.67 | 7.89 | 1.83 | 12.85 | 2.74 | 8.40 | 1.40 | 8.63 | 1.32 | 0.59 | 0.57 | 680 |
| 8287 | <0.5 | 2.8 | 1.6 | 1.4 | 2.3 | 0.28 | 1.3 | 0.19 | 0.07 | 0.20 | 0.01 | 0.13 | 0.02 | 0.06 | <0.01 | 0.07 | <0.01 | 10.58 | 4.65 | 60 |
| 8288 | 0.7 | 4.1 | 3.0 | 2.3 | 3.9 | 0.48 | 1.9 | 0.46 | 0.13 | 0.48 | 0.07 | 0.31 | 0.07 | 0.17 | 0.02 | 0.19 | 0.03 | 13.37 | 0.10 | 40 |
| 8289 | <0.5 | 1.5 | 1.9 | 1.4 | 2.5 | 0.31 | 0.8 | 0.18 | 0.10 | 0.24 | 0.01 | 0.17 | 0.03 | 0.09 | <0.01 | <0.05 | <0.01 | 13.28 | 0.31 | 40 |
| 8290 | 0.8 | 5.5 | 1.6 | 1.4 | 2.4 | 0.28 | 1.1 | 0.20 | 0.05 | 0.17 | <0.01 | 0.16 | 0.02 | 0.11 | <0.01 | 0.08 | <0.01 | 9.83 | 6.36 | 40 |
| 8291 | 5.6 | 5.6 | 1.8 | 1.6 | 2.3 | 0.27 | 1.1 | 0.18 | 0.05 | 0.14 | <0.01 | 0.15 | 0.02 | 0.09 | <0.01 | <0.05 | <0.01 | 9.65 | 4.59 | 40 |
| 8292 | 1.0 | 127.7 | 17.9 | 26.3 | 59.6 | 5.93 | 21.5 | 3.67 | 0.58 | 2.69 | 0.51 | 3.31 | 0.66 | 1.98 | 0.33 | 2.23 | 0.34 | 0.05 | 0.05 | 600 |
| 8293 | <0.5 | 308.6 | 42.3 | 25.7 | 67.6 | 8.06 | 36.4 | 8.76 | 1.63 | 9.71 | 1.59 | 8.74 | 1.69 | 4.75 | 0.74 | 4.44 | 0.69 | 1.00 | 0.23 | 1280 |
| 8294 | <0.5 | 58.5 | 11.7 | 17.2 | 30.7 | 3.99 | 14.4 | 2.53 | 0.46 | 1.98 | 0.31 | 1.81 | 0.36 | 1.09 | 0.19 | 1.15 | 0.17 | 4.71 | 0.32 | 520 |
| 8295 | <0.5 | 60.1 | 8.0 | 13.6 | 23.6 | 2.59 | 9.1 | 1.31 | 0.24 | 0.90 | 0.17 | 1.17 | 0.24 | 0.82 | 0.14 | 0.86 | 0.13 | 4.26 | 0.30 | 570 |
| 8296 | 1.0 | 127.8 | 111.9 | 44.6 | 78.0 | 9.68 | 42.4 | 11.55 | 2.58 | 15.84 | 2.60 | 15.09 | 3.07 | 8.34 | 1.21 | 7.13 | 1.02 | 1.28 | 0.10 | 4050 |
| 8297 | <0.5 | 206.7 | 70.2 | 22.8 | 57.7 | 7.74 | 36.4 | 12.03 | 2.44 | 16.11 | 2.62 | 14.67 | 2.59 | 6.67 | 0.86 | 4.18 | 0.49 | 0.14 | 0.48 | 5130 |
| 8298 | <0.5 | 22.9 | 2.8 | 2.2 | 5.4 | 0.71 | 2.8 | 0.66 | 0.13 | 0.57 | 0.11 | 0.46 | 0.10 | 0.26 | 0.05 | 0.24 | 0.06 | 0.41 | 0.02 | 80 |
| 8299 | 0.7 | 287.8 | 43.8 | 43.1 | 97.6 | 12.28 | 51.4 | 10.06 | 2.94 | 9.16 | 1.51 | 8.18 | 1.68 | 4.58 | 0.69 | 4.11 | 0.64 | 0.43 | 0.07 | 670 |
| 8300 | <0.5 | 288.9 | 43.7 | 42.3 | 94.0 | 11.88 | 50.4 | 9.76 | 3.10 | 9.17 | 1.48 | 8.18 | 1.66 | 4.61 | 0.70 | 4.03 | 0.65 | 0.03 | 0.05 | 630 |
| 8301 | 1.1 | 280.2 | 40.0 | 39.2 | 89.7 | 11.11 | 46.5 | 9.32 | 2.91 | 8.57 | 1.44 | 7.59 | 1.53 | 4.07 | 0.65 | 3.69 | 0.59 | <0.02 | 0.08 | 600 |
| 8302 | 1.5 | 180.1 | 18.6 | 27.0 | 58.6 | 7.01 | 25.2 | 4.33 | 0.64 | 3.04 | 0.55 | 2.79 | 0.67 | 2.03 | 0.34 | 2.09 | 0.35 | 0.15 | 0.41 | 700 |
| 8303 | 1.4 | 194.8 | 17.3 | 27.4 | 59.6 | 7.03 | 25.8 | 4.36 | 0.65 | 3.18 | 0.52 | 2.90 | 0.64 | 1.88 | 0.33 | 2.04 | 0.33 | 0.14 | 0.48 | 730 |
| 8304 | 1.5 | 125.1 | 115.9 | 43.6 | 70.2 | 10.25 | 44.0 | 11.44 | 2.61 | 14.86 | 2.59 | 14.95 | 3.12 | 8.60 | 1.15 | 6.90 | 1.03 | 0.90 | 0.08 | 3900 |
| 8305 | 1.4 | 137.1 | 115.1 | 43.1 | 67.0 | 9.82 | 41.7 | 10.80 | 2.44 | 14.86 | 2.54 | 14.78 | 3.13 | 8.58 | 1.16 | 6.97 | 1.02 | 0.94 | 0.07 | 3740 |
| 8306 | <0.5 | 154.2 | 33.2 | 15.2 | 37.5 | 5.02 | 23.1 | 5.67 | 1.81 | 5.99 | 1.06 | 6.06 | 1.22 | 3.53 | 0.51 | 3.01 | 0.46 | 0.03 | <0.02 | 340 |
| 8307 | <0.5 | 155.5 | 33.4 | 15.1 | 36.9 | 5.10 | 22.0 | 5.72 | 1.90 | 6.08 | 1.07 | 6.05 | 1.26 | 3.52 | 0.51 | 3.25 | 0.47 | 0.03 | 0.02 | 340 |
| 8308 | 0.6 | 153.0 | 33.8 | 15.9 | 38.8 | 5.19 | 24.0 | 5.66 | 1.93 | 6.33 | 1.08 | 6.32 | 1.28 | 3.55 | 0.51 | 3.20 | 0.48 | 0.03 | 0.02 | 340 |

Appendix 4C

| Element | Mo | Cu | Pb | Zn | Ni | As | Cd | Sb | Bi | Ag | Au | Hg | Tl | Se |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX | 1DX |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppm |
| MDL | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.01 | 0.1 | 0.5 |
| RPD % | 17.6 | 9.6 | 13.3 | 5.8 | 12.0 | 29.2 | 24.2 | 27.1 | 18.5 | 6.7 | 34.0 | 30.2 | 13.5 | 12.8 |
| RPD count | 94 | 94 | 95 | 95 | 95 | 84 | 29 | 49 | 39 | 16 | 20 | 16 | 48 | 3 |
| APR % | 54.2 | 97.6 | 101.9 | 58.5 | 31.1 | 82.0 | 45.8 | 55.0 | <MDL | 20.0 | 65.1 | NA | NA | <MDL |
| APR error % | 49.8 | 8.7 | 20.9 | 11.9 | 12.7 | 54.9 | 44.5 | 55.3 | | 0.0 | 28.9 | | | |
| Sample | | | | | | | | | | | | | | |
| 8175 | 41.2 | >10000 | 4.0 | 5 | 3.5 | 31.5 | <0.1 | 0.2 | 21.4 | 6.8 | 2.5 | 0.07 | <0.1 | <0.5 |
| 8176 | 2.4 | 160.3 | 6.8 | 62 | 89.0 | 4.7 | 0.2 | <0.1 | 0.3 | 0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8177 | 2.0 | 153.5 | 38.1 | 72 | 84.1 | 17.3 | 0.1 | 0.1 | 0.2 | <0.1 | <0.5 | <0.01 | 0.1 | <0.5 |
| 8178 | 0.3 | 4.7 | 1.3 | 34 | 20.2 | 1.5 | <0.1 | <0.1 | 0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8179 | 0.6 | 108.4 | 36.6 | 55 | 90.9 | 8.0 | <0.1 | 0.2 | 0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8180 | 0.3 | 2.8 | 0.7 | 15 | 8.9 | 0.8 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8181 | 0.4 | 154.6 | 2.0 | 19 | 11.2 | 2.1 | <0.1 | <0.1 | 0.2 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8182 | 1.0 | 98.6 | 13.3 | 87 | 101.6 | 53.1 | 0.2 | 0.2 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8183 | 0.8 | 303.7 | 17.1 | 88 | 27.1 | 2.4 | 0.2 | 0.6 | <0.1 | 0.1 | 3.5 | <0.01 | <0.1 | <0.5 |
| 8185 | 0.8 | 304.8 | 17.3 | 93 | 26.8 | 2.3 | 0.2 | 0.6 | <0.1 | 0.1 | 3.8 | <0.01 | <0.1 | <0.5 |
| 8186 | 0.4 | 1710.8 | 5.5 | 40 | 12.8 | 7.6 | <0.1 | 0.3 | 0.1 | <0.1 | 1.4 | <0.01 | 0.2 | <0.5 |
| 8187 | 1.3 | 98.8 | 9.8 | 89 | 97.5 | 18.2 | <0.1 | 0.2 | 0.1 | <0.1 | 0.8 | <0.01 | <0.1 | <0.5 |
| 8188 | 1.0 | 333.4 | 19.0 | 98 | 29.3 | 2.8 | 0.2 | 0.7 | <0.1 | 0.1 | 4.9 | <0.01 | <0.1 | 0.6 |
| 8189 | 1.1 | 15.6 | 13.3 | 124 | 6.4 | 14.1 | 0.4 | 0.2 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8190 | 1.8 | 71.1 | 17.1 | 85 | 79.4 | 45.6 | <0.1 | 0.2 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8191 | 0.4 | 7.5 | 21.7 | 263 | 3.7 | 15.0 | <0.1 | 1.3 | <0.1 | <0.1 | <0.5 | 0.49 | 0.1 | <0.5 |
| 8192 | 0.8 | 5.4 | 88.0 | 53 | 2.6 | 92.9 | <0.1 | 5.9 | <0.1 | 4.0 | 17.7 | 1.07 | 0.4 | <0.5 |
| 8193 | 0.5 | 4.4 | 15.5 | 265 | 20.5 | 3.6 | 0.8 | 1.8 | <0.1 | <0.1 | 1.5 | 0.05 | 0.4 | <0.5 |
| 8194 | 0.3 | 3.3 | 8.1 | 38 | 1.4 | 2.8 | <0.1 | 0.3 | <0.1 | <0.1 | <0.5 | 0.02 | <0.1 | <0.5 |
| 8195 | 4.9 | 22.0 | 11.4 | 104 | 3.8 | 3.2 | <0.1 | <0.1 | 0.2 | <0.1 | 4.9 | <0.01 | <0.1 | 0.9 |
| 8196 | 59.2 | 467.2 | 123.2 | 67 | 17.1 | 4.0 | <0.1 | 0.2 | 29.3 | 0.8 | 53.2 | 0.02 | 0.2 | 0.5 |
| 8197 | 1.5 | 5.8 | 5.1 | 72 | 2.1 | 1.4 | <0.1 | <0.1 | 0.3 | <0.1 | 2.3 | <0.01 | <0.1 | <0.5 |
| 8198 | 0.7 | 11.1 | 17.8 | 113 | 2.1 | 6.3 | 0.2 | <0.1 | 0.5 | <0.1 | 1.6 | <0.01 | 0.1 | <0.5 |
| 8199 | 1.0 | 316.3 | 8.9 | 68 | 22.3 | 1.8 | <0.1 | 0.2 | 0.4 | <0.1 | 0.9 | <0.01 | 0.4 | <0.5 |
| 8200 | 0.5 | 176.0 | 1.9 | 170 | 23.6 | 1.2 | <0.1 | <0.1 | <0.1 | <0.1 | 1.0 | <0.01 | <0.1 | <0.5 |
| 8201 | 0.8 | 1349.9 | 5.7 | 38 | 4.6 | 13.8 | <0.1 | 0.3 | 0.5 | <0.1 | 1.1 | <0.01 | 0.3 | <0.5 |
| 8202 | 2.7 | 448.2 | 24.2 | 17 | 4.3 | 37.6 | <0.1 | 0.6 | 0.2 | 0.4 | 0.6 | 0.01 | 0.3 | <0.5 |
| 8203 | 0.6 | 1663.3 | 7.5 | 38 | 12.8 | 11.8 | <0.1 | 0.4 | 0.2 | <0.1 | 0.5 | <0.01 | 0.2 | <0.5 |
| 8204 | 1.6 | 118.4 | 8.9 | 84 | 94.4 | 17.8 | <0.1 | 0.2 | 0.1 | <0.1 | 1.0 | <0.01 | <0.1 | <0.5 |
| 8205 | 0.4 | 16.6 | 2.1 | 49 | 19.9 | 3.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8206 | 0.7 | 99.0 | 10.0 | 80 | 100.9 | 9.4 | <0.1 | 0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8207 | 0.7 | 104.0 | 9.3 | 80 | 106.0 | 8.6 | <0.1 | 0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8208 | 0.2 | 2.6 | 0.5 | 6 | 2.4 | 0.8 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8209 | 0.2 | 563.9 | 70.4 | 37 | 9.8 | 6.8 | <0.1 | 0.2 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8210 | 0.6 | 237.6 | 2.7 | 22 | 11.8 | 2.4 | <0.1 | <0.1 | 0.2 | <0.1 | <0.5 | <0.01 | <0.1 | 0.6 |
| 8211 | 0.9 | 26.4 | 2.4 | 4 | 3.8 | 2.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8212 | 0.3 | 29.6 | 0.9 | 16 | 5.2 | 1.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8213 | 0.4 | 3.0 | 2.2 | 5 | 2.2 | 2.6 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8214 | 0.5 | 9.9 | 21.2 | 75 | 0.7 | 6.5 | <0.1 | 0.3 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8215 | 0.2 | 1.7 | 6.6 | 76 | 2.3 | 1.8 | 0.2 | <0.1 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8216 | 0.6 | 6.4 | 15.3 | 50 | 0.7 | 3.2 | <0.1 | 0.2 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8217 | 0.5 | 7.0 | 21.5 | 72 | 0.8 | 1.5 | <0.1 | 0.1 | 0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8218 | 1.0 | 159.4 | 47.7 | 65 | 11.9 | 57.3 | 0.2 | 1.7 | 0.8 | <0.1 | 1.8 | 0.08 | 0.3 | <0.5 |
| 8220 | 0.3 | 1791.8 | 3.5 | 38 | 11.7 | 5.1 | <0.1 | 0.3 | <0.1 | <0.1 | <0.5 | <0.01 | 0.1 | <0.5 |
| 8221 | 1.0 | 98.7 | 8.8 | 81 | 89.1 | 17.4 | <0.1 | 0.2 | <0.1 | <0.1 | <0.5 | <0.01 | <0.1 | <0.5 |
| 8222 | 0.3 | 8.9 | 4.0 | 32 | 0.4 | 1.3 | 0.2 | <0.1 | <0.1 | <0.1 | 3.6 | <0.01 | <0.1 | <0.5 |
| 8223 | 0.2 | 6.8 | 16.7 | 44 | 1.7 | <0.5 | <0.1 | <0.1 | 0.2 | <0.1 | 0.7 | <0.01 | <0.1 | <0.5 |
| 8224 | 0.6 | 6.6 | 16.6 | 67 | 1.7 | 4.3 | 0.2 | 0.4 | 0.2 | <0.1 | 3.6 | <0.01 | 0.4 | <0.5 |
| 8225 | 0.3 | 55.9 | 20.5 | 79 | 1.1 | <0.5 | <0.1 | 0.1 | 0.2 | 0.2 | 2.2 | <0.01 | 0.1 | <0.5 |
| 8226 | 0.9 | 84.8 | 21.5 | 76 | 0.6 | <0.5 | 0.3 | 0.1 | 0.5 | 0.2 | 2.6 | <0.01 | 0.2 | <0.5 |
| 8227 | 0.6 | 47.7 | 21.3 | 53 | 4.2 | 4.2 | 0.2 | 0.4 | 0.2 | <0.1 | <0.5 | <0.01 | 0.1 | <0.5 |
| 8228 | 0.2 | 37.7 | 5.6 | 14 | 0.2 | 1.4 | 0.1 | 0.1 | <0.1 | <0.1 | 3.4 | <0.01 | 0.1 | <0.5 |

Appendix 4D

| Element | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd | Sb | Bi | V | Ca | P | La | Cr | Mg | Ba | Ti | B | Al | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 |
| Units | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppm | % | ppm | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm | ppm | % | ppm | % | ppm | % | % |
| MDL | 0.01 | 0.01 | 0.01 | 0.1 | 2 | 0.1 | 0.1 | 1 | 0.01 | 0.1 | 0.1 | 0.2 | 0.1 | 0.5 | 0.01 | 0.02 | 0.02 | 2 | 0.01 | 0.001 | 0.5 | 0.5 | 0.01 | 0.5 | 0.001 | 20 | 0.01 | 0.001 |
| RPD % | 15.6 | 7.3 | 13.6 | 12.4 | 8.2 | 7.9 | 10.9 | 6.7 | 3.0 | 17.2 | 6.5 | 20.4 | 6.8 | 9.9 | 27.7 | 12.8 | 13.4 | 6.0 | 13.0 | 8.9 | 4.7 | 9.6 | 6.4 | 12.1 | 14.5 | 12.5 | 6.9 | 12.5 |
| RPD count | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 10 | 27 | 27 | 27 | 25 | 27 | 26 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 4 | 27 | 27 |
| APR % | 50.3 | 100.6 | 95.9 | 60.0 | 27.4 | 31.3 | 34.1 | 26.3 | 38.0 | 75.3 | 65.0 | 77.5 | 64.8 | 22.8 | 42.9 | 37.8 | 7.7 | 50.9 | 20.1 | 115.4 | 75.0 | 16.2 | 17.9 | 17.3 | 20.7 | <MDL | 28.9 | 21.0 |
| APR error % | 49.2 | 12.3 | 20.7 | 17.6 | 16.2 | 11.5 | 14.0 | 12.5 | 3.8 | 53.8 | 27.6 | 27.3 | 16.3 | 26.6 | 39.3 | 92.4 | 13.2 | 14.4 | 30.0 | 34.8 | 19.3 | 13.6 | 13.6 | 9.6 | 11.1 | | 27.0 | 20.3 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8175 | 47.61 | >10000 | 3.81 | 5.2 | 8792 | 4.3 | 1.6 | 221 | 0.22 | 30.0 | 7.8 | 2.3 | 1.3 | 26.6 | 0.05 | 0.18 | 21.99 | 6 | 1.35 | 0.569 | 3.1 | 12.0 | 0.14 | 1223.3 | 0.008 | <20 | 0.14 | 0.011 |
| 8176 | 2.25 | 140.33 | 5.66 | 62.2 | 84 | 90.6 | 26.6 | 192 | 4.59 | 4.0 | 0.3 | <0.2 | 2.1 | 48.2 | 0.23 | 0.03 | 0.13 | 133 | 1.23 | 0.179 | 20.3 | 48.1 | 1.68 | 109.4 | 0.310 | <20 | 1.41 | 0.057 |
| 8177 | 1.77 | 135.97 | 14.46 | 70.6 | 63 | 86.1 | 27.4 | 232 | 4.66 | 14.7 | 0.3 | 0.3 | 2.7 | 69.8 | 0.08 | 0.04 | 0.19 | 151 | 0.90 | 0.179 | 24.8 | 66.1 | 2.03 | 279.6 | 0.316 | <20 | 1.70 | 0.123 |
| 8178 | 0.24 | 4.37 | 1.16 | 32.2 | 3 | 21.7 | 10.1 | 206 | 2.56 | 1.2 | 1.2 | <0.2 | 7.3 | 55.3 | 0.02 | 0.04 | 0.09 | 17 | 0.46 | 0.117 | 31.4 | 18.0 | 1.61 | 805.3 | 0.061 | <20 | 1.60 | 0.018 |
| 8179 | 0.72 | 87.48 | 32.47 | 51.1 | 30 | 94.4 | 24.8 | 221 | 4.26 | 7.6 | 0.4 | 0.7 | 1.5 | 322.6 | 0.09 | 0.10 | 0.12 | 128 | 2.08 | 0.170 | 17.6 | 101.5 | 1.57 | 50.3 | 0.328 | <20 | 1.52 | 0.031 |
| 8180 | 0.25 | 2.34 | 0.64 | 15.2 | <2 | 9.4 | 2.0 | 459 | 1.29 | 0.9 | 0.1 | <0.2 | 0.6 | 8.6 | 0.04 | 0.04 | <0.02 | 4 | 0.38 | 0.014 | 2.4 | 7.4 | 0.80 | 353.8 | 0.004 | <20 | 0.80 | 0.005 |
| 8181 | 0.63 | 150.38 | 1.80 | 21.3 | 14 | 12.4 | 19.4 | 1299 | 4.80 | 2.1 | 0.2 | <0.2 | 0.5 | 6.4 | 0.04 | 0.03 | 0.22 | 8 | 0.22 | 0.013 | 1.1 | 9.6 | 1.00 | 37.5 | 0.006 | <20 | 1.11 | 0.003 |
| 8182 | 0.93 | 88.68 | 12.56 | 86.9 | 35 | 102.3 | 36.1 | 478 | 5.55 | 46.9 | 0.2 | 0.5 | 1.4 | 33.5 | 0.15 | 0.11 | 0.04 | 131 | 0.86 | 0.139 | 21.0 | 29.8 | 2.07 | 162.0 | 0.326 | <20 | 1.55 | 0.030 |
| 8183 | 0.72 | 299.29 | 15.70 | 83.1 | 129 | 27.8 | 15.3 | 388 | 3.89 | 1.8 | 0.8 | 4.0 | 1.7 | 54.0 | 0.13 | 0.21 | 0.06 | 223 | 1.22 | 0.078 | 11.8 | 41.7 | 0.59 | 40.1 | 0.283 | <20 | 1.88 | 0.342 |
| 8185 | 0.72 | 306.89 | 15.41 | 83.7 | 124 | 26.5 | 14.7 | 387 | 3.86 | 1.8 | 0.7 | 4.9 | 1.8 | 52.3 | 0.13 | 0.22 | 0.06 | 217 | 1.21 | 0.078 | 11.4 | 40.0 | 0.60 | 39.1 | 0.280 | <20 | 1.84 | 0.347 |
| 8186 | 0.34 | 1677.70 | 5.24 | 40.9 | 82 | 14.5 | 4.6 | 83 | 1.65 | 7.2 | 0.5 | 0.4 | 5.8 | 4.9 | 0.04 | 0.16 | 0.13 | 16 | 0.14 | 0.048 | 34.9 | 16.9 | 1.81 | 195.5 | 0.008 | <20 | 1.55 | 0.008 |
| 8187 | 1.06 | 74.53 | 8.54 | 75.7 | 50 | 84.9 | 34.8 | 403 | 6.08 | 15.0 | 0.2 | 0.7 | 2.2 | 19.9 | 0.07 | 0.09 | 0.08 | 136 | 1.21 | 0.145 | 17.7 | 72.4 | 2.25 | 285.8 | 0.469 | <20 | 1.78 | 0.032 |
| 8188 | 0.73 | 322.36 | 17.78 | 96.9 | 156 | 29.7 | 16.8 | 449 | 4.02 | 2.1 | 0.6 | 5.4 | 1.9 | 64.2 | 0.19 | 0.28 | 0.07 | 239 | 1.75 | 0.101 | 12.7 | 44.8 | 0.70 | 43.3 | 0.314 | <20 | 2.59 | 0.427 |
| 8189 | 0.88 | 13.28 | 10.79 | 108.5 | 22 | 5.2 | 22.5 | 494 | 5.90 | 12.0 | 0.2 | <0.2 | 1.8 | 50.4 | 0.33 | 0.10 | 0.04 | 121 | 0.92 | 0.234 | 33.0 | 1.2 | 1.35 | 445.1 | 0.310 | <20 | 1.45 | 0.030 |
| 8190 | 1.55 | 52.92 | 14.04 | 72.3 | 43 | 69.1 | 34.0 | 346 | 5.60 | 37.0 | 0.2 | <0.2 | 2.3 | 35.4 | 0.07 | 0.09 | 0.04 | 136 | 1.62 | 0.169 | 21.7 | 36.5 | 1.88 | 37.2 | 0.306 | <20 | 1.72 | 0.054 |
| 8191 | 0.27 | 5.15 | 17.71 | 211.7 | 13 | 3.4 | 1.5 | 182 | 3.07 | 12.0 | 1.0 | <0.2 | 3.7 | 9.4 | 0.05 | 0.47 | <0.02 | 17 | 0.04 | 0.038 | 15.3 | 2.6 | 0.02 | 67.4 | 0.004 | <20 | 0.24 | 0.002 |
| 8192 | 0.60 | 3.81 | 80.33 | 45.9 | 3597 | 2.5 | 1.4 | 85 | 1.73 | 78.2 | 1.0 | 17.7 | 12.2 | 21.8 | 0.05 | 3.58 | 0.05 | 28 | 0.02 | 0.025 | 16.5 | 5.2 | 0.02 | 88.2 | 0.007 | <20 | 0.11 | 0.002 |
| 8193 | 0.31 | 3.42 | 12.01 | 227.4 | 67 | 17.8 | 11.0 | 2003 | 2.62 | 3.2 | 1.6 | <0.2 | 3.9 | 10.5 | 0.55 | 0.55 | 0.06 | 21 | 0.07 | 0.053 | 22.6 | 3.2 | 0.03 | 198.1 | 0.009 | <20 | 0.32 | 0.009 |
| 8194 | 0.23 | 2.80 | 7.47 | 38.9 | 28 | 1.4 | 2.8 | 1202 | 2.16 | 2.6 | 0.7 | <0.2 | 3.9 | 208.5 | 0.10 | 0.09 | 0.05 | 28 | 3.63 | 0.063 | 35.6 | 2.6 | 0.12 | 1105.9 | 0.014 | <20 | 0.28 | 0.022 |
| 8195 | 4.47 | 17.34 | 11.58 | 94.0 | 29 | 3.5 | 5.9 | 922 | 1.96 | 2.6 | 0.8 | <0.2 | 1.7 | 87.3 | 0.14 | 0.04 | 0.23 | 31 | 2.24 | 0.088 | 26.3 | 3.5 | 0.58 | 468.3 | 0.008 | <20 | 0.84 | 0.029 |
| 8196 | 52.39 | 438.97 | 121.23 | 60.7 | 791 | 16.5 | 9.5 | 138 | 1.42 | 3.9 | 0.8 | 50.4 | 6.0 | 12.4 | 0.04 | 0.07 | 25.75 | 9 | 0.12 | 0.030 | 47.2 | 11.0 | 0.90 | 149.2 | 0.006 | <20 | 1.23 | 0.010 |
| 8197 | 1.11 | 3.71 | 4.45 | 63.3 | 17 | 1.7 | 3.7 | 958 | 2.30 | 1.3 | 0.6 | 0.3 | 2.4 | 56.4 | 0.09 | 0.05 | 0.07 | 31 | 1.91 | 0.082 | 31.0 | 2.9 | 0.43 | 391.5 | 0.020 | <20 | 0.63 | 0.043 |
| 8198 | 0.55 | 8.47 | 17.20 | 102.6 | 72 | 1.7 | 3.8 | 1100 | 2.08 | 5.3 | 0.9 | <0.2 | 2.4 | 115.4 | 0.22 | 0.04 | 0.44 | 25 | 2.97 | 0.087 | 31.1 | 3.0 | 0.45 | 795.4 | 0.006 | <20 | 0.74 | 0.026 |
| 8199 | 0.73 | 296.89 | 7.53 | 63.0 | 26 | 21.4 | 8.3 | 223 | 1.69 | 1.9 | 0.6 | <0.2 | 5.2 | 7.9 | 0.05 | 0.09 | 0.36 | 10 | 0.13 | 0.034 | 29.7 | 14.6 | 1.25 | 140.5 | 0.006 | <20 | 1.43 | 0.014 |
| 8200 | 0.46 | 153.10 | 1.92 | 164.0 | 10 | 23.1 | 38.5 | 709 | 9.97 | 0.9 | 0.1 | <0.2 | 0.9 | 13.0 | <0.01 | 0.03 | <0.02 | 96 | 0.93 | 0.291 | 19.7 | 25.7 | 3.81 | 184.6 | 0.304 | <20 | 3.27 | 0.019 |
| 8201 | 0.75 | 1333.03 | 5.30 | 38.4 | 95 | 4.6 | 4.2 | 415 | 1.25 | 12.2 | 3.6 | <0.2 | 1.7 | 3.3 | 0.03 | 0.15 | 0.39 | 7 | 1.01 | 0.020 | 10.5 | 6.3 | 2.03 | 121.8 | 0.005 | <20 | 1.03 | 0.003 |
| 8202 | 2.42 | 432.69 | 19.71 | 16.7 | 358 | 4.5 | 17.6 | 812 | 0.89 | 30.2 | 0.2 | <0.2 | 0.7 | 4.5 | 0.05 | 0.37 | 0.18 | 3 | 1.59 | 0.009 | 2.7 | 5.6 | 1.06 | 239.1 | 0.016 | <20 | 0.20 | 0.004 |
| 8203 | 0.30 | 1519.41 | 7.09 | 36.0 | 99 | 12.8 | 5.2 | 72 | 1.59 | 10.9 | 0.5 | 0.4 | 5.4 | 4.1 | 0.03 | 0.15 | 0.20 | 14 | 0.13 | 0.049 | 30.4 | 14.4 | 1.67 | 164.5 | 0.005 | <20 | 1.43 | 0.006 |
| 8204 | 1.29 | 91.99 | 7.10 | 77.8 | 50 | 85.0 | 36.6 | 392 | 6.23 | 13.6 | 0.2 | <0.2 | 2.2 | 17.4 | 0.05 | 0.08 | 0.08 | 129 | 1.29 | 0.146 | 18.8 | 56.8 | 2.22 | 166.6 | 0.429 | <20 | 1.81 | 0.031 |
| 8205 | 0.24 | 14.08 | 1.77 | 47.8 | 10 | 18.9 | 9.3 | 325 | 2.07 | 3.1 | 0.2 | <0.2 | 2.7 | 15.4 | 0.04 | 0.02 | <0.02 | 35 | 0.59 | 0.027 | 15.9 | 30.9 | 2.05 | 125.7 | 0.163 | <20 | 1.40 | 0.019 |
| 8206 | 0.75 | 78.52 | 8.37 | 74.0 | 40 | 95.7 | 34.3 | 241 | 5.22 | 7.5 | 0.1 | <0.2 | 1.3 | 32.0 | 0.08 | 0.06 | 0.05 | 112 | 0.94 | 0.139 | 18.7 | 33.9 | 1.85 | 135.8 | 0.287 | <20 | 1.40 | 0.030 |
| 8207 | 0.53 | 82.69 | 7.68 | 72.4 | 42 | 96.2 | 34.2 | 246 | 5.16 | 6.8 | 0.1 | <0.2 | 1.3 | 29.3 | 0.07 | 0.05 | 0.05 | 109 | 0.83 | 0.132 | 18.4 | 37.8 | 1.88 | 79.8 | 0.277 | <20 | 1.41 | 0.030 |
| 8208 | 0.21 | 2.15 | 0.44 | 4.6 | 7 | 2.6 | 1.4 | 72 | 0.30 | 0.8 | 0.1 | <0.2 | 0.8 | 4.6 | 0.01 | <0.02 | 0.04 | 3 | 0.11 | 0.022 | 2.9 | 5.7 | 0.31 | 264.5 | 0.007 | <20 | 0.21 | 0.003 |
| 8209 | 0.23 | 550.32 | 73.19 | 37.2 | 61 | 10.8 | 5.2 | 534 | 1.75 | 6.3 | 0.3 | 0.9 | 2.1 | 1.8 | 0.03 | 0.10 | 0.09 | 7 | 0.52 | 0.026 | 28.8 | 6.9 | 2.08 | 34.1 | 0.003 | <20 | 1.59 | 0.002 |
| 8210 | 0.52 | 222.04 | 2.39 | 21.0 | 17 | 10.6 | 20.6 | 1021 | 4.36 | 2.3 | 0.3 | 0.5 | 0.6 | 3.5 | 0.04 | 0.04 | 0.16 | 7 | 0.06 | 0.015 | 1.1 | 8.8 | 1.07 | 157.4 | 0.002 | <20 | 1.22 | 0.001 |
| 8211 | 1.51 | 21.31 | 2.18 | 2.9 | 8 | 5.4 | 2.3 | 130 | 0.78 | 2.2 | 0.2 | <0.2 | 0.6 | 1.5 | 0.04 | 0.06 | 0.04 | <2 | 0.02 | 0.005 | 3.1 | 8.5 | 0.15 | 38.6 | 0.002 | <20 | 0.16 | 0.003 |
| 8212 | 0.28 | 24.09 | 0.79 | 15.2 | 7 | 5.1 | 7.4 | 739 | 2.05 | 1.1 | 0.1 | <0.2 | 0.5 | 2.4 | <0.01 | 0.03 | 0.04 | 6 | <0.01 | 0.012 | 1.1 | 7.7 | 0.77 | 153.9 | 0.001 | <20 | 0.83 | 0.002 |
| 8213 | 0.33 | 3.02 | 1.95 | 4.4 | 7 | 1.9 | 0.6 | 264 | 0.71 | 2.6 | 0.1 | <0.2 | 0.5 | 2.7 | 0.02 | 0.03 | <0.02 | <2 | <0.01 | 0.006 | 1.3 | 4.7 | 0.17 | 208.3 | <0.001 | <20 | 0.21 | 0.004 |
| 8214 | 0.73 | 11.93 | 27.43 | 101.4 | 137 | 1.6 | 3.1 | 776 | 2.27 | 8.2 | 1.7 | <0.2 | 6.1 | 450.4 | 0.15 | 0.11 | 0.13 | 45 | 1.45 | 0.042 | 40.8 | 4.1 | 0.33 | 279.4 | 0.116 | <20 | 3.62 | 2.279 |
| 8215 | 0.21 | 1.48 | 5.29 | 72.1 | 12 | 1.7 | 4.1 | 1418 | 2.22 | 1.1 | 0.4 | <0.2 | 2.4 | 225.9 | 0.20 | 0.03 | <0.02 | 26 | 2.36 | 0.082 | 27.6 | 3.1 | 0.33 | 1616.6 | 0.017 | <20 | 0.67 | 0.033 |
| 8216 | 0.97 | 8.75 | 22.90 | 84.7 | 59 | 1.2 | 2.3 | 659 | 1.86 | 4.3 | 1.8 | <0.2 | 6.3 | 276.1 | 0.13 | 0.10 | 0.12 | 38 | 1.56 | 0.043 | 39.4 | 2.3 | 0.09 | 242.0 | 0.110 | 57 | 4.15 | 3.195 |

Appendix 4D

| Element | K | W | Sc | Tl | S | Hg | Se | Te | Ga | Cs | Ge | Hf | Nb | Rb | Sn | Ta | Zr | Y | Ce | In | Re | Be | Li | Pd | Pt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 |
| Units | % | ppm | ppm | ppm | % | ppb | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppb | ppb |
| MDL | 0.01 | 0.1 | 0.1 | 0.02 | 0.02 | 5 | 0.1 | 0.02 | 0.1 | 0.02 | 0.1 | 0.02 | 0.02 | 0.1 | 0.1 | 0.05 | 0.1 | 0.01 | 0.1 | 0.02 | 1 | 0.1 | 0.1 | 10 | 2 |
| RPD % | 8.7 | 33.3 | 5.2 | 5.2 | 8.6 | 35.0 | 29.4 | 45.2 | 6.1 | 10.3 | 19.2 | 29.4 | 8.5 | 11.3 | 29.3 | <MDL | 12.8 | 3.4 | 4.4 | 34.3 | 18.2 | 19.4 | 7.3 | 24.5 | 45.0 |
| RPD count | 27 | 2 | 27 | 15 | 24 | 13 | 27 | 8 | 27 | 27 | 16 | 27 | 16 | 27 | 26 | 27 | 27 | 27 | 27 | 20 | 7 | 22 | 27 | 7 | 4 |
| APR % | 29.2 | <MDL | 9.2 | NA | 100.0 | NA | 59.5 | 17.5 | 37.5 | NA | 12.0 | 4.1 | 0.3 | 53.8 | 54.2 | <MDL | 4.7 | 35.3 | 63.9 | 14.2 | NA | 11.7 | 71.6 | 91.5 | <MDL |
| APR error % | 14.2 | | 21.2 | | 0.0 | | 36.1 | 84.3 | 12.2 | | 74.5 | 69.9 | 28.0 | 40.8 | 51.9 | | 70.8 | 17.7 | 15.8 | 53.1 | | 109.4 | 30.3 | 43.1 | |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8175 | 0.06 | <0.1 | 0.7 | 0.03 | 0.15 | 71 | 0.4 | 0.10 | 0.4 | 0.10 | <0.1 | 0.06 | 0.14 | 2.8 | <0.1 | <0.05 | 2.2 | 13.97 | 7.7 | 0.03 | 5 | 0.2 | 1.9 | <10 | 3 |
| 8176 | 0.08 | 0.1 | 2.1 | <0.02 | 0.09 | <5 | 0.2 | <0.02 | 9.9 | 0.27 | <0.1 | 0.13 | 0.10 | 3.1 | 0.6 | <0.05 | 6.7 | 10.34 | 45.1 | <0.02 | <1 | 0.2 | 32.3 | <10 | 3 |
| 8177 | 0.51 | <0.1 | 6.0 | 0.10 | 0.08 | <5 | 0.3 | 0.03 | 9.7 | 1.49 | 0.2 | 0.26 | 0.07 | 24.6 | 2.6 | <0.05 | 11.0 | 13.49 | 56.3 | 0.04 | <1 | 0.7 | 44.5 | <10 | 3 |
| 8178 | 0.37 | <0.1 | 2.1 | 0.09 | <0.02 | <5 | <0.1 | 0.03 | 4.8 | 1.77 | <0.1 | 0.17 | 0.03 | 15.8 | 0.7 | <0.05 | 5.3 | 11.38 | 57.4 | <0.02 | <1 | 0.7 | 38.5 | <10 | 2 |
| 8179 | 0.04 | 0.1 | 2.6 | <0.02 | <0.02 | <5 | 0.2 | 0.03 | 10.3 | 0.15 | 0.2 | 0.04 | 0.13 | 1.8 | 0.7 | <0.05 | 4.4 | 9.63 | 39.9 | <0.02 | <1 | 0.4 | 25.4 | <10 | <2 |
| 8180 | 0.08 | <0.1 | 2.1 | <0.02 | <0.02 | <5 | <0.1 | 0.05 | 1.9 | 0.38 | <0.1 | 0.05 | <0.02 | 3.7 | 0.1 | <0.05 | 1.1 | 3.50 | 7.9 | 0.03 | <1 | 0.4 | 18.1 | <10 | <2 |
| 8181 | 0.03 | <0.1 | 1.9 | <0.02 | 1.28 | <5 | 0.4 | 0.02 | 2.9 | 0.20 | <0.1 | 0.05 | 0.02 | 1.6 | <0.1 | <0.05 | 1.6 | 5.28 | 3.3 | 0.16 | <1 | 0.2 | 23.5 | <10 | <2 |
| 8182 | 0.05 | <0.1 | 2.8 | <0.02 | 0.06 | <5 | 0.3 | 0.03 | 10.2 | 0.22 | 0.2 | 0.22 | 0.20 | 2.2 | 0.6 | <0.05 | 8.8 | 9.92 | 46.0 | 0.02 | <1 | 0.3 | 44.0 | <10 | 2 |
| 8183 | 0.21 | <0.1 | 3.4 | <0.02 | 0.03 | <5 | 0.3 | 0.04 | 7.8 | 0.37 | 0.1 | 0.09 | <0.02 | 9.8 | 1.0 | <0.05 | 3.7 | 11.61 | 24.2 | 0.04 | <1 | 0.3 | 9.9 | 26 | 3 |
| 8185 | 0.21 | <0.1 | 3.5 | <0.02 | 0.03 | 8 | 0.4 | 0.05 | 7.6 | 0.36 | 0.2 | 0.15 | 0.03 | 9.4 | 1.0 | <0.05 | 5.3 | 11.59 | 24.0 | 0.02 | <1 | <0.1 | 9.9 | 21 | <2 |
| 8186 | 0.38 | <0.1 | 3.6 | 0.16 | 0.04 | <5 | 0.1 | 0.06 | 5.1 | 2.09 | <0.1 | 0.25 | <0.02 | 19.4 | 0.8 | <0.05 | 6.2 | 6.97 | 72.2 | 0.06 | <1 | 1.1 | 56.7 | <10 | <2 |
| 8187 | 0.05 | 0.1 | 4.0 | <0.02 | 0.18 | <5 | 0.3 | <0.02 | 11.1 | 0.36 | 0.2 | 0.40 | 0.12 | 2.3 | 1.4 | <0.05 | 16.3 | 10.80 | 42.5 | 0.03 | <1 | 0.4 | 47.9 | <10 | <2 |
| 8188 | 0.24 | <0.1 | 3.8 | <0.02 | 0.03 | 9 | 0.4 | <0.02 | 8.4 | 0.41 | <0.1 | 0.21 | 0.03 | 11.5 | 1.2 | <0.05 | 6.6 | 13.63 | 27.3 | 0.03 | <1 | 0.2 | 11.7 | 19 | <2 |
| 8189 | 0.06 | <0.1 | 2.4 | <0.02 | 0.04 | 6 | 0.3 | <0.02 | 12.8 | 0.17 | <0.1 | 0.19 | 0.40 | 4.5 | 0.8 | <0.05 | 7.3 | 13.73 | 72.9 | 0.04 | <1 | 0.6 | 42.9 | <10 | <2 |
| 8190 | 0.07 | 0.1 | 4.5 | <0.02 | 0.21 | <5 | 0.4 | <0.02 | 10.6 | 1.10 | 0.1 | 0.14 | 0.08 | 3.6 | 0.5 | <0.05 | 7.3 | 10.17 | 48.7 | <0.02 | 3 | 0.7 | 40.8 | <10 | <2 |
| 8191 | 0.21 | 1.0 | 3.1 | 0.08 | 0.04 | 446 | 0.2 | 0.03 | 0.6 | 0.96 | <0.1 | 0.08 | 0.03 | 5.7 | 0.3 | <0.05 | 3.2 | 3.83 | 32.9 | 0.05 | <1 | 1.5 | 0.8 | <10 | <2 |
| 8192 | 0.09 | 1.0 | 0.6 | 0.34 | 0.06 | 995 | 0.2 | <0.02 | 0.4 | 0.27 | <0.1 | 0.17 | 0.05 | 2.8 | 0.2 | <0.05 | 6.1 | 1.82 | 34.2 | <0.02 | <1 | 0.4 | 0.6 | <10 | 3 |
| 8193 | 0.18 | 1.4 | 3.1 | 0.30 | <0.02 | 61 | <0.1 | <0.02 | 0.9 | 2.18 | <0.1 | 0.14 | 0.05 | 7.9 | 0.3 | <0.05 | 6.6 | 6.72 | 56.1 | 0.04 | <1 | 1.2 | 1.8 | <10 | <2 |
| 8194 | 0.25 | <0.1 | 2.5 | 0.06 | 0.02 | 18 | 0.2 | <0.02 | 0.7 | 2.52 | <0.1 | 0.09 | 0.05 | 10.5 | 0.4 | <0.05 | 2.8 | 9.42 | 66.9 | 0.04 | 2 | 1.2 | 0.6 | <10 | <2 |
| 8195 | 0.22 | <0.1 | 2.2 | 0.08 | 0.06 | 8 | 0.7 | <0.02 | 4.5 | 0.92 | <0.1 | 0.11 | <0.02 | 7.6 | 0.2 | <0.05 | 8.3 | 10.06 | 50.6 | <0.02 | 15 | 0.6 | 37.5 | <10 | <2 |
| 8196 | 0.41 | <0.1 | 2.8 | 0.17 | <0.02 | 12 | 0.6 | 0.56 | 3.8 | 1.67 | <0.1 | 0.17 | <0.02 | 17.5 | 0.4 | <0.05 | 5.6 | 6.09 | 84.0 | 0.03 | 16 | 2.1 | 43.1 | <10 | <2 |
| 8197 | 0.15 | <0.1 | 1.7 | 0.03 | <0.02 | 5 | 0.2 | <0.02 | 3.9 | 0.61 | <0.1 | 0.17 | <0.02 | 5.5 | 0.1 | <0.05 | 8.2 | 7.50 | 57.9 | <0.02 | 4 | 0.3 | 28.5 | 10 | 3 |
| 8198 | 0.24 | <0.1 | 2.1 | 0.08 | 0.11 | 6 | 0.3 | <0.02 | 3.8 | 1.36 | <0.1 | 0.06 | <0.02 | 9.0 | <0.1 | <0.05 | 4.5 | 8.31 | 58.7 | 0.02 | 4 | 0.4 | 28.5 | <10 | <2 |
| 8199 | 0.36 | <0.1 | 2.1 | 0.34 | <0.02 | <5 | 0.1 | <0.02 | 4.3 | 2.32 | <0.1 | 0.22 | <0.02 | 21.2 | 0.4 | <0.05 | 7.6 | 6.82 | 55.1 | 0.03 | 3 | 1.2 | 48.7 | <10 | <2 |
| 8200 | 0.02 | <0.1 | 11.5 | <0.02 | <0.02 | <5 | <0.1 | 0.03 | 19.7 | 0.33 | 0.3 | 0.11 | 0.07 | 0.6 | 0.6 | <0.05 | 3.0 | 18.46 | 43.1 | 0.08 | <1 | 1.1 | 70.3 | <10 | <2 |
| 8201 | 0.04 | <0.1 | 1.0 | 0.22 | 0.11 | 13 | 0.2 | <0.02 | 3.1 | 0.10 | <0.1 | 0.13 | <0.02 | 1.7 | 0.1 | <0.05 | 4.8 | 3.70 | 22.5 | 0.04 | 3 | <0.1 | 22.9 | <10 | <2 |
| 8202 | 0.04 | <0.1 | 1.4 | 0.26 | 0.37 | 15 | 0.2 | <0.02 | 0.8 | 0.10 | <0.1 | 0.04 | 0.03 | 1.5 | 0.1 | <0.05 | 1.4 | 4.45 | 6.6 | 0.09 | 3 | <0.1 | 5.5 | <10 | <2 |
| 8203 | 0.37 | <0.1 | 3.4 | 0.16 | 0.04 | 8 | 0.3 | 0.02 | 4.7 | 1.94 | <0.1 | 0.18 | <0.02 | 19.3 | 0.5 | <0.05 | 5.5 | 6.80 | 66.3 | 0.04 | <1 | 0.8 | 53.6 | <10 | <2 |
| 8204 | 0.04 | <0.1 | 3.4 | <0.02 | 0.20 | <5 | 0.3 | <0.02 | 12.1 | 0.45 | 0.2 | 0.25 | 0.11 | 1.9 | 0.6 | <0.05 | 12.1 | 11.17 | 43.1 | 0.02 | 1 | 0.4 | 46.5 | <10 | <2 |
| 8205 | 0.09 | <0.1 | 2.6 | <0.02 | <0.02 | <5 | 0.1 | <0.02 | 5.9 | 0.31 | <0.1 | 0.34 | 0.05 | 3.3 | 0.7 | <0.05 | 11.8 | 5.71 | 29.3 | 0.02 | <1 | 0.5 | 41.4 | 11 | <2 |
| 8206 | 0.04 | <0.1 | 2.1 | <0.02 | 0.12 | <5 | 0.3 | <0.02 | 10.3 | 0.23 | 0.1 | 0.14 | 0.12 | 1.5 | 0.5 | <0.05 | 6.9 | 9.61 | 42.5 | <0.02 | <1 | 0.2 | 37.9 | <10 | <2 |
| 8207 | 0.04 | <0.1 | 2.2 | <0.02 | 0.06 | 6 | 0.4 | <0.02 | 9.8 | 0.23 | 0.2 | 0.08 | 0.10 | 1.6 | 0.5 | <0.05 | 4.4 | 9.26 | 41.2 | <0.02 | 1 | 0.1 | 39.1 | <10 | <2 |
| 8208 | 0.01 | <0.1 | 0.4 | <0.02 | <0.02 | <5 | 0.1 | <0.02 | 0.6 | 0.03 | <0.1 | 0.02 | 0.03 | 0.3 | <0.1 | <0.05 | 0.8 | 1.47 | 6.0 | <0.02 | <1 | <0.1 | 7.0 | <10 | <2 |
| 8209 | 0.14 | <0.1 | 2.9 | 0.06 | <0.02 | 10 | 0.2 | 0.04 | 4.3 | 0.48 | <0.1 | 0.09 | <0.02 | 5.1 | 0.3 | <0.05 | 3.5 | 4.77 | 55.6 | 0.08 | 2 | 0.4 | 49.0 | <10 | <2 |
| 8210 | 0.04 | <0.1 | 1.8 | <0.02 | 0.75 | <5 | 0.6 | <0.02 | 3.1 | 0.28 | <0.1 | 0.06 | <0.02 | 2.3 | 0.1 | <0.05 | 1.6 | 3.76 | 3.7 | 0.17 | 1 | 0.1 | 26.8 | <10 | <2 |
| 8211 | 0.02 | <0.1 | 0.4 | <0.02 | <0.02 | <5 | 0.1 | <0.02 | 0.5 | 0.08 | <0.1 | 0.02 | 0.03 | 1.1 | 0.1 | <0.05 | 0.9 | 0.85 | 6.5 | <0.02 | 2 | 0.1 | 3.2 | <10 | <2 |
| 8212 | 0.02 | <0.1 | 1.2 | <0.02 | 0.18 | 7 | 0.2 | <0.02 | 2.1 | 0.16 | <0.1 | 0.03 | <0.02 | 1.3 | <0.1 | <0.05 | 1.0 | 3.16 | 3.2 | 0.10 | <1 | 0.2 | 20.0 | <10 | <2 |
| 8213 | 0.04 | <0.1 | 0.8 | <0.02 | 0.03 | <5 | <0.1 | <0.02 | 0.5 | 0.09 | <0.1 | <0.02 | 0.02 | 1.4 | <0.1 | <0.05 | 0.7 | 0.83 | 3.5 | 0.07 | 2 | <0.1 | 4.5 | <10 | <2 |
| 8214 | 0.17 | 0.4 | 0.8 | 0.09 | <0.02 | 10 | 0.2 | <0.02 | 9.4 | 12.66 | <0.1 | 0.30 | 0.05 | 8.7 | 0.8 | <0.05 | 24.4 | 12.80 | 71.3 | 0.03 | 2 | 1.4 | 45.2 | <10 | <2 |
| 8215 | 0.27 | <0.1 | 1.9 | 0.05 | 0.04 | <5 | 0.1 | <0.02 | 3.4 | 0.82 | <0.1 | 0.14 | 0.03 | 8.7 | 0.2 | <0.05 | 9.7 | 8.68 | 49.8 | 0.02 | <1 | 0.5 | 21.8 | <10 | <2 |
| 8216 | 0.11 | 0.4 | 0.3 | 0.07 | <0.02 | <5 | 0.2 | <0.02 | 10.7 | 6.71 | 0.2 | 0.37 | 0.07 | 5.4 | 0.4 | <0.05 | 29.6 | 10.28 | 65.8 | <0.02 | 2 | 2.0 | 29.8 | <10 | <2 |

| Element | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd | Sb | Bi | V | Ca | P | La | Cr | Mg | Ba | Ti | B | Al | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 |
| Units | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppm | % | ppm | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm | ppm | % | ppm | % | ppm | % | % |
| MDL | 0.01 | 0.01 | 0.01 | 0.1 | 2 | 0.1 | 0.1 | 1 | 0.01 | 0.1 | 0.1 | 0.2 | 0.1 | 0.5 | 0.01 | 0.02 | 0.02 | 2 | 0.01 | 0.001 | 0.5 | 0.5 | 0.01 | 0.5 | 0.001 | 20 | 0.01 | 0.001 |
| RPD % | 15.6 | 7.3 | 13.6 | 12.4 | 8.2 | 7.9 | 10.9 | 6.7 | 3.0 | 17.2 | 6.5 | 20.4 | 6.8 | 9.9 | 27.7 | 12.8 | 13.4 | 6.0 | 13.0 | 8.9 | 4.7 | 9.6 | 6.4 | 12.1 | 14.5 | 12.5 | 6.9 | 12.5 |
| RPD count | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 10 | 27 | 27 | 27 | 25 | 27 | 26 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 4 | 27 | 27 |
| APR % | 50.3 | 100.6 | 95.9 | 60.0 | 27.4 | 31.3 | 34.1 | 26.3 | 38.0 | 75.3 | 65.0 | 77.5 | 64.8 | 22.8 | 42.9 | 37.8 | 7.7 | 50.9 | 20.1 | 115.4 | 75.0 | 16.2 | 17.9 | 17.3 | 20.7 | <MDL | 28.9 | 21.0 |
| APR error % | 49.2 | 12.3 | 20.7 | 17.6 | 16.2 | 11.5 | 14.0 | 12.5 | 3.8 | 53.8 | 27.6 | 27.3 | 16.3 | 26.6 | 39.3 | 92.4 | 13.2 | 14.4 | 30.0 | 34.8 | 19.3 | 13.6 | 13.6 | 9.6 | 11.1 | | 27.0 | 20.3 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8217 | 0.30 | 5.80 | 17.91 | 67.4 | 46 | 1.0 | 3.4 | 824 | 2.14 | 0.7 | 0.8 | 0.9 | 4.0 | 242.1 | 0.13 | 0.06 | 0.08 | 25 | 2.72 | 0.036 | 45.8 | 2.0 | 0.22 | 1147.8 | 0.018 | <20 | 0.63 | 0.031 |
| 8218 | 1.07 | 165.83 | 49.73 | 68.4 | 101 | 12.6 | 12.0 | 364 | 0.82 | 52.5 | 0.6 | 1.2 | 1.6 | 107.1 | 0.19 | 1.26 | 0.86 | <2 | 28.66 | 0.020 | 22.1 | 2.8 | 0.87 | 42.9 | 0.003 | <20 | 0.39 | 0.012 |
| 8220 | 0.21 | 1843.51 | 3.45 | 39.5 | 78 | 12.5 | 3.8 | 78 | 1.62 | 4.7 | 0.6 | <0.2 | 5.5 | 5.7 | 0.01 | 0.14 | 0.09 | 16 | 0.24 | 0.048 | 32.7 | 17.1 | 1.76 | 198.8 | 0.006 | <20 | 1.63 | 0.008 |
| 8221 | 1.05 | 88.88 | 7.99 | 82.9 | 53 | 92.8 | 36.0 | 410 | 6.44 | 14.2 | 0.2 | <0.2 | 2.1 | 20.3 | 0.05 | 0.08 | 0.06 | 144 | 1.34 | 0.146 | 20.3 | 61.8 | 2.37 | 286.2 | 0.481 | <20 | 1.97 | 0.037 |
| 8222 | 0.18 | 9.39 | 4.41 | 35.0 | 24 | 0.7 | 1.5 | >10000 | 1.71 | 1.2 | 1.2 | <0.2 | 1.6 | 195.8 | 0.13 | 0.05 | 0.04 | 65 | 11.46 | 0.016 | 17.4 | 2.5 | 0.09 | 29.0 | 0.135 | <20 | 0.46 | 0.021 |
| 8223 | 0.26 | 6.66 | 16.90 | 44.8 | 27 | 2.3 | 2.2 | 685 | 1.53 | 0.9 | 0.5 | 2.7 | 1.0 | 27.4 | 0.11 | 0.05 | 0.16 | 27 | 0.60 | 0.014 | 8.5 | 2.0 | 0.10 | 65.4 | 0.057 | <20 | 0.69 | 0.044 |
| 8224 | 0.34 | 5.65 | 15.13 | 60.1 | 43 | 1.7 | 2.7 | 1112 | 2.06 | 4.8 | 1.0 | 1.7 | 1.7 | 26.2 | 0.14 | 0.28 | 0.13 | 56 | 1.14 | 0.017 | 21.8 | 4.1 | 0.09 | 46.2 | 0.114 | <20 | 0.77 | 0.031 |
| 8225 | 0.11 | 53.02 | 18.78 | 78.7 | 171 | 1.4 | 7.4 | 682 | 2.27 | 1.0 | 0.8 | 1.5 | 5.7 | 189.3 | 0.05 | 0.06 | 0.16 | 73 | 0.75 | 0.052 | 30.4 | 1.5 | 0.29 | 95.4 | 0.159 | <20 | 1.89 | 0.749 |
| 8226 | 0.76 | 75.62 | 19.92 | 71.4 | 188 | 1.0 | 7.5 | 1032 | 3.05 | 1.1 | 1.0 | 2.8 | 6.9 | 303.8 | 0.20 | 0.08 | 0.46 | 123 | 1.78 | 0.059 | 40.8 | 1.5 | 0.34 | 105.9 | 0.113 | <20 | 1.08 | 0.112 |
| 8227 | 0.66 | 45.02 | 20.82 | 56.6 | 44 | 4.8 | 7.9 | 1005 | 3.24 | 5.1 | 2.3 | 1.3 | 9.3 | 268.4 | 0.17 | 0.25 | 0.16 | 153 | 3.33 | 0.147 | 65.1 | 9.7 | 0.11 | 61.3 | 0.268 | <20 | 0.65 | 0.035 |
| 8228 | 0.13 | 34.53 | 6.07 | 16.9 | 36 | 0.9 | 1.7 | 320 | 1.24 | 2.0 | 0.9 | 2.6 | 7.0 | 116.8 | 0.10 | 0.05 | 0.07 | 73 | 0.99 | 0.032 | 35.8 | 0.9 | 0.05 | 37.2 | 0.131 | <20 | 3.39 | 2.601 |
| 8246 | 0.14 | 39.92 | 2.21 | 28.2 | 5 | 5.2 | 2.5 | 2533 | 1.27 | 2.8 | <0.1 | 0.2 | <0.1 | 139.0 | 0.03 | 0.02 | <0.02 | 11 | 20.51 | 0.005 | 14.7 | 3.3 | 0.47 | 11.1 | 0.003 | <20 | 0.59 | 0.007 |
| 8247 | 1.36 | 70.23 | 12.23 | 189.3 | 43 | 45.3 | 44.4 | 665 | 9.82 | 35.9 | 0.3 | 0.2 | 1.7 | 42.5 | 0.05 | 0.14 | <0.02 | 141 | 1.38 | 0.299 | 37.9 | 33.9 | 2.63 | 47.6 | 0.275 | <20 | 3.28 | 0.126 |
| 8248 | 0.44 | 254.20 | 28.93 | 275.5 | 23 | 39.1 | 31.3 | 733 | 7.78 | 7.7 | 0.1 | 0.2 | 2.3 | 12.4 | 0.20 | 0.03 | 0.14 | 101 | 0.92 | 0.242 | 30.4 | 29.1 | 4.42 | 42.3 | 0.278 | <20 | 4.00 | 0.031 |
| 8249 | 9.96 | 1798.35 | 1.47 | 66.9 | 211 | 7.6 | 4.5 | 272 | 2.48 | 22.0 | 0.6 | 1.4 | 3.3 | 3.5 | 0.01 | 0.06 | 0.47 | 9 | 0.12 | 0.071 | 2.3 | 8.7 | 1.97 | 86.7 | 0.016 | <20 | 1.78 | 0.004 |
| 8250 | 1.02 | 42.78 | 2323.05 | 1000.1 | 446 | 41.5 | 39.5 | 1433 | 3.67 | 86.4 | 0.2 | 1.5 | 1.7 | 42.5 | 6.27 | 0.15 | 1.00 | 105 | 4.87 | 0.376 | 44.3 | 26.8 | 4.12 | 37.7 | 0.024 | <20 | 3.44 | 0.035 |
| 8251 | 16.21 | 5591.57 | 8.44 | 214.9 | 261 | 29.6 | 13.9 | 1496 | 5.79 | 0.7 | 0.4 | <0.2 | 0.5 | 51.5 | 0.37 | 0.07 | <0.02 | 101 | 6.26 | 0.300 | 16.0 | 32.9 | 3.26 | 121.0 | 0.023 | <20 | 2.93 | 0.003 |
| 8252 | 0.28 | 142.74 | 1072.89 | 1222.6 | 958 | 4.9 | 1.1 | 118 | 1.53 | 22.6 | 0.5 | <0.2 | 6.9 | 4.3 | 3.90 | 0.54 | 0.26 | 18 | 0.08 | 0.048 | 32.9 | 24.4 | 1.15 | 50.2 | 0.003 | <20 | 1.27 | 0.006 |
| 8253 | 0.31 | 157.49 | 1821.73 | 2934.8 | 806 | 8.5 | 3.3 | 51 | 1.49 | 10.2 | 0.7 | <0.2 | 5.0 | 2.7 | 22.23 | 0.38 | 0.44 | 18 | 0.05 | 0.039 | 18.3 | 21.6 | 1.06 | 55.6 | 0.003 | <20 | 1.14 | 0.007 |
| 8254 | 0.44 | 86.60 | 495.99 | 828.7 | 887 | 13.3 | 5.1 | 353 | 1.98 | 32.5 | 0.7 | <0.2 | 7.1 | 9.1 | 4.85 | 0.49 | 0.22 | 21 | 1.52 | 0.043 | 31.1 | 25.9 | 2.01 | 447.6 | 0.004 | <20 | 1.43 | 0.006 |
| 8255 | 0.31 | 2.79 | 6.60 | 26.3 | 19 | 19.3 | 6.4 | 263 | 2.25 | 1.2 | 1.2 | <0.2 | 7.1 | 4.2 | 0.04 | 0.31 | 0.29 | 18 | 0.29 | 0.053 | 48.3 | 23.0 | 0.81 | 58.6 | 0.010 | <20 | 1.17 | 0.005 |
| 8256 | 0.24 | 7.63 | 9.04 | 38.2 | 58 | 14.9 | 6.3 | 580 | 1.84 | 18.4 | 0.7 | <0.2 | 4.4 | 9.7 | 0.02 | 0.21 | 0.30 | 17 | 4.07 | 0.047 | 26.1 | 16.4 | 3.92 | 76.8 | 0.006 | <20 | 2.01 | 0.010 |
| 8257 | 0.76 | 85.08 | 18.00 | 73.6 | 38 | 91.5 | 27.7 | 184 | 4.12 | 2.3 | 0.4 | 0.4 | 3.0 | 55.4 | 0.16 | 0.09 | 0.06 | 162 | 1.26 | 0.179 | 25.5 | 46.2 | 2.14 | 245.7 | 0.498 | <20 | 1.90 | 0.120 |
| 8258 | 0.34 | 62.32 | 11.62 | 76.9 | 31 | 77.8 | 24.0 | 193 | 3.74 | 1.6 | 0.5 | 0.7 | 4.0 | 26.8 | 0.12 | 0.07 | 0.06 | 127 | 1.58 | 0.152 | 25.7 | 57.6 | 2.80 | 99.3 | 0.424 | <20 | 2.07 | 0.059 |
| 8259 | 0.62 | 0.64 | 1.39 | 47.1 | <2 | 8.4 | 3.0 | 314 | 1.46 | 0.5 | 1.7 | <0.2 | 4.4 | 89.1 | 0.03 | <0.02 | 0.02 | 6 | 12.53 | 0.024 | 15.6 | 6.2 | 3.28 | 7.3 | 0.036 | <20 | 1.75 | 0.027 |
| 8260 | 0.86 | 82.75 | 9.51 | 68.3 | 25 | 105.6 | 28.6 | 212 | 4.39 | 1.2 | 0.3 | 0.4 | 2.7 | 27.4 | 0.05 | 0.06 | 0.06 | 135 | 1.21 | 0.196 | 25.4 | 59.0 | 2.58 | 30.5 | 0.375 | <20 | 2.11 | 0.064 |
| 8261 | 0.26 | 89.50 | 3.88 | 69.1 | 21 | 119.3 | 27.2 | 159 | 3.75 | 0.7 | 0.3 | <0.2 | 2.6 | 53.2 | 0.04 | 0.03 | 0.05 | 118 | 1.50 | 0.183 | 20.5 | 133.6 | 2.18 | 45.5 | 0.246 | <20 | 1.65 | 0.052 |
| 8262 | 0.88 | 69.08 | 7.48 | 66.8 | 18 | 47.5 | 25.1 | 208 | 4.09 | 1.2 | 0.2 | 0.3 | 2.6 | 114.7 | 0.06 | 0.08 | 0.06 | 133 | 1.61 | 0.214 | 25.6 | 7.8 | 1.44 | 127.5 | 0.271 | <20 | 1.48 | 0.061 |
| 8263 | 0.17 | 1069.54 | 2.50 | 40.9 | 16 | 11.2 | 3.6 | 82 | 1.60 | 3.5 | 0.5 | <0.2 | 4.7 | 3.6 | <0.01 | 0.16 | 0.08 | 14 | 0.10 | 0.032 | 24.6 | 13.1 | 1.82 | 666.9 | 0.006 | <20 | 1.67 | 0.010 |
| 8264 | 2.11 | 557.00 | 83.59 | 10.8 | 157 | 2.3 | 8.7 | 293 | 0.93 | 47.3 | 0.2 | 0.5 | 1.2 | 2.1 | 0.02 | 0.72 | 0.11 | <2 | 0.28 | 0.005 | 3.6 | 7.8 | 0.36 | 235.1 | 0.001 | <20 | 0.24 | 0.011 |
| 8265 | 52.89 | 763.36 | 887.13 | 21.1 | 3664 | 15.4 | 39.0 | 62 | 5.32 | 423.8 | 0.7 | 13.3 | 1.5 | 7.7 | 0.07 | 5.16 | 4.01 | 6 | 0.02 | 0.011 | 8.4 | 5.5 | 0.14 | 2271.3 | 0.002 | <20 | 0.29 | 0.005 |
| 8266 | 0.43 | 6961.02 | 1.29 | 1.7 | 5373 | 1.1 | 0.5 | 57 | 0.38 | 36.7 | 23.7 | 3.9 | 1.6 | 2.9 | <0.01 | 0.09 | 190.01 | 23 | 0.05 | 0.025 | 1.7 | 6.1 | 0.04 | 174.4 | 0.002 | <20 | 0.14 | <0.001 |
| 8267 | 0.40 | 8288.43 | 1.17 | 1.7 | 9131 | 1.1 | 0.4 | 48 | 0.27 | 18.3 | 11.3 | 2.8 | 1.3 | 6.1 | <0.01 | 0.05 | 215.51 | 23 | 0.04 | 0.022 | 1.6 | 4.9 | 0.03 | 409.0 | <0.001 | <20 | 0.13 | 0.002 |
| 8268 | 10.68 | >10000 | 4.10 | 139.3 | 21384 | 36.3 | 33.4 | 2574 | 2.17 | 25.7 | 0.4 | 50.3 | 0.9 | 28.0 | 0.07 | 0.08 | 39.03 | 88 | 2.94 | 0.336 | 24.9 | 34.0 | 5.57 | 284.9 | 0.007 | <20 | 3.40 | 0.020 |
| 8269 | 1.06 | 118.80 | 6.24 | 87.2 | 62 | 56.7 | 33.3 | 423 | 6.45 | 4.5 | 0.4 | 0.4 | 2.3 | 34.6 | 0.03 | 0.04 | 0.74 | 153 | 2.59 | 0.193 | 31.0 | 76.6 | 2.43 | 34.4 | 0.442 | <20 | 2.27 | 0.061 |
| 8270 | 0.08 | 51.62 | 1.75 | 15.6 | 23 | 10.0 | 5.0 | 86 | 1.16 | 1.7 | 0.7 | <0.2 | 6.2 | 4.4 | 0.02 | 0.03 | 0.21 | 16 | 0.21 | 0.038 | 13.8 | 24.3 | 0.89 | 101.7 | 0.145 | <20 | 1.10 | 0.021 |
| 8271 | 0.08 | 7.70 | 4.26 | 20.2 | 4 | 11.6 | 5.8 | 102 | 1.28 | 0.9 | 0.4 | <0.2 | 6.2 | 6.3 | 0.01 | 0.02 | 0.21 | 8 | 0.10 | 0.028 | 16.9 | 24.1 | 0.91 | 126.5 | 0.020 | <20 | 0.93 | 0.021 |
| 8272 | 0.69 | 58.31 | 21.24 | 64.6 | 40 | 60.5 | 27.9 | 296 | 5.19 | 10.2 | 0.3 | 0.7 | 3.0 | 33.1 | 0.06 | 0.07 | 0.12 | 139 | 1.49 | 0.193 | 26.5 | 59.9 | 1.76 | 321.9 | 0.350 | <20 | 1.79 | 0.060 |
| 8273 | 0.80 | 70.61 | 7.68 | 70.9 | 31 | 75.9 | 31.5 | 267 | 5.61 | 6.1 | 0.3 | <0.2 | 2.3 | 71.9 | 0.05 | 0.10 | 0.12 | 139 | 1.15 | 0.192 | 23.6 | 45.0 | 1.98 | 19.0 | 0.275 | <20 | 1.86 | 0.049 |
| 8274 | 0.39 | 69.28 | 6.82 | 67.4 | 29 | 70.8 | 30.3 | 277 | 5.43 | 6.3 | 0.3 | 1.0 | 2.0 | 75.0 | 0.06 | 0.09 | 0.09 | 132 | 1.15 | 0.180 | 23.7 | 44.8 | 1.91 | 35.3 | 0.254 | 36 | 1.80 | 0.055 |
| 8275 | 0.58 | 147.20 | 15.84 | 47.2 | 108 | 167.2 | 40.6 | 302 | 5.02 | 77.9 | 0.2 | 1.7 | 2.6 | 51.5 | 0.09 | 0.05 | 0.06 | 148 | 1.40 | 0.130 | 19.4 | 285.1 | 3.10 | 66.2 | 0.191 | <20 | 1.72 | 0.091 |
| 8276 | 0.11 | 6.28 | 41.98 | 29.9 | 23 | 10.1 | 2.2 | 419 | 1.89 | 5.9 | 0.4 | <0.2 | 5.3 | 10.6 | 0.03 | 0.05 | 0.11 | 19 | 0.60 | 0.031 | 26.4 | 19.9 | 1.51 | 47.2 | 0.002 | <20 | 1.35 | 0.034 |
| 8277 | 0.24 | 44.65 | 19.11 | 32.9 | 22 | 68.4 | 12.1 | 414 | 3.03 | 25.7 | 0.2 | 0.7 | 1.4 | 16.0 | 0.07 | 0.05 | 0.06 | 62 | 0.57 | 0.076 | 15.3 | 124.3 | 2.19 | 61.1 | 0.110 | <20 | 1.58 | 0.029 |

| Element | K | W | Sc | Tl | S | Hg | Se | Te | Ga | Cs | Ge | Hf | Nb | Rb | Sn | Ta | Zr | Y | Ce | In | Re | Be | Li | Pd | Pt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 |
| Units | % | ppm | ppm | ppm | % | ppb | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppb | ppb |
| MDL | 0.01 | 0.1 | 0.1 | 0.02 | 0.02 | 5 | 0.1 | 0.02 | 0.1 | 0.02 | 0.1 | 0.02 | 0.02 | 0.1 | 0.1 | 0.05 | 0.1 | 0.01 | 0.1 | 0.02 | 1 | 0.1 | 0.1 | 10 | 2 |
| RPD % | 8.7 | 33.3 | 5.2 | 5.2 | 8.6 | 35.0 | 29.4 | 45.2 | 6.1 | 10.3 | 19.2 | 29.4 | 8.5 | 11.3 | 29.3 | <MDL | 12.8 | 3.4 | 4.4 | 34.3 | 18.2 | 19.4 | 7.3 | 24.5 | 45.0 |
| RPD count | 27 | 2 | 27 | 15 | 24 | 13 | 27 | 8 | 27 | 27 | 16 | 27 | 16 | 27 | 26 | 27 | 27 | 27 | 27 | 20 | 7 | 22 | 27 | 7 | 4 |
| APR % | 29.2 | <MDL | 9.2 | NA | 100.0 | NA | 59.5 | 17.5 | 37.5 | NA | 12.0 | 4.1 | 0.3 | 53.8 | 54.2 | <MDL | 4.7 | 35.3 | 63.9 | 14.2 | NA | 11.7 | 71.6 | 91.5 | <MDL |
| APR error % | 14.2 | | 21.2 | | 0.0 | | 36.1 | 84.3 | 12.2 | | 74.5 | 69.9 | 28.0 | 40.8 | 51.9 | | 70.8 | 17.7 | 15.8 | 53.1 | | 109.4 | 30.3 | 43.1 | |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8217 | 0.28 | <0.1 | 0.9 | 0.11 | 0.03 | 6 | 0.1 | <0.02 | 3.0 | 0.63 | <0.1 | 0.18 | <0.02 | 12.1 | <0.1 | <0.05 | 10.4 | 11.98 | 84.0 | <0.02 | <1 | 0.4 | 23.1 | <10 | <2 |
| 8218 | 0.10 | <0.1 | 2.0 | 0.31 | 0.18 | 98 | 0.5 | 0.18 | 1.0 | 0.37 | <0.1 | 0.12 | 0.06 | 4.7 | 0.2 | <0.05 | 3.9 | 10.79 | 40.8 | 0.04 | <1 | 0.2 | 21.8 | <10 | <2 |
| 8220 | 0.42 | <0.1 | 3.5 | 0.15 | 0.05 | 11 | 0.3 | <0.02 | 5.1 | 2.35 | <0.1 | 0.17 | <0.02 | 22.1 | 0.7 | <0.05 | 5.5 | 6.90 | 70.1 | 0.05 | <1 | 1.2 | 55.9 | <10 | <2 |
| 8221 | 0.06 | <0.1 | 4.3 | <0.02 | 0.18 | 9 | 0.5 | 0.02 | 12.3 | 0.49 | 0.2 | 0.23 | 0.11 | 2.9 | 0.8 | <0.05 | 11.9 | 11.48 | 45.5 | 0.03 | 1 | 0.5 | 47.9 | <10 | <2 |
| 8222 | 0.09 | 0.2 | 1.4 | 0.06 | <0.02 | 13 | 0.2 | 0.02 | 3.3 | 0.40 | 0.1 | 0.45 | 1.26 | 4.3 | 1.1 | <0.05 | 29.2 | 14.22 | 38.6 | <0.02 | 2 | 1.1 | 9.3 | 14 | <2 |
| 8223 | 0.13 | 0.1 | 0.4 | 0.09 | <0.02 | <5 | <0.1 | <0.02 | 4.0 | 0.11 | <0.1 | 0.98 | 0.39 | 5.4 | 0.5 | <0.05 | 29.4 | 3.95 | 18.7 | 0.02 | <1 | 0.6 | 15.8 | <10 | <2 |
| 8224 | 0.10 | 0.3 | 0.8 | 0.26 | <0.02 | 8 | 0.2 | 0.03 | 5.0 | 0.21 | 0.1 | 1.72 | 1.07 | 4.9 | 0.8 | <0.05 | 57.5 | 9.06 | 41.1 | 0.02 | <1 | 0.7 | 18.5 | 23 | <2 |
| 8225 | 0.17 | 0.2 | 2.0 | 0.10 | <0.02 | <5 | 0.1 | 0.05 | 5.2 | 7.33 | <0.1 | 0.09 | 0.47 | 20.7 | 0.7 | <0.05 | 5.6 | 6.80 | 55.6 | 0.03 | <1 | 3.4 | 29.6 | <10 | <2 |
| 8226 | 0.24 | 0.2 | 1.5 | 0.25 | <0.02 | <5 | 0.2 | 0.10 | 8.3 | 2.91 | 0.1 | 0.09 | 0.25 | 41.6 | 1.1 | <0.05 | 4.5 | 6.01 | 70.1 | 0.04 | <1 | 2.7 | 17.4 | <10 | <2 |
| 8227 | 0.36 | 1.1 | 3.3 | 0.23 | <0.02 | <5 | 0.2 | 0.10 | 5.7 | 1.11 | <0.1 | 0.06 | 1.25 | 31.3 | 1.2 | <0.05 | 6.0 | 11.38 | 110.6 | 0.03 | <1 | 2.8 | 10.1 | <10 | <2 |
| 8228 | 0.23 | <0.1 | 0.8 | 0.14 | <0.02 | <5 | 0.2 | 0.05 | 6.8 | 8.75 | <0.1 | 0.11 | 0.35 | 17.0 | 0.8 | <0.05 | 4.3 | 5.99 | 70.9 | <0.02 | <1 | 1.9 | 2.3 | <10 | <2 |
| 8246 | <0.01 | <0.1 | 5.9 | 0.02 | <0.02 | <5 | 0.1 | <0.02 | 3.0 | 0.05 | <0.1 | <0.02 | <0.02 | 0.2 | 0.2 | <0.05 | 0.1 | 10.39 | 33.8 | 0.24 | <1 | <0.1 | 8.2 | <10 | <2 |
| 8247 | 0.15 | <0.1 | 13.8 | 0.03 | 0.08 | <5 | 0.2 | <0.02 | 17.7 | 1.63 | 0.4 | 0.09 | 0.32 | 7.5 | 1.1 | <0.05 | 6.2 | 25.53 | 72.5 | 0.08 | <1 | 0.9 | 63.3 | <10 | <2 |
| 8248 | 0.05 | <0.1 | 8.6 | <0.02 | <0.02 | <5 | 0.3 | <0.02 | 20.0 | 0.43 | 0.3 | 0.12 | 0.16 | 1.8 | 0.7 | <0.05 | 5.3 | 17.04 | 57.9 | 0.10 | <1 | 1.0 | 96.1 | <10 | <2 |
| 8249 | 0.05 | <0.1 | 1.0 | <0.02 | 0.04 | <5 | 0.1 | 0.03 | 5.1 | 0.21 | <0.1 | 0.05 | 0.05 | 1.6 | 0.3 | <0.05 | 1.7 | 3.12 | 5.1 | 0.11 | <1 | 0.5 | 63.5 | <10 | <2 |
| 8250 | 0.08 | <0.1 | 12.1 | <0.02 | 0.03 | 82 | 0.5 | 0.03 | 17.9 | 0.30 | 0.2 | 0.02 | 0.03 | 3.4 | 0.7 | <0.05 | 2.6 | 35.24 | 80.8 | 0.16 | <1 | 0.7 | 127.0 | <10 | <2 |
| 8251 | 0.06 | <0.1 | 14.9 | <0.02 | 0.19 | 10 | 0.7 | <0.02 | 19.9 | 0.12 | 0.4 | 0.09 | 0.04 | 1.0 | 0.5 | <0.05 | 4.1 | 16.53 | 34.5 | 0.12 | 1 | 0.5 | 66.9 | <10 | <2 |
| 8252 | 0.21 | <0.1 | 2.2 | 0.05 | 0.06 | 1705 | 0.1 | <0.02 | 6.0 | 0.23 | <0.1 | 0.08 | <0.02 | 7.7 | 0.9 | <0.05 | 2.8 | 3.92 | 59.1 | 0.08 | <1 | 0.3 | 47.1 | <10 | <2 |
| 8253 | 0.18 | <0.1 | 2.2 | 0.04 | 0.51 | 1955 | 0.4 | <0.02 | 5.2 | 0.34 | 0.1 | 0.09 | <0.02 | 6.5 | 0.6 | <0.05 | 3.1 | 2.73 | 38.1 | 0.06 | 1 | 0.2 | 49.6 | <10 | <2 |
| 8254 | 0.29 | <0.1 | 3.9 | 0.07 | 0.09 | 589 | 0.2 | 0.02 | 6.2 | 0.57 | <0.1 | 0.12 | <0.02 | 11.6 | 0.8 | <0.05 | 4.6 | 6.70 | 60.4 | 0.03 | <1 | 0.9 | 58.5 | <10 | <2 |
| 8255 | 0.50 | <0.1 | 4.4 | 0.09 | <0.02 | <5 | 0.1 | <0.02 | 4.4 | 1.20 | 0.1 | 0.17 | 0.02 | 21.7 | 0.7 | <0.05 | 6.3 | 8.23 | 81.5 | 0.04 | <1 | 2.1 | 26.8 | <10 | <2 |
| 8256 | 0.44 | <0.1 | 4.9 | 0.37 | 0.04 | 20 | 0.1 | <0.02 | 6.5 | 2.38 | <0.1 | 0.26 | <0.02 | 23.9 | 0.7 | <0.05 | 9.7 | 12.12 | 48.7 | 0.05 | <1 | 0.9 | 90.1 | <10 | <2 |
| 8257 | 0.81 | 0.2 | 4.1 | 0.19 | 0.09 | <5 | 0.3 | 0.03 | 11.6 | 2.72 | 0.4 | 0.49 | 0.28 | 40.6 | 0.9 | <0.05 | 19.2 | 12.44 | 55.2 | 0.03 | <1 | 0.7 | 55.6 | <10 | <2 |
| 8258 | 0.45 | 0.2 | 5.1 | 0.12 | 0.03 | <5 | 0.3 | <0.02 | 12.0 | 3.27 | 0.3 | 0.52 | 0.21 | 30.1 | 0.9 | <0.05 | 19.2 | 12.85 | 54.7 | 0.02 | <1 | 0.8 | 69.5 | <10 | <2 |
| 8259 | 0.02 | <0.1 | 0.7 | <0.02 | <0.02 | <5 | 0.1 | 0.03 | 6.2 | 0.39 | 0.2 | 0.20 | 0.07 | 0.4 | 0.6 | <0.05 | 9.4 | 10.84 | 26.8 | <0.02 | 2 | 0.3 | 49.7 | <10 | <2 |
| 8260 | 0.11 | 0.1 | 2.8 | <0.02 | 0.13 | <5 | 0.2 | <0.02 | 12.4 | 1.46 | 0.3 | 0.30 | 0.16 | 6.0 | 0.5 | <0.05 | 12.0 | 12.24 | 56.0 | 0.02 | 1 | 0.4 | 53.2 | <10 | <2 |
| 8261 | 0.13 | <0.1 | 2.6 | <0.02 | 0.06 | <5 | 0.2 | <0.02 | 11.0 | 0.40 | 0.1 | 0.14 | 0.11 | 6.9 | 0.5 | <0.05 | 6.9 | 10.06 | 44.5 | <0.02 | <1 | 0.1 | 42.4 | <10 | 3 |
| 8262 | 0.08 | 0.1 | 2.1 | <0.02 | 0.12 | <5 | 0.4 | <0.02 | 12.4 | 0.15 | 0.2 | 0.17 | 0.15 | 3.2 | 0.6 | <0.05 | 8.0 | 12.32 | 56.3 | <0.02 | <1 | 0.1 | 27.7 | <10 | <2 |
| 8263 | 0.32 | <0.1 | 2.6 | 0.15 | 0.03 | <5 | 0.1 | <0.02 | 4.8 | 1.40 | <0.1 | 0.15 | <0.02 | 16.5 | 0.5 | <0.05 | 4.5 | 4.72 | 52.0 | 0.03 | <1 | 0.4 | 58.8 | <10 | <2 |
| 8264 | 0.07 | <0.1 | 0.5 | 0.62 | 0.17 | 23 | 0.1 | <0.02 | 1.0 | 0.09 | <0.1 | 0.05 | <0.02 | 1.8 | <0.1 | <0.05 | 1.4 | 2.41 | 7.5 | 0.04 | 7 | <0.1 | 5.5 | <10 | <2 |
| 8265 | 0.12 | <0.1 | 1.1 | 1.05 | 0.16 | 171 | 2.5 | 0.31 | 1.9 | 0.26 | <0.1 | 0.08 | 0.06 | 4.0 | 0.5 | <0.05 | 2.3 | 2.32 | 15.5 | 0.07 | 6 | 0.2 | 5.6 | <10 | <2 |
| 8266 | 0.08 | <0.1 | 0.4 | <0.02 | 0.03 | 23 | 0.8 | 0.05 | 0.4 | 0.09 | <0.1 | 0.09 | 0.03 | 2.4 | 0.2 | <0.05 | 3.9 | 3.84 | 4.0 | <0.02 | <1 | <0.1 | 1.1 | <10 | <2 |
| 8267 | 0.08 | <0.1 | 0.3 | <0.02 | 0.06 | 13 | 0.6 | <0.02 | 0.4 | 0.08 | <0.1 | 0.07 | 0.02 | 2.3 | <0.1 | <0.05 | 2.5 | 2.10 | 3.6 | <0.02 | <1 | <0.1 | 0.8 | <10 | <2 |
| 8268 | 0.14 | <0.1 | 9.3 | 0.37 | 0.71 | 43 | 1.0 | <0.02 | 14.7 | 0.13 | <0.1 | 0.05 | <0.02 | 4.0 | 0.4 | <0.05 | 2.3 | 17.72 | 51.9 | 0.08 | <1 | 0.4 | 100.1 | <10 | <2 |
| 8269 | 0.05 | <0.1 | 2.4 | <0.02 | 0.21 | <5 | 0.3 | <0.02 | 17.3 | 0.16 | 0.2 | 0.36 | 0.30 | 1.8 | 0.5 | <0.05 | 14.4 | 11.51 | 60.4 | 0.02 | 2 | 0.3 | 62.1 | <10 | <2 |
| 8270 | 0.27 | 0.1 | 2.8 | 0.05 | <0.02 | <5 | <0.1 | <0.02 | 4.7 | 0.28 | <0.1 | 0.22 | 0.17 | 9.7 | 0.9 | <0.05 | 5.9 | 9.09 | 32.2 | <0.02 | <1 | 0.4 | 27.8 | <10 | <2 |
| 8271 | 0.14 | <0.1 | 0.9 | 0.02 | <0.02 | <5 | <0.1 | <0.02 | 4.2 | 0.18 | <0.1 | 0.12 | 0.02 | 4.7 | 0.2 | <0.05 | 4.1 | 8.53 | 35.5 | <0.02 | <1 | 0.7 | 21.2 | <10 | <2 |
| 8272 | 0.08 | <0.1 | 3.4 | <0.02 | 0.05 | <5 | 0.1 | <0.02 | 13.0 | 0.25 | 0.1 | 0.12 | 0.17 | 4.0 | 0.4 | <0.05 | 5.0 | 10.20 | 53.6 | 0.03 | <1 | 0.3 | 29.0 | <10 | <2 |
| 8273 | 0.05 | <0.1 | 2.5 | <0.02 | 0.14 | <5 | 0.3 | <0.02 | 13.8 | 0.13 | 0.1 | 0.16 | 0.21 | 1.4 | 0.5 | <0.05 | 7.5 | 10.33 | 50.7 | <0.02 | <1 | 0.4 | 55.5 | <10 | <2 |
| 8274 | 0.04 | <0.1 | 2.3 | <0.02 | 0.06 | <5 | 0.3 | <0.02 | 14.1 | 0.14 | 0.2 | 0.12 | 0.17 | 1.1 | 0.5 | <0.05 | 6.0 | 10.08 | 48.5 | <0.02 | <1 | 0.7 | 51.4 | <10 | <2 |
| 8275 | 0.26 | <0.1 | 6.6 | 0.14 | 0.16 | <5 | 0.5 | <0.02 | 9.7 | 3.76 | 0.3 | 0.17 | 0.02 | 20.2 | 0.5 | <0.05 | 9.6 | 9.16 | 41.6 | 0.03 | 2 | 0.8 | 73.0 | <10 | 9 |
| 8276 | 0.21 | <0.1 | 2.8 | 0.04 | <0.02 | 5 | <0.1 | <0.02 | 7.4 | 0.76 | <0.1 | 0.10 | <0.02 | 6.8 | 0.3 | <0.05 | 4.6 | 10.92 | 50.4 | 0.03 | <1 | 0.5 | 37.7 | <10 | <2 |
| 8277 | 0.04 | <0.1 | 3.5 | <0.02 | <0.02 | <5 | 0.2 | <0.02 | 7.2 | 0.56 | 0.2 | 0.16 | 0.08 | 1.7 | 0.4 | <0.05 | 5.6 | 7.63 | 33.5 | 0.02 | <1 | 0.5 | 53.9 | <10 | <2 |

| Element | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd | Sb | Bi | V | Ca | P | La | Cr | Mg | Ba | Ti | B | Al | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 |
| Units | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppm | % | ppm | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm | ppm | % | ppm | % | ppm | % | % |
| MDL | 0.01 | 0.01 | 0.01 | 0.1 | 2 | 0.1 | 0.1 | 1 | 0.01 | 0.1 | 0.1 | 0.2 | 0.1 | 0.5 | 0.01 | 0.02 | 0.02 | 2 | 0.01 | 0.001 | 0.5 | 0.5 | 0.01 | 0.5 | 0.001 | 20 | 0.01 | 0.001 |
| RPD % | 15.6 | 7.3 | 13.6 | 12.4 | 8.2 | 7.9 | 10.9 | 6.7 | 3.0 | 17.2 | 6.5 | 20.4 | 6.8 | 9.9 | 27.7 | 12.8 | 13.4 | 6.0 | 13.0 | 8.9 | 4.7 | 9.6 | 6.4 | 12.1 | 14.5 | 12.5 | 6.9 | 12.5 |
| RPD count | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 10 | 27 | 27 | 27 | 25 | 27 | 26 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 4 | 27 | 27 |
| APR % | 50.3 | 100.6 | 95.9 | 60.0 | 27.4 | 31.3 | 34.1 | 26.3 | 38.0 | 75.3 | 65.0 | 77.5 | 64.8 | 22.8 | 42.9 | 37.8 | 7.7 | 50.9 | 20.1 | 115.4 | 75.0 | 16.2 | 17.9 | 17.3 | 20.7 | <MDL | 28.9 | 21.0 |
| APR error % | 49.2 | 12.3 | 20.7 | 17.6 | 16.2 | 11.5 | 14.0 | 12.5 | 3.8 | 53.8 | 27.6 | 27.3 | 16.3 | 26.6 | 39.3 | 92.4 | 13.2 | 14.4 | 30.0 | 34.8 | 19.3 | 13.6 | 13.6 | 9.6 | 11.1 | | 27.0 | 20.3 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8278 | 0.36 | 177.59 | 5.27 | 58.8 | 96 | 201.6 | 43.3 | 331 | 5.66 | 9.5 | 0.2 | 2.2 | 1.9 | 49.6 | 0.12 | 0.08 | 0.06 | 150 | 1.81 | 0.130 | 17.7 | 366.7 | 3.42 | 228.1 | 0.239 | <20 | 2.00 | 0.046 |
| 8279 | 0.82 | 155.92 | 11.60 | 89.4 | 130 | 192.3 | 53.9 | 850 | 7.92 | 38.4 | 0.2 | 1.7 | 1.5 | 74.4 | 0.09 | 0.14 | 0.10 | 230 | 3.89 | 0.147 | 22.8 | 444.8 | 4.53 | 186.6 | 0.427 | <20 | 3.10 | 0.022 |
| 8280 | 0.17 | 135.38 | 32.18 | 30.9 | 101 | 18.9 | 2.0 | 383 | 1.88 | 1.7 | 1.7 | <0.2 | 13.2 | 19.7 | 0.04 | 0.10 | 0.29 | 19 | 0.82 | 0.017 | 20.1 | 20.6 | 2.06 | 232.3 | 0.020 | <20 | 2.05 | 0.017 |
| 8281 | 3.20 | 20.66 | 77.70 | 34.8 | 77 | 5.8 | 8.1 | 345 | 1.24 | 3.9 | 0.5 | <0.2 | 4.5 | 9.6 | 0.12 | 0.14 | 0.24 | 5 | 0.08 | 0.032 | 25.2 | 3.7 | 0.09 | 265.3 | 0.003 | <20 | 0.49 | 0.008 |
| 8282 | 0.18 | 7.28 | 18.15 | 63.8 | 28 | 2.5 | 7.6 | 1276 | 3.18 | 3.0 | 0.9 | 2.0 | 2.5 | 97.8 | 0.19 | 0.07 | 0.10 | 27 | 3.66 | 0.126 | 18.1 | 1.4 | 0.23 | 1735.4 | 0.001 | <20 | 0.42 | 0.034 |
| 8283 | 0.04 | 10.71 | 14.03 | 67.0 | 37 | 2.1 | 6.9 | 1211 | 2.95 | 1.2 | 1.2 | 0.7 | 3.1 | 182.8 | 0.12 | 0.04 | 0.15 | 17 | 3.35 | 0.115 | 28.5 | 1.3 | 0.94 | 1621.2 | 0.002 | <20 | 0.37 | 0.047 |
| 8284 | 1.16 | 17.52 | 60.63 | 40.8 | 206 | 9.8 | 13.6 | 547 | 1.61 | 14.7 | 0.3 | 0.4 | 3.0 | 32.9 | 0.15 | 0.09 | 0.95 | 4 | 0.91 | 0.033 | 20.3 | 2.7 | 0.37 | 1755.0 | 0.001 | <20 | 0.43 | 0.009 |
| 8285 | 0.24 | 6.59 | 15.75 | 77.7 | 14 | 6.5 | 6.4 | 1154 | 3.24 | 1.6 | 0.5 | <0.2 | 3.3 | 78.8 | 0.30 | 0.04 | 0.08 | 24 | 2.14 | 0.126 | 38.6 | 1.2 | 0.67 | 1363.6 | 0.001 | <20 | 0.52 | 0.037 |
| 8286 | 0.35 | 705.97 | 208.59 | 41.0 | 731 | 9.3 | 5.8 | 675 | 1.68 | 2.3 | 0.5 | 0.4 | 2.5 | 522.1 | 0.05 | 0.33 | 2.53 | 16 | 1.89 | 0.043 | 14.7 | 10.9 | 1.60 | 1506.7 | 0.005 | <20 | 1.56 | 0.016 |
| 8287 | 0.30 | 221.70 | >10000 | >10000 | 30274 | 14.2 | 31.5 | 1365 | 4.69 | 5.9 | 0.3 | <0.2 | 0.2 | 84.1 | 392.98 | 7.93 | 0.25 | <2 | 14.07 | 0.003 | 1.3 | 1.5 | 7.80 | 8.9 | <0.001 | <20 | 0.01 | 0.008 |
| 8288 | 0.60 | 17.25 | 78.76 | 630.7 | 838 | 1.7 | 1.4 | 1342 | 1.18 | 1.9 | 0.2 | <0.2 | 0.3 | 162.0 | 5.65 | 0.26 | <0.02 | <2 | 24.28 | 0.002 | 2.2 | 1.9 | 9.97 | 12.7 | <0.001 | <20 | 0.01 | 0.014 |
| 8289 | 0.11 | 40.10 | 16.23 | 9728.1 | 2693 | 2.5 | 4.2 | 1375 | 0.99 | 0.8 | 0.1 | <0.2 | 0.2 | 160.4 | 23.26 | 0.09 | <0.02 | <2 | 23.80 | 0.002 | 1.2 | 0.9 | 10.06 | 6.7 | <0.001 | <20 | <0.01 | 0.017 |
| 8290 | 0.23 | 172.22 | >10000 | >10000 | 59698 | 5.8 | 18.6 | 1293 | 2.53 | 4.0 | 0.3 | <0.2 | 0.3 | 79.8 | 241.22 | 8.04 | 0.04 | 2 | 15.10 | 0.003 | 1.4 | 2.3 | 8.28 | 4.7 | <0.001 | <20 | 0.02 | 0.013 |
| 8291 | 0.21 | 69.28 | >10000 | >10000 | 29059 | 4.9 | 12.9 | 1234 | 1.87 | 3.0 | 0.3 | <0.2 | 0.3 | 85.5 | 95.95 | 12.36 | 0.04 | 2 | 14.42 | 0.003 | 1.3 | 2.2 | 8.11 | 8.7 | <0.001 | <20 | 0.02 | 0.013 |
| 8292 | 1.16 | 85.63 | 118.00 | 68.7 | 353 | 6.6 | 3.5 | 53 | 2.08 | 6.2 | 0.4 | <0.2 | 3.8 | 5.6 | 0.12 | 0.14 | 0.33 | 9 | 0.06 | 0.016 | 23.6 | 11.1 | 0.75 | 194.0 | 0.003 | <20 | 1.07 | 0.002 |
| 8293 | 1.25 | 1791.13 | 6005.88 | 359.9 | 1773 | 40.4 | 18.4 | 1589 | 7.42 | 25.2 | 0.2 | <0.2 | 1.0 | 47.3 | 0.44 | 0.03 | 5.25 | 132 | 3.57 | 0.304 | 23.8 | 39.8 | 7.99 | 843.8 | 0.018 | <20 | 6.17 | 0.014 |
| 8294 | 31.99 | 5.52 | 18.64 | 29.2 | 402 | 58.3 | 0.3 | 14 | 0.37 | 9.8 | 7.6 | <0.2 | 2.8 | 9.8 | 0.33 | 10.74 | 0.17 | 579 | 0.19 | 0.010 | 5.2 | 13.5 | 0.11 | 31.2 | 0.002 | <20 | 0.33 | 0.006 |
| 8295 | 50.87 | 10.35 | 27.26 | 48.3 | 279 | 79.6 | 1.3 | 11 | 0.53 | 12.8 | 4.8 | 0.6 | 2.1 | 3.9 | 0.15 | 10.22 | 0.19 | 395 | 0.09 | 0.010 | 6.2 | 10.5 | 0.07 | 17.7 | 0.002 | <20 | 0.31 | 0.006 |
| 8296 | 94.95 | 136.67 | 26.39 | 3536.4 | 164 | 1326.7 | 84.8 | 421 | 3.69 | 79.6 | 74.9 | 0.7 | 7.6 | 78.4 | 49.53 | 7.74 | 0.26 | 42 | 3.34 | 0.650 | 32.9 | 13.7 | 0.27 | 28.8 | 0.005 | <20 | 2.16 | 0.011 |
| 8297 | 12.32 | 27.00 | 50.74 | 588.9 | 118 | 102.0 | 2.1 | 6 | 2.44 | 21.8 | 13.1 | 2.1 | 7.5 | 68.4 | 4.91 | 1.56 | 1.22 | 22 | 0.33 | 0.073 | 11.2 | 1.1 | 0.23 | 80.4 | <0.001 | <20 | 1.00 | 0.012 |
| 8298 | 0.49 | 185.60 | 9.43 | 11.8 | 69 | 7.0 | 2.5 | 167 | 0.59 | 3.5 | 0.2 | <0.2 | 0.5 | 5.4 | 0.03 | 0.06 | 0.39 | 23 | 1.22 | 0.002 | 1.9 | 8.8 | 0.50 | 11.1 | 0.001 | <20 | 0.33 | 0.007 |
| 8299 | 1.90 | 74.33 | 38.87 | 118.5 | 73 | 44.0 | 44.3 | 464 | 7.43 | 34.1 | 0.3 | 1.3 | 1.9 | 68.1 | 0.19 | 0.07 | 0.10 | 140 | 2.41 | 0.342 | 41.7 | 42.7 | 2.47 | 198.8 | 0.183 | <20 | 2.69 | 0.243 |
| 8300 | 1.38 | 80.36 | 11.85 | 136.2 | 35 | 62.1 | 34.2 | 762 | 7.92 | 2.6 | 0.3 | <0.2 | 2.1 | 50.9 | 0.13 | 0.03 | 0.04 | 88 | 1.53 | 0.336 | 35.6 | 44.7 | 2.04 | 209.1 | 0.254 | 20 | 2.74 | 0.162 |
| 8301 | 1.40 | 75.18 | 8.82 | 127.4 | 38 | 47.9 | 39.4 | 632 | 8.28 | 1.0 | 0.3 | <0.2 | 1.9 | 69.4 | 0.16 | 0.03 | 0.06 | 106 | 1.50 | 0.313 | 35.7 | 40.2 | 1.78 | 168.5 | 0.190 | <20 | 2.56 | 0.248 |
| 8302 | 0.33 | 123.62 | 1975.23 | 2023.0 | 781 | 6.9 | 2.1 | 49 | 1.58 | 12.4 | 0.6 | <0.2 | 4.4 | 3.1 | 11.48 | 0.44 | 0.39 | 19 | 0.06 | 0.050 | 17.9 | 23.8 | 1.05 | 89.8 | 0.004 | <20 | 1.16 | 0.010 |
| 8303 | 0.27 | 138.70 | 1573.97 | 5088.2 | 757 | 6.1 | 1.8 | 43 | 1.61 | 12.1 | 0.6 | <0.2 | 4.6 | 3.4 | 29.56 | 0.46 | 0.39 | 19 | 0.06 | 0.050 | 18.3 | 22.3 | 1.13 | 92.6 | 0.003 | <20 | 1.20 | 0.007 |
| 8304 | 107.48 | 141.29 | 23.79 | 3334.2 | 137 | 1453.9 | 85.5 | 322 | 3.82 | 81.5 | 74.7 | 0.3 | 7.4 | 69.1 | 42.56 | 11.32 | 0.22 | 38 | 2.63 | 0.826 | 34.1 | 12.1 | 0.20 | 26.5 | 0.005 | <20 | 2.06 | 0.014 |
| 8305 | 107.89 | 144.85 | 36.28 | 3480.0 | 158 | 1397.7 | 96.2 | 412 | 3.64 | 75.6 | 67.0 | <0.2 | 7.0 | 61.8 | 48.38 | 10.88 | 0.26 | 35 | 2.58 | 0.721 | 31.3 | 10.5 | 0.19 | 26.1 | 0.004 | <20 | 1.87 | 0.011 |
| 8306 | 0.91 | 338.20 | 15.96 | 99.1 | 142 | 29.4 | 16.9 | 418 | 4.01 | 2.7 | 0.6 | 5.2 | 1.8 | 47.4 | 0.18 | 0.50 | 0.06 | 256 | 1.38 | 0.098 | 13.8 | 40.7 | 0.63 | 42.7 | 0.290 | <20 | 2.03 | 0.354 |
| 8307 | 0.89 | 344.78 | 16.91 | 96.0 | 136 | 29.2 | 15.9 | 416 | 3.94 | 1.4 | 0.6 | 5.3 | 1.6 | 47.7 | 0.21 | 0.54 | 0.06 | 250 | 1.32 | 0.100 | 13.6 | 37.5 | 0.62 | 42.1 | 0.285 | <20 | 1.97 | 0.334 |
| 8308 | 0.86 | 337.87 | 16.09 | 98.9 | 136 | 30.1 | 16.6 | 428 | 3.98 | 1.5 | 0.6 | 4.5 | 1.7 | 48.4 | 0.19 | 0.52 | 0.06 | 253 | 1.32 | 0.099 | 13.2 | 38.7 | 0.62 | 42.5 | 0.288 | <20 | 2.00 | 0.340 |

| Element | K | W | Sc | Tl | S | Hg | Se | Te | Ga | Cs | Ge | Hf | Nb | Rb | Sn | Ta | Zr | Y | Ce | In | Re | Be | Li | Pd | Pt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 | 1F04 |
| Units | % | ppm | ppm | ppm | % | ppb | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppb | ppm | ppm | ppb | ppb |
| MDL | 0.01 | 0.1 | 0.1 | 0.02 | 0.02 | 5 | 0.1 | 0.02 | 0.1 | 0.02 | 0.1 | 0.02 | 0.02 | 0.1 | 0.1 | 0.05 | 0.1 | 0.01 | 0.1 | 0.02 | 1 | 0.1 | 0.1 | 10 | 2 |
| RPD % | 8.7 | 33.3 | 5.2 | 5.2 | 8.6 | 35.0 | 29.4 | 45.2 | 6.1 | 10.3 | 19.2 | 29.4 | 8.5 | 11.3 | 29.3 | <MDL | 12.8 | 3.4 | 4.4 | 34.3 | 18.2 | 19.4 | 7.3 | 24.5 | 45.0 |
| RPD count | 27 | 2 | 27 | 15 | 24 | 13 | 27 | 8 | 27 | 27 | 16 | 27 | 16 | 27 | 26 | 27 | 27 | 27 | 27 | 20 | 7 | 22 | 27 | 7 | 4 |
| APR % | 29.2 | <MDL | 9.2 | NA | 100.0 | NA | 59.5 | 17.5 | 37.5 | NA | 12.0 | 4.1 | 0.3 | 53.8 | 54.2 | <MDL | 4.7 | 35.3 | 63.9 | 14.2 | NA | 11.7 | 71.6 | 91.5 | <MDL |
| APR error % | 14.2 | | 21.2 | | 0.0 | | 36.1 | 84.3 | 12.2 | | 74.5 | 69.9 | 28.0 | 40.8 | 51.9 | | 70.8 | 17.7 | 15.8 | 53.1 | | 109.4 | 30.3 | 43.1 | |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8278 | 0.05 | <0.1 | 5.7 | <0.02 | 0.11 | 6 | 0.5 | 0.04 | 11.0 | 1.22 | 0.2 | 0.31 | 0.08 | 2.0 | 0.6 | <0.05 | 9.8 | 10.81 | 37.0 | 0.03 | <1 | 0.5 | 50.8 | <10 | <2 |
| 8279 | 0.03 | <0.1 | 10.2 | <0.02 | 0.27 | <5 | 0.7 | <0.02 | 16.5 | 2.43 | 0.4 | 0.52 | 0.14 | 1.4 | 0.8 | <0.05 | 19.4 | 13.39 | 51.2 | 0.06 | 3 | 0.9 | 77.0 | <10 | 9 |
| 8280 | 0.59 | <0.1 | 4.3 | 0.13 | <0.02 | <5 | 0.2 | <0.02 | 9.1 | 3.57 | <0.1 | 0.17 | 0.03 | 24.2 | 1.9 | <0.05 | 5.4 | 14.84 | 45.9 | 0.02 | <1 | 1.5 | 65.0 | <10 | <2 |
| 8281 | 0.35 | <0.1 | 2.2 | 0.15 | <0.02 | 9 | 0.1 | <0.02 | 1.5 | 1.52 | <0.1 | 0.06 | <0.02 | 11.5 | 0.3 | <0.05 | 4.2 | 4.38 | 51.6 | <0.02 | 2 | 1.3 | 5.7 | <10 | <2 |
| 8282 | 0.29 | <0.1 | 6.6 | 0.07 | 0.05 | <5 | 0.2 | <0.02 | 1.2 | 2.44 | <0.1 | 0.07 | <0.02 | 9.7 | <0.1 | <0.05 | 5.1 | 8.45 | 37.9 | 0.06 | <1 | 0.9 | 0.9 | <10 | <2 |
| 8283 | 0.35 | <0.1 | 5.8 | 0.08 | 0.05 | <5 | 0.3 | <0.02 | 1.4 | 2.27 | <0.1 | 0.04 | <0.02 | 12.0 | <0.1 | <0.05 | 4.3 | 8.06 | 54.4 | 0.05 | <1 | 0.6 | 1.2 | <10 | <2 |
| 8284 | 0.33 | <0.1 | 2.5 | 0.17 | 0.17 | <5 | 0.4 | 0.02 | 1.3 | 1.07 | <0.1 | 0.06 | <0.02 | 10.8 | 0.3 | <0.05 | 2.9 | 11.41 | 37.6 | <0.02 | <1 | 1.1 | 2.4 | <10 | <2 |
| 8285 | 0.30 | <0.1 | 6.5 | 0.08 | 0.04 | <5 | 0.2 | <0.02 | 1.6 | 2.98 | <0.1 | 0.03 | <0.02 | 9.2 | <0.1 | <0.05 | 2.1 | 21.92 | 60.3 | 0.06 | <1 | 1.1 | 0.9 | <10 | <2 |
| 8286 | 0.32 | <0.1 | 3.1 | 0.07 | 0.09 | 20 | 1.4 | 0.08 | 6.3 | 0.83 | <0.1 | 0.23 | <0.02 | 12.2 | 0.7 | <0.05 | 9.2 | 15.84 | 27.3 | 0.07 | <1 | 1.0 | 45.3 | <10 | <2 |
| 8287 | <0.01 | 0.2 | 0.2 | 0.23 | 3.59 | 4368 | 6.4 | <0.02 | 24.0 | 0.02 | 61.0 | <0.02 | <0.02 | 0.1 | 5.0 | <0.05 | 0.5 | 1.34 | 1.9 | 0.50 | 1 | 0.3 | 0.2 | - | <2 |
| 8288 | <0.01 | 0.8 | 0.3 | <0.02 | 0.09 | 69 | 0.4 | <0.02 | 1.0 | <0.02 | <0.1 | <0.02 | <0.02 | 0.1 | 0.2 | <0.05 | 0.4 | 2.37 | 3.2 | <0.02 | <1 | 0.4 | 0.3 | <10 | <2 |
| 8289 | <0.01 | 0.1 | 0.2 | 0.02 | 0.27 | 177 | 0.9 | <0.02 | 4.2 | <0.02 | 0.5 | <0.02 | <0.02 | 0.1 | 0.5 | <0.05 | 0.2 | 1.62 | 1.8 | 0.03 | <1 | 0.4 | 0.2 | 26 | <2 |
| 8290 | <0.01 | 0.5 | 0.4 | 0.20 | 5.19 | 1566 | 4.7 | <0.02 | 22.5 | 0.03 | 64.6 | 0.04 | <0.02 | 0.2 | 2.7 | <0.05 | 0.8 | 1.36 | 2.0 | 0.17 | <1 | 0.2 | 0.3 | - | <2 |
| 8291 | <0.01 | 0.9 | 0.4 | 0.19 | 4.02 | 669 | 3.0 | <0.02 | 9.2 | 0.02 | 18.2 | 0.02 | <0.02 | 0.2 | 1.7 | <0.05 | 0.9 | 1.30 | 1.9 | 0.07 | <1 | 0.5 | 0.5 | - | <2 |
| 8292 | 0.29 | <0.1 | 2.1 | 0.10 | 0.04 | 34 | 0.1 | <0.02 | 3.4 | 0.74 | <0.1 | 0.11 | <0.02 | 11.2 | 0.4 | <0.05 | 3.6 | 2.48 | 44.7 | <0.02 | <1 | 0.6 | 24.8 | <10 | <2 |
| 8293 | 0.11 | <0.1 | 14.4 | <0.02 | 0.18 | 5 | 0.6 | <0.02 | 20.5 | 2.00 | 0.1 | 0.04 | <0.02 | 4.5 | 0.8 | <0.05 | 0.9 | 24.59 | 52.4 | 0.18 | <1 | 2.5 | 291.3 | <10 | <2 |
| 8294 | 0.27 | <0.1 | 1.2 | 0.84 | 0.25 | 98 | 16.5 | 0.13 | 1.5 | 0.57 | <0.1 | 0.18 | 0.05 | 12.4 | 0.5 | <0.05 | 7.9 | 5.08 | 9.9 | <0.02 | 182 | 0.2 | 3.5 | <10 | <2 |
| 8295 | 0.23 | <0.1 | 1.0 | 1.12 | 0.15 | 101 | 13.4 | 0.13 | 1.3 | 0.46 | <0.1 | 0.16 | 0.05 | 9.6 | 0.3 | <0.05 | 7.7 | 2.22 | 10.8 | <0.02 | 155 | 0.3 | 4.0 | <10 | <2 |
| 8296 | 0.75 | <0.1 | 7.0 | 4.13 | 0.08 | 221 | 9.6 | 0.08 | 4.5 | 1.15 | 0.1 | 0.02 | 0.08 | 27.8 | 1.2 | <0.05 | 2.4 | 94.93 | 52.6 | 0.02 | 34 | 4.3 | 20.1 | <10 | <2 |
| 8297 | 0.71 | <0.1 | 1.9 | 13.11 | 0.54 | 300 | 10.5 | 0.18 | 2.5 | 0.20 | <0.1 | 0.13 | 0.02 | 13.1 | 2.4 | <0.05 | 6.7 | 58.75 | 24.6 | 0.06 | 10 | 1.4 | 10.3 | <10 | <2 |
| 8298 | <0.01 | <0.1 | 0.5 | <0.02 | <0.02 | <5 | <0.1 | 0.05 | 2.4 | 0.03 | <0.1 | <0.02 | <0.02 | 0.2 | <0.1 | <0.05 | 0.5 | 1.61 | 4.2 | 0.03 | <1 | <0.1 | 9.8 | <10 | <2 |
| 8299 | 0.80 | <0.1 | 13.3 | 0.13 | 0.06 | 6 | 0.5 | 0.03 | 13.9 | 2.52 | 0.3 | 0.12 | 0.15 | 46.5 | 1.1 | <0.05 | 6.7 | 26.50 | 79.1 | 0.09 | 2 | 0.4 | 46.3 | <10 | <2 |
| 8300 | 0.47 | <0.1 | 2.9 | 0.09 | 0.06 | <5 | 0.4 | <0.02 | 13.0 | 3.99 | 0.2 | 0.09 | 0.30 | 29.8 | 0.7 | <0.05 | 7.0 | 21.68 | 65.3 | 0.05 | <1 | 0.5 | 39.5 | <10 | <2 |
| 8301 | 0.60 | <0.1 | 3.4 | 0.15 | 0.09 | 5 | 0.3 | 0.03 | 11.4 | 3.35 | 0.2 | 0.12 | 0.21 | 39.6 | 0.9 | <0.05 | 7.9 | 21.85 | 63.9 | 0.04 | <1 | 0.4 | 32.0 | <10 | <2 |
| 8302 | 0.21 | <0.1 | 2.3 | 0.04 | 0.45 | 1552 | 0.4 | <0.02 | 5.0 | 0.39 | <0.1 | 0.09 | 0.03 | 9.8 | 0.6 | <0.05 | 3.3 | 2.71 | 35.4 | 0.03 | <1 | 0.4 | 50.5 | <10 | <2 |
| 8303 | 0.21 | <0.1 | 2.3 | 0.04 | 0.51 | 3534 | 0.4 | 0.03 | 5.0 | 0.37 | <0.1 | 0.08 | <0.02 | 9.1 | 0.7 | <0.05 | 2.8 | 2.70 | 35.6 | 0.08 | <1 | 0.3 | 55.2 | <10 | <2 |
| 8304 | 0.64 | <0.1 | 7.4 | 3.92 | 0.08 | 208 | 9.5 | 0.06 | 3.9 | 1.14 | 0.2 | 0.06 | 0.07 | 31.3 | 0.9 | <0.05 | 2.6 | 99.11 | 52.1 | <0.02 | 40 | 4.4 | 18.2 | <10 | <2 |
| 8305 | 0.58 | <0.1 | 6.9 | 3.79 | 0.08 | 196 | 9.4 | 0.08 | 3.5 | 1.03 | 0.2 | 0.03 | 0.07 | 27.0 | 15.4 | <0.05 | 2.4 | 98.90 | 49.2 | <0.02 | 40 | 3.7 | 14.3 | <10 | <2 |
| 8306 | 0.23 | <0.1 | 3.1 | 0.02 | 0.03 | 26 | 0.5 | 0.02 | 8.0 | 0.56 | 0.1 | 0.26 | 0.03 | 14.3 | 1.1 | <0.05 | 9.2 | 13.20 | 27.3 | 0.03 | 2 | 0.1 | 11.2 | 25 | <2 |
| 8307 | 0.23 | <0.1 | 3.0 | <0.02 | 0.03 | 15 | 0.5 | 0.03 | 7.6 | 0.45 | 0.1 | 0.27 | 0.04 | 14.4 | 1.1 | <0.05 | 9.7 | 13.02 | 26.9 | 0.02 | <1 | <0.1 | 10.4 | 17 | <2 |
| 8308 | 0.23 | <0.1 | 3.0 | <0.02 | 0.03 | 15 | 0.4 | <0.02 | 7.8 | 0.41 | 0.1 | 0.24 | 0.03 | 14.9 | 1.1 | <0.05 | 9.8 | 13.17 | 27.4 | 0.03 | 1 | 0.1 | 11.3 | 15 | <2 |

Appendix 4E

| Element | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd | Sb | Bi | V | Ca | P | La | Cr | Mg | Ba | Ti | Al | Na | K | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm | ppm | % | ppm | % | % | % | % | ppm |
| MDL | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 0.1 | 0.2 | 1 | 0.01 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.01 | 0.001 | 0.1 | 1 | 0.01 | 1 | 0.001 | 0.01 | 0.001 | 0.01 | 0.1 |
| RPD % | 28.1 | 6.4 | 11.5 | 11.1 | 23.2 | 6.8 | 10.8 | 4.8 | 2.3 | 29.4 | 11.6 | <MDL | 4.8 | 4.4 | 23.9 | 6.6 | 21.5 | 2.3 | 10.3 | 5.0 | 6.9 | 5.7 | 2.0 | 6.0 | 3.7 | 4.5 | 5.2 | 10.1 | 21.4 |
| RPD count | 27 | 27 | 27 | 27 | 22 | 27 | 27 | 27 | 27 | 25 | 27 | 27 | 27 | 27 | 23 | 26 | 12 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| APR % | 68.8 | 103.4 | 97.8 | 98.2 | 40.0 | 100.3 | 99.8 | 101.6 | 92.0 | 120.0 | 88.6 | <MDL | 99.5 | 97.3 | 82.1 | 75.7 | <MDL | 103.7 | 102.3 | 124.3 | 98.4 | 80.4 | 97.1 | 98.3 | 110.4 | 102.1 | 99.2 | 97.8 | 52.4 |
| APR error % | 69.9 | 6.1 | 21.9 | 13.9 | 0.0 | 9.3 | 11.0 | 5.7 | 3.5 | 58.0 | 34.5 |  | 15.6 | 10.8 | 29.7 | 42.4 |  | 11.1 | 12.4 | 25.7 | 13.3 | 8.1 | 6.4 | 7.6 | 14.8 | 10.4 | 7.2 | 11.6 | 43.9 |
| Sample |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8175 | 51.2 | >10000 | 4.0 | 6 | 8.7 | 3.8 | 1.9 | 210 | 0.28 | 32 | 8.9 | <0.1 | 1.6 | 40 | <0.1 | <0.1 | 22.1 | 10 | 1.49 | 0.661 | 5.4 | 6 | 0.15 | 1528 | 0.018 | 0.31 | 0.027 | 0.17 | <0.1 |
| 8176 | 2.9 | 165.3 | 7.6 | 106 | 0.3 | 137.7 | 42.6 | 1326 | 8.03 | 11 | 0.9 | <0.1 | 4.1 | 433 | 0.3 | 0.2 | 0.2 | 329 | 5.84 | 0.205 | 35.3 | 241 | 4.02 | 350 | 2.547 | 5.66 | 2.257 | 0.89 | 0.6 |
| 8177 | 2.7 | 162.1 | 18.1 | 111 | <0.1 | 141.3 | 43.9 | 1544 | 8.44 | 19 | 1.3 | <0.1 | 4.8 | 583 | 0.3 | 0.2 | 0.2 | 359 | 5.39 | 0.212 | 36.0 | 234 | 3.94 | 501 | 3.099 | 6.16 | 1.738 | 0.93 | 0.6 |
| 8178 | 0.5 | 7.2 | 1.9 | 42 | 0.5 | 24.1 | 11.9 | 210 | 3.69 | 2 | 2.8 | <0.1 | 11.1 | 79 | 0.1 | 0.4 | 0.2 | 41 | 0.51 | 0.128 | 33.7 | 29 | 2.03 | 1050 | 0.219 | 6.56 | 0.233 | 2.82 | 0.9 |
| 8179 | 0.8 | 98.6 | 32.7 | 95 | 5.1 | 131.4 | 38.1 | 1142 | 7.79 | 21 | 1.1 | <0.1 | 3.4 | 1309 | 0.3 | 0.6 | 0.1 | 322 | 6.65 | 0.190 | 32.6 | 247 | 3.45 | 133 | 2.129 | 6.00 | 2.533 | 0.37 | 0.5 |
| 8180 | 0.3 | 2.3 | 3.2 | 27 | 0.2 | 10.5 | 2.1 | 471 | 1.49 | 3 | 0.6 | <0.1 | 2.3 | 19 | 0.2 | 0.7 | <0.1 | 7 | 0.43 | 0.020 | 19.6 | 11 | 0.88 | 494 | 0.055 | 1.78 | 0.036 | 0.60 | 0.3 |
| 8181 | 0.6 | 165.0 | 13.4 | 26 | 0.6 | 13.6 | 20.7 | 1355 | 4.93 | <1 | 0.6 | <0.1 | 2.0 | 18 | 0.1 | 0.2 | 0.2 | 16 | 0.25 | 0.016 | 8.2 | 12 | 1.05 | 61 | 0.049 | 1.49 | 0.024 | 0.21 | 0.1 |
| 8182 | 1.1 | 95.5 | 13.2 | 131 | 0.1 | 148.4 | 56.2 | 1664 | 8.61 | 57 | 0.5 | <0.1 | 3.0 | 301 | 0.3 | 0.5 | <0.1 | 303 | 5.65 | 0.142 | 31.2 | 220 | 4.89 | 514 | 1.808 | 5.24 | 1.647 | 1.00 | 0.3 |
| 8183 | 1.5 | 334.5 | 18.7 | 167 | 0.2 | 95.9 | 47.7 | 1596 | 9.42 | 4 | 1.1 | <0.1 | 2.7 | 222 | 0.3 | 0.7 | <0.1 | 463 | 6.67 | 0.100 | 17.1 | 199 | 3.42 | 243 | 1.482 | 7.02 | 1.746 | 0.80 | 0.3 |
| 8185 | 1.2 | 331.7 | 15.5 | 161 | 0.2 | 90.7 | 45.6 | 1596 | 9.56 | 4 | 0.9 | <0.1 | 2.5 | 225 | 0.3 | 0.8 | <0.1 | 459 | 6.61 | 0.093 | 15.7 | 204 | 3.39 | 225 | 1.451 | 6.71 | 1.647 | 0.75 | 0.4 |
| 8186 | 0.9 | 1726.0 | 8.9 | 52 | 0.1 | 16.9 | 5.8 | 110 | 2.36 | 9 | 2.8 | <0.1 | 10.1 | 36 | 0.1 | 1.0 | 0.2 | 59 | 0.19 | 0.057 | 37.8 | 30 | 2.38 | 665 | 0.288 | 7.18 | 0.540 | 3.86 | 1.9 |
| 8187 | 1.5 | 104.0 | 9.8 | 125 | 0.2 | 128.2 | 58.8 | 1362 | 9.06 | 18 | 0.7 | <0.1 | 3.7 | 290 | 0.3 | 0.4 | <0.1 | 318 | 5.50 | 0.162 | 32.6 | 266 | 4.61 | 721 | 1.953 | 5.65 | 2.296 | 0.51 | 0.7 |
| 8188 | 1.3 | 335.0 | 16.8 | 155 | 0.2 | 87.4 | 44.2 | 1605 | 9.42 | 3 | 0.9 | <0.1 | 2.5 | 227 | 0.3 | 0.8 | <0.1 | 467 | 6.65 | 0.099 | 16.8 | 189 | 3.46 | 236 | 1.401 | 6.97 | 1.667 | 0.78 | 0.2 |
| 8189 | 1.3 | 23.7 | 12.4 | 152 | <0.1 | 7.7 | 32.9 | 1514 | 8.23 | 22 | 0.6 | <0.1 | 4.2 | 346 | 0.5 | 0.4 | <0.1 | 245 | 3.09 | 0.257 | 50.5 | 4 | 2.14 | 951 | 1.881 | 7.55 | 3.296 | 1.98 | 0.5 |
| 8190 | 2.0 | 74.0 | 19.8 | 134 | 0.1 | 104.9 | 58.0 | 1393 | 9.16 | 35 | 0.7 | <0.1 | 4.4 | 361 | 0.3 | 0.6 | <0.1 | 323 | 5.81 | 0.186 | 38.8 | 133 | 3.75 | 347 | 2.039 | 6.08 | 2.022 | 0.90 | 0.5 |
| 8191 | 0.6 | 7.6 | 32.9 | 348 | <0.1 | 6.5 | 2.4 | 212 | 4.26 | 19 | 2.5 | <0.1 | 7.1 | 54 | 0.1 | 5.3 | <0.1 | 65 | 0.08 | 0.050 | 37.4 | 7 | 0.15 | 293 | 0.323 | 10.49 | 0.195 | >10 | 28.8 |
| 8192 | 1.1 | 5.1 | 91.4 | 61 | 4.5 | 4.3 | 1.9 | 98 | 2.12 | 95 | 3.0 | <0.1 | 27.6 | 95 | 0.2 | 9.5 | <0.1 | 98 | 0.04 | 0.039 | 54.7 | 18 | 0.06 | 128 | 0.439 | 1.61 | 0.030 | 1.49 | 49.8 |
| 8193 | 0.7 | 4.8 | 29.5 | 316 | 0.1 | 22.7 | 13.7 | 2207 | 3.78 | 9 | 2.8 | <0.1 | 5.8 | 154 | 0.8 | 5.7 | <0.1 | 63 | 0.28 | 0.062 | 33.7 | 8 | 0.13 | 662 | 0.298 | 10.32 | 1.037 | 9.77 | 16.2 |
| 8194 | 0.3 | 4.5 | 10.0 | 84 | <0.1 | 2.9 | 5.9 | 1361 | 3.19 | 5 | 2.8 | <0.1 | 6.4 | 353 | 0.2 | 0.7 | <0.1 | 59 | 3.97 | 0.067 | 43.8 | 6 | 0.25 | 1506 | 0.246 | 10.73 | 3.790 | 3.02 | 1.0 |
| 8195 | 6.2 | 25.4 | 24.0 | 144 | <0.1 | 5.2 | 7.8 | 1073 | 3.02 | 6 | 2.5 | <0.1 | 5.4 | 459 | 0.1 | 0.6 | 0.2 | 63 | 2.68 | 0.107 | 39.9 | 6 | 0.93 | 987 | 0.270 | 10.03 | 3.837 | 3.24 | 1.3 |
| 8196 | 62.8 | 492.5 | 128.9 | 83 | 1.6 | 22.7 | 13.0 | 167 | 2.82 | 6 | 4.7 | <0.1 | 12.7 | 36 | 0.2 | 1.0 | 23.4 | 85 | 0.16 | 0.034 | 36.1 | 38 | 1.74 | 358 | 0.353 | 9.59 | 0.810 | 4.66 | 2.0 |
| 8197 | 1.9 | 7.3 | 20.6 | 89 | <0.1 | 1.9 | 5.3 | 1072 | 3.05 | 3 | 2.2 | <0.1 | 5.0 | 633 | 0.1 | 0.4 | 0.2 | 56 | 2.23 | 0.087 | 33.2 | 5 | 0.52 | 914 | 0.210 | 9.61 | 4.814 | 2.39 | 0.8 |
| 8198 | 0.8 | 12.3 | 29.7 | 155 | <0.1 | 2.2 | 5.6 | 1179 | 2.97 | 7 | 2.0 | <0.1 | 4.8 | 340 | 0.3 | 0.6 | 0.4 | 56 | 3.12 | 0.088 | 36.3 | 5 | 0.61 | 957 | 0.220 | 9.48 | 3.850 | 2.58 | 0.5 |
| 8199 | 1.1 | 319.7 | 10.8 | 83 | <0.1 | 24.9 | 10.3 | 239 | 2.71 | 3 | 3.2 | <0.1 | 9.9 | 39 | <0.1 | 0.8 | 0.4 | 68 | 0.19 | 0.038 | 26.3 | 35 | 1.85 | 346 | 0.290 | 7.94 | 1.133 | 3.63 | 2.0 |
| 8200 | 1.0 | 181.3 | 2.9 | 176 | <0.1 | 25.1 | 41.9 | 700 | 9.90 | 4 | 0.2 | <0.1 | 1.4 | 38 | <0.1 | 0.2 | <0.1 | 156 | 2.30 | 0.307 | 27.1 | 24 | 3.81 | 776 | 2.368 | 6.95 | 2.299 | 2.06 | 0.4 |
| 8201 | 1.1 | 1444.2 | 6.9 | 44 | 0.1 | 5.5 | 4.6 | 437 | 1.40 | 14 | 6.4 | <0.1 | 3.1 | 13 | <0.1 | 0.5 | 0.4 | 19 | 1.11 | 0.021 | 19.8 | 9 | 2.09 | 343 | 0.057 | 2.24 | 0.044 | 1.09 | 0.4 |
| 8202 | 2.9 | 456.4 | 22.8 | 20 | 0.5 | 5.6 | 20.6 | 821 | 1.02 | 29 | 0.6 | <0.1 | 1.4 | 27 | <0.1 | 0.6 | 0.2 | 17 | 1.70 | 0.010 | 6.0 | 8 | 1.14 | 596 | 0.050 | 1.96 | 0.180 | 2.01 | 0.2 |
| 8203 | 0.7 | 1723.6 | 10.9 | 50 | 0.2 | 16.0 | 6.8 | 101 | 2.36 | 13 | 3.0 | <0.1 | 10.1 | 33 | 0.1 | 1.2 | 0.2 | 58 | 0.16 | 0.058 | 35.9 | 27 | 2.33 | 631 | 0.278 | 7.13 | 0.557 | 3.80 | 1.8 |
| 8204 | 1.9 | 110.6 | 8.5 | 117 | 0.1 | 125.1 | 57.9 | 1431 | 9.08 | 15 | 0.6 | <0.1 | 3.5 | 293 | 0.3 | 0.4 | <0.1 | 312 | 5.65 | 0.161 | 31.8 | 273 | 4.69 | 548 | 1.963 | 5.56 | 2.248 | 0.49 | 0.6 |
| 8205 | 0.5 | 18.2 | 4.1 | 56 | <0.1 | 22.9 | 12.1 | 414 | 2.67 | 4 | 1.3 | <0.1 | 5.2 | 102 | 0.1 | 0.1 | <0.1 | 54 | 1.09 | 0.037 | 24.1 | 45 | 2.37 | 1466 | 0.321 | 3.88 | 0.543 | 2.17 | 0.4 |
| 8206 | 0.9 | 90.1 | 10.1 | 123 | <0.1 | 150.3 | 60.9 | 1529 | 9.06 | 12 | 0.5 | <0.1 | 3.0 | 347 | 0.3 | 0.3 | <0.1 | 308 | 5.79 | 0.148 | 29.8 | 341 | 5.00 | 809 | 1.840 | 5.19 | 1.710 | 1.29 | 0.2 |
| 8207 | 0.9 | 93.6 | 9.3 | 120 | 0.2 | 162.7 | 63.8 | 1492 | 9.11 | 10 | 0.5 | <0.1 | 3.1 | 325 | 0.2 | 0.3 | <0.1 | 305 | 5.88 | 0.139 | 28.4 | 380 | 5.10 | 725 | 1.820 | 5.15 | 1.691 | 1.18 | 0.3 |
| 8208 | 0.4 | 4.0 | 1.0 | 6 | <0.1 | 3.7 | 1.7 | 81 | 0.37 | 1 | 0.4 | <0.1 | 1.5 | 10 | <0.1 | <0.1 | <0.1 | 4 | 0.16 | 0.024 | 4.5 | 7 | 0.32 | 362 | 0.036 | 0.50 | 0.027 | 0.26 | <0.1 |
| 8209 | 0.4 | 575.3 | 74.3 | 45 | 0.1 | 12.4 | 6.4 | 568 | 2.06 | 7 | 2.2 | <0.1 | 4.6 | 6 | <0.1 | 0.5 | <0.1 | 21 | 0.52 | 0.028 | 42.0 | 12 | 2.29 | 145 | 0.079 | 3.81 | 0.021 | 1.35 | 0.4 |
| 8210 | 0.5 | 222.7 | 3.0 | 24 | <0.1 | 12.5 | 22.7 | 1065 | 4.68 | 3 | 0.8 | <0.1 | 3.0 | 12 | <0.1 | 0.2 | 0.1 | 21 | 0.06 | 0.018 | 10.7 | 13 | 1.15 | 218 | 0.054 | 1.85 | 0.018 | 0.34 | 0.2 |
| 8211 | 1.1 | 25.8 | 2.1 | 4 | <0.1 | 4.2 | 2.8 | 148 | 0.99 | 2 | 0.3 | <0.1 | 1.0 | 4 | <0.1 | 0.1 | <0.1 | 11 | 0.02 | 0.006 | 5.0 | 8 | 0.16 | 54 | 0.014 | 0.33 | 0.012 | 0.10 | 0.2 |
| 8212 | 0.2 | 27.0 | 1.2 | 15 | <0.1 | 5.6 | 8.4 | 789 | 2.36 | 2 | 0.6 | <0.1 | 2.0 | 8 | <0.1 | 0.1 | <0.1 | 19 | 0.01 | 0.016 | 8.6 | 10 | 0.86 | 214 | 0.038 | 1.25 | 0.019 | 0.17 | 0.2 |
| 8213 | 0.4 | 4.5 | 2.3 | 6 | <0.1 | 2.2 | 0.8 | 266 | 0.81 | 3 | 0.3 | <0.1 | 1.1 | 9 | <0.1 | 0.2 | <0.1 | 12 | <0.01 | 0.007 | 5.5 | 8 | 0.20 | 264 | 0.018 | 0.70 | 0.032 | 0.24 | 0.1 |
| 8214 | 2.0 | 12.0 | 28.3 | 126 | 0.1 | 1.2 | 5.1 | 1182 | 3.22 | 10 | 3.0 | <0.1 | 7.5 | 1940 | 0.4 | 0.7 | 0.1 | 70 | 2.80 | 0.047 | 53.6 | 5 | 0.46 | 2935 | 0.314 | 10.50 | 3.896 | 4.83 | 1.4 |
| 8215 | 0.2 | 3.0 | 8.6 | 109 | <0.1 | 3.0 | 6.4 | 1573 | 3.15 | 3 | 2.0 | <0.1 | 5.6 | 502 | 0.3 | 0.4 | <0.1 | 60 | 2.56 | 0.096 | 34.8 | 7 | 0.53 | 1781 | 0.210 | 9.48 | 4.218 | 2.37 | 0.7 |
| 8216 | 1.1 | 8.7 | 21.2 | 100 | <0.1 | 1.1 | 5.6 | 1234 | 3.16 | 4 | 2.8 | <0.1 | 7.2 | 1801 | 0.2 | 0.6 | <0.1 | 72 | 3.37 | 0.046 | 52.6 | 5 | 0.32 | 2815 | 0.309 | 10.38 | 4.463 | 4.14 | 1.1 |

Appendix 4E

| Element | Zr | Ce | Sn | Y | Nb | Ta | Be | Sc | Li | S | Rb | Hf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm |
| MDL | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 | 1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 |
| RPD % | 4.5 | 6.0 | 23.2 | 4.0 | 5.8 | 7.5 | 23.6 | 1.9 | 13.1 | 0.0 | 9.6 | 4.4 |
| RPD count | 27 | 27 | 27 | 27 | 27 | 27 | 20 | 27 | 27 | 7 | 27 | 27 |
| APR % | 94.8 | 92.3 | 104.3 | 91.0 | 120.4 | 83.9 | <MDL | 107.1 | 110.9 | <MDL | 93.0 | 82.0 |
| APR error % | 14.6 | 10.9 | 51.6 | 14.4 | 9.0 | 28.9 | | 11.4 | 33.3 | | 14.8 | 12.5 |
| Sample | | | | | | | | | | | | |
| 8175 | 1.9 | 13 | 0.2 | 18.3 | 0.3 | <0.1 | <1 | 1 | 17.7 | 0.2 | 6.9 | <0.1 |
| 8176 | 224.4 | 81 | 2.0 | 26.6 | 28.9 | 1.6 | 2 | 25 | 45.2 | <0.1 | 27.1 | 5.8 |
| 8177 | 287.8 | 84 | 3.1 | 28.8 | 37.4 | 1.8 | 2 | 26 | 52.8 | <0.1 | 36.5 | 7.1 |
| 8178 | 103.5 | 71 | 2.5 | 23.3 | 8.8 | 0.6 | 1 | 9 | 67.6 | <0.1 | 119.3 | 2.9 |
| 8179 | 176.9 | 75 | 2.3 | 24.6 | 25.4 | 1.3 | 2 | 24 | 30.0 | <0.1 | 12.9 | 5.1 |
| 8180 | 23.6 | 43 | 0.6 | 7.7 | 2.2 | <0.1 | <1 | 3 | 34.5 | <0.1 | 30.2 | 0.7 |
| 8181 | 22.6 | 19 | 0.5 | 10.1 | 2.1 | 0.1 | <1 | 3 | 38.0 | 1.4 | 10.3 | 0.6 |
| 8182 | 184.7 | 71 | 1.7 | 22.6 | 23.1 | 1.1 | 1 | 36 | 50.4 | <0.1 | 25.3 | 5.0 |
| 8183 | 146.9 | 38 | 2.2 | 32.4 | 13.8 | 0.7 | <1 | 38 | 14.4 | <0.1 | 22.9 | 4.2 |
| 8185 | 137.2 | 36 | 1.8 | 29.9 | 12.5 | 0.7 | <1 | 37 | 16.2 | <0.1 | 20.7 | 3.8 |
| 8186 | 118.1 | 81 | 2.5 | 22.2 | 11.0 | 0.6 | 1 | 11 | 94.8 | <0.1 | 151.2 | 3.5 |
| 8187 | 206.2 | 74 | 1.8 | 26.2 | 26.3 | 1.4 | 1 | 32 | 59.1 | 0.2 | 13.3 | 6.1 |
| 8188 | 152.8 | 38 | 2.1 | 32.2 | 13.3 | 0.7 | <1 | 37 | 16.8 | <0.1 | 21.5 | 4.0 |
| 8189 | 203.7 | 111 | 2.5 | 27.9 | 37.4 | 2.0 | 2 | 18 | 57.6 | <0.1 | 52.6 | 5.4 |
| 8190 | 271.3 | 85 | 1.9 | 26.5 | 29.1 | 1.6 | 1 | 29 | 58.0 | 0.2 | 24.7 | 7.4 |
| 8191 | 106.7 | 76 | 1.2 | 13.6 | 15.0 | 0.5 | 3 | 4 | 4.1 | <0.1 | 214.5 | 2.5 |
| 8192 | 132.5 | 114 | 0.5 | 12.3 | 19.6 | 0.4 | 1 | 2 | 6.3 | <0.1 | 42.3 | 3.5 |
| 8193 | 116.0 | 77 | 1.3 | 13.7 | 14.6 | 0.5 | 3 | 4 | 5.8 | <0.1 | 253.8 | 3.2 |
| 8194 | 156.9 | 90 | 1.1 | 21.9 | 11.0 | 0.4 | 2 | 3 | 12.4 | <0.1 | 88.3 | 3.7 |
| 8195 | 117.7 | 75 | 0.6 | 19.5 | 12.1 | 0.5 | 3 | 5 | 52.6 | <0.1 | 96.4 | 2.7 |
| 8196 | 151.5 | 76 | 4.1 | 25.3 | 15.2 | 0.9 | 3 | 15 | 61.5 | <0.1 | 202.6 | 4.2 |
| 8197 | 116.7 | 63 | 0.8 | 12.9 | 10.1 | 0.4 | 2 | 4 | 37.6 | <0.1 | 59.1 | 2.6 |
| 8198 | 86.5 | 64 | 0.8 | 13.3 | 11.1 | 0.4 | 2 | 4 | 39.7 | 0.1 | 84.8 | 2.1 |
| 8199 | 106.8 | 52 | 3.3 | 18.5 | 12.7 | 0.8 | 2 | 11 | 61.8 | <0.1 | 159.1 | 2.9 |
| 8200 | 36.2 | 66 | 1.6 | 26.6 | 33.2 | 1.6 | 1 | 24 | 72.5 | <0.1 | 37.1 | 1.2 |
| 8201 | 34.9 | 40 | 0.6 | 8.0 | 2.5 | 0.1 | <1 | 2 | 44.3 | 0.1 | 25.2 | 1.0 |
| 8202 | 19.9 | 12 | 0.3 | 6.7 | 1.5 | <0.1 | <1 | 2 | 32.1 | 0.4 | 42.1 | 0.5 |
| 8203 | 116.4 | 76 | 2.6 | 20.5 | 9.9 | 0.6 | 2 | 11 | 101.7 | <0.1 | 150.0 | 3.5 |
| 8204 | 198.0 | 69 | 1.9 | 23.4 | 24.3 | 1.2 | <1 | 32 | 49.6 | 0.2 | 13.7 | 5.5 |
| 8205 | 88.1 | 43 | 1.3 | 13.6 | 7.5 | 0.4 | <1 | 8 | 60.0 | <0.1 | 48.7 | 2.3 |
| 8206 | 189.6 | 65 | 1.9 | 23.3 | 23.4 | 1.1 | <1 | 33 | 51.8 | 0.1 | 31.8 | 5.2 |
| 8207 | 185.4 | 65 | 1.6 | 22.5 | 21.8 | 1.1 | <1 | 34 | 50.5 | <0.1 | 28.4 | 5.2 |
| 8208 | 11.3 | 9 | <0.1 | 3.3 | 0.5 | <0.1 | <1 | <1 | 24.4 | <0.1 | 5.2 | 0.3 |
| 8209 | 63.5 | 79 | 1.5 | 16.2 | 4.0 | 0.2 | <1 | 5 | 78.1 | <0.1 | 51.4 | 1.7 |
| 8210 | 27.4 | 22 | 0.4 | 8.3 | 2.2 | 0.1 | <1 | 3 | 37.9 | 0.8 | 15.2 | 0.7 |
| 8211 | 8.2 | 10 | 0.2 | 2.3 | 0.6 | <0.1 | <1 | <1 | 7.4 | <0.1 | 4.2 | 0.2 |
| 8212 | 18.2 | 19 | 0.3 | 6.4 | 1.6 | <0.1 | <1 | 2 | 35.5 | 0.2 | 7.8 | 0.6 |
| 8213 | 10.0 | 12 | <0.1 | 2.5 | 0.7 | <0.1 | <1 | 1 | 15.2 | <0.1 | 9.8 | 0.3 |
| 8214 | 190.4 | 102 | 1.0 | 22.7 | 16.0 | 0.6 | 2 | 2 | 105.9 | <0.1 | 111.1 | 4.0 |
| 8215 | 133.1 | 66 | 0.8 | 15.3 | 10.8 | 0.4 | 2 | 4 | 35.3 | <0.1 | 69.5 | 3.0 |
| 8216 | 184.9 | 95 | 1.0 | 22.4 | 15.3 | 0.6 | 3 | 2 | 52.6 | <0.1 | 104.5 | 3.7 |

| Element | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd | Sb | Bi | V | Ca | P | La | Cr | Mg | Ba | Ti | Al | Na | K | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm | ppm | % | ppm | % | % | % | % | ppm |
| MDL | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 0.1 | 0.2 | 1 | 0.01 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.01 | 0.001 | 0.1 | 1 | 0.01 | 1 | 0.001 | 0.01 | 0.001 | 0.01 | 0.1 |
| RPD % | 28.1 | 6.4 | 11.5 | 11.1 | 23.2 | 6.8 | 10.8 | 4.8 | 2.3 | 29.4 | 11.6 | <MDL | 4.8 | 4.4 | 23.9 | 6.6 | 21.5 | 2.3 | 10.3 | 5.0 | 6.9 | 5.7 | 2.0 | 6.0 | 3.7 | 4.5 | 5.2 | 10.1 | 21.4 |
| RPD count | 27 | 27 | 27 | 27 | 22 | 27 | 27 | 27 | 27 | 25 | 27 | 27 | 27 | 27 | 23 | 26 | 12 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| APR % | 68.8 | 103.4 | 97.8 | 98.2 | 40.0 | 100.3 | 99.8 | 101.6 | 92.0 | 120.0 | 88.6 | <MDL | 99.5 | 97.3 | 82.1 | 75.7 | <MDL | 103.7 | 102.3 | 124.3 | 98.4 | 80.4 | 97.1 | 98.3 | 110.4 | 102.1 | 99.2 | 97.8 | 52.4 |
| APR error % | 69.9 | 6.1 | 21.9 | 13.9 | 0.0 | 9.3 | 11.0 | 5.7 | 3.5 | 58.0 | 34.5 | | 15.6 | 10.8 | 29.7 | 42.4 | | 11.1 | 12.4 | 25.7 | 13.3 | 8.1 | 6.4 | 7.6 | 14.8 | 10.4 | 7.2 | 11.6 | 43.9 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8217 | 0.7 | 6.5 | 26.4 | 129 | 0.2 | 1.3 | 5.4 | 1014 | 3.19 | 4 | 3.4 | <0.1 | 8.8 | 848 | 0.2 | 1.1 | 0.1 | 68 | 3.08 | 0.049 | 60.1 | 4 | 0.38 | 2842 | 0.293 | 11.70 | 2.984 | 6.00 | 1.2 |
| 8218 | 1.2 | 189.9 | 46.5 | 86 | 0.2 | 14.5 | 12.7 | 387 | 0.89 | 54 | 1.5 | <0.1 | 3.3 | 122 | 0.3 | 2.1 | 0.8 | 16 | 29.71 | 0.022 | 25.3 | 7 | 1.06 | 180 | 0.051 | 1.66 | 0.266 | 0.77 | 0.4 |
| 8220 | 0.7 | 1888.9 | 7.2 | 52 | 0.1 | 14.5 | 4.9 | 111 | 2.37 | 5 | 3.0 | <0.1 | 10.1 | 37 | <0.1 | 1.0 | 0.1 | 59 | 0.32 | 0.057 | 37.5 | 27 | 2.40 | 667 | 0.271 | 7.73 | 0.593 | 3.90 | 1.7 |
| 8221 | 1.2 | 91.3 | 9.2 | 110 | 0.1 | 113.4 | 53.6 | 1409 | 9.13 | 16 | 0.6 | <0.1 | 3.5 | 305 | 0.3 | 0.4 | <0.1 | 319 | 5.62 | 0.170 | 34.2 | 278 | 4.55 | 745 | 1.971 | 6.05 | 2.150 | 0.54 | 0.5 |
| 8222 | 0.3 | 9.3 | 9.3 | 39 | <0.1 | 1.5 | 4.1 | >10000 | 2.80 | <1 | 3.0 | <0.1 | 4.2 | 2589 | 0.3 | 0.2 | <0.1 | 128 | 13.13 | 0.020 | 42.6 | 6 | 0.12 | 1953 | 0.285 | 6.47 | 2.047 | 3.71 | 0.5 |
| 8223 | 0.3 | 6.6 | 18.6 | 53 | 0.5 | 2.8 | 2.2 | 879 | 2.10 | 1 | 1.5 | <0.1 | 6.1 | 2085 | 0.1 | 0.1 | 0.2 | 52 | 1.12 | 0.014 | 17.9 | 5 | 0.16 | 3160 | 0.117 | 10.48 | 4.357 | 4.77 | 0.3 |
| 8224 | 0.4 | 7.3 | 18.9 | 73 | <0.1 | 1.9 | 2.8 | 1506 | 2.94 | 5 | 4.9 | <0.1 | 8.1 | 2605 | 0.3 | 0.5 | 0.1 | 102 | 2.19 | 0.020 | 51.7 | 7 | 0.14 | 3541 | 0.263 | 10.30 | 4.114 | 4.58 | 0.8 |
| 8225 | 0.1 | 60.3 | 21.1 | 112 | 0.2 | 2.2 | 12.0 | 1197 | 5.00 | 2 | 1.4 | <0.1 | 12.6 | 1860 | <0.1 | 0.3 | 0.2 | 218 | 1.90 | 0.066 | 51.0 | 4 | 0.56 | 3423 | 0.572 | 10.24 | 1.918 | 8.06 | 0.8 |
| 8226 | 1.0 | 92.1 | 29.5 | 95 | 0.1 | 1.2 | 9.0 | 1241 | 4.56 | 1 | 4.3 | <0.1 | 17.4 | 1616 | 0.4 | 0.6 | 0.6 | 245 | 2.04 | 0.063 | 48.6 | 4 | 0.49 | 3803 | 0.383 | 10.09 | 0.829 | 9.57 | 6.3 |
| 8227 | 0.9 | 64.7 | 31.2 | 110 | <0.1 | 10.3 | 16.8 | 1480 | 5.08 | 6 | 4.6 | <0.1 | 19.1 | 2316 | 0.4 | 0.8 | 0.2 | 253 | 4.15 | 0.164 | 93.7 | 17 | 0.35 | 2378 | 0.510 | 8.48 | 1.582 | 7.47 | 2.5 |
| 8228 | 0.2 | 42.8 | 12.2 | 97 | <0.1 | 3.7 | 12.2 | 1259 | 4.27 | 3 | 1.6 | <0.1 | 14.6 | 1790 | 0.2 | 0.4 | 0.1 | 173 | 2.33 | 0.046 | 51.4 | 3 | 0.52 | 1842 | 0.334 | 9.79 | 3.444 | 5.65 | 0.5 |
| 8246 | 0.1 | 41.7 | 1.9 | 30 | <0.1 | 5.5 | 2.4 | 2398 | 1.25 | 2 | <0.1 | <0.1 | <0.1 | 137 | <0.1 | <0.1 | <0.1 | 10 | 19.52 | 0.006 | 14.5 | 5 | 0.46 | 17 | 0.037 | 0.61 | 0.020 | 0.01 | <0.1 |
| 8247 | 1.8 | 77.3 | 33.1 | 219 | <0.1 | 49.4 | 48.1 | 2444 | 11.14 | 51 | 0.6 | <0.1 | 2.6 | 258 | 0.2 | 0.5 | <0.1 | 186 | 2.46 | 0.349 | 43.4 | 42 | 2.69 | 598 | 2.527 | 8.67 | 2.347 | 1.28 | 0.4 |
| 8248 | 0.7 | 241.0 | 41.2 | 296 | <0.1 | 40.5 | 34.3 | 908 | 7.65 | 14 | 0.5 | <0.1 | 4.0 | 60 | 0.2 | 0.2 | 0.1 | 143 | 1.78 | 0.264 | 40.5 | 38 | 4.21 | 101 | 1.710 | 7.77 | 2.864 | 0.27 | 1.0 |
| 8249 | 10.4 | 1833.4 | 1.3 | 76 | 0.4 | 8.2 | 4.9 | 280 | 2.66 | 24 | 1.3 | <0.1 | 5.3 | 6 | <0.1 | 0.2 | 0.5 | 12 | 0.13 | 0.081 | 2.9 | 11 | 2.10 | 109 | 0.062 | 2.42 | 0.035 | 0.28 | 0.2 |
| 8250 | 1.5 | 51.1 | 2373.7 | 1036 | 0.5 | 44.9 | 44.3 | 1458 | 4.03 | 80 | 0.5 | <0.1 | 2.7 | 78 | 6.2 | 0.5 | 0.9 | 198 | 4.20 | 0.226 | 49.8 | 31 | 4.30 | 88 | 2.397 | 9.45 | 3.838 | 0.67 | 0.7 |
| 8251 | 22.0 | 5910.0 | 9.3 | 215 | 0.3 | 28.5 | 16.2 | 1503 | 6.49 | 2 | 3.7 | <0.1 | 2.6 | 54 | 0.6 | 0.3 | <0.1 | 118 | 5.25 | 0.336 | 23.8 | 37 | 3.30 | 270 | 2.358 | 7.85 | 0.074 | 3.03 | 1.2 |
| 8252 | 0.4 | 152.5 | 1081.7 | 1235 | 1.0 | 5.5 | 1.6 | 115 | 1.70 | 24 | 1.9 | <0.1 | 8.6 | 37 | 3.9 | 1.6 | 0.3 | 50 | 0.09 | 0.058 | 27.6 | 33 | 1.35 | 420 | 0.312 | 5.66 | 0.616 | 3.17 | 1.1 |
| 8253 | 0.4 | 165.4 | 1937.9 | 3138 | 0.8 | 9.5 | 4.2 | 58 | 1.71 | 12 | 2.1 | <0.1 | 7.6 | 36 | 22.3 | 1.3 | 0.4 | 50 | 0.07 | 0.048 | 21.2 | 30 | 1.29 | 452 | 0.263 | 5.01 | 0.609 | 3.54 | 1.1 |
| 8254 | 0.5 | 86.5 | 491.0 | 813 | 0.8 | 13.6 | 6.3 | 353 | 2.15 | 34 | 2.2 | <0.1 | 9.8 | 38 | 4.5 | 1.4 | 0.2 | 56 | 1.50 | 0.051 | 31.0 | 43 | 2.24 | 765 | 0.316 | 6.35 | 0.492 | 3.81 | 1.2 |
| 8255 | 0.6 | 4.0 | 10.6 | 32 | <0.1 | 21.9 | 8.5 | 245 | 3.39 | 2 | 3.1 | <0.1 | 7.7 | 30 | <0.1 | 1.5 | 0.4 | 71 | 0.25 | 0.057 | 24.6 | 50 | 1.27 | 400 | 0.365 | 5.76 | 0.396 | 3.37 | 1.3 |
| 8256 | 0.6 | 7.9 | 10.1 | 42 | <0.1 | 15.5 | 7.3 | 569 | 2.14 | 18 | 3.2 | <0.1 | 9.6 | 28 | <0.1 | 1.0 | 0.3 | 43 | 3.55 | 0.053 | 25.7 | 23 | 4.30 | 359 | 0.235 | 5.66 | 0.409 | 2.70 | 1.6 |
| 8257 | 1.4 | 95.7 | 20.1 | 112 | <0.1 | 147.9 | 44.5 | 1346 | 8.27 | 3 | 1.4 | <0.1 | 5.6 | 524 | 0.4 | 0.3 | <0.1 | 361 | 6.07 | 0.224 | 37.4 | 224 | 4.33 | 511 | 2.692 | 6.58 | 1.821 | 1.23 | 0.9 |
| 8258 | 0.9 | 65.3 | 14.4 | 99 | <0.1 | 109.8 | 34.0 | 1000 | 6.41 | 1 | 1.9 | <0.1 | 6.9 | 310 | 0.3 | 0.2 | <0.1 | 273 | 4.39 | 0.180 | 38.2 | 189 | 4.11 | 886 | 2.107 | 6.54 | 1.766 | 1.92 | 0.8 |
| 8259 | 0.6 | 1.2 | 1.9 | 78 | <0.1 | 11.2 | 5.2 | 619 | 3.09 | <1 | 2.8 | <0.1 | 7.2 | 108 | <0.1 | 0.3 | <0.1 | 22 | 15.64 | 0.026 | 24.9 | 8 | 8.73 | 22 | 0.122 | 2.89 | 0.235 | 0.08 | 0.2 |
| 8260 | 1.5 | 96.3 | 11.0 | 104 | <0.1 | 164.9 | 47.5 | 1507 | 8.66 | 2 | 1.2 | <0.1 | 5.2 | 392 | 0.3 | 0.3 | <0.1 | 380 | 5.93 | 0.221 | 38.3 | 246 | 4.88 | 245 | 2.704 | 6.60 | 1.795 | 0.60 | 0.6 |
| 8261 | 0.6 | 98.0 | 5.6 | 113 | 0.1 | 188.5 | 48.8 | 1411 | 8.88 | 2 | 1.2 | <0.1 | 4.9 | 328 | 0.2 | 0.2 | <0.1 | 369 | 5.96 | 0.205 | 35.7 | 352 | 5.14 | 375 | 2.582 | 6.59 | 1.788 | 1.17 | 0.6 |
| 8262 | 1.3 | 82.1 | 9.0 | 113 | <0.1 | 68.7 | 40.7 | 1385 | 9.14 | 2 | 1.3 | <0.1 | 5.7 | 623 | 0.2 | 0.3 | <0.1 | 392 | 5.01 | 0.257 | 44.2 | 20 | 3.04 | 457 | 2.768 | 7.68 | 2.712 | 1.38 | 0.7 |
| 8263 | 0.4 | 1169.8 | 7.0 | 51 | <0.1 | 13.1 | 5.0 | 108 | 2.15 | 4 | 2.4 | <0.1 | 8.5 | 32 | <0.1 | 0.9 | 0.1 | 46 | 0.14 | 0.038 | 31.5 | 21 | 2.37 | 1068 | 0.247 | 6.42 | 0.608 | 2.51 | 1.5 |
| 8264 | 2.2 | 581.8 | 79.5 | 13 | 0.2 | 2.7 | 10.9 | 288 | 0.92 | 49 | 0.7 | <0.1 | 1.9 | 20 | <0.1 | 1.0 | 0.1 | 3 | 0.29 | 0.005 | 5.4 | 10 | 0.39 | 633 | 0.028 | 1.93 | 0.339 | 1.69 | 0.2 |
| 8265 | 57.3 | 802.9 | 922.9 | 24 | 4.1 | 16.3 | 43.9 | 68 | 5.41 | 449 | 1.5 | <0.1 | 2.6 | 22 | 0.1 | 6.9 | 4.0 | 11 | 0.03 | 0.013 | 10.4 | 16 | 0.24 | 874 | 0.049 | 1.91 | 0.161 | 1.56 | 0.4 |
| 8266 | 0.8 | 7416.8 | 2.5 | 5 | 5.2 | 2.0 | 1.0 | 71 | 0.50 | 44 | 26.3 | <0.1 | 2.3 | 6 | <0.1 | 0.2 | 210.1 | 133 | 0.06 | 0.033 | 2.7 | 6 | 0.14 | 230 | 0.029 | 0.90 | 0.009 | 0.51 | 0.2 |
| 8267 | 0.5 | 8206.2 | 1.7 | 5 | 8.0 | 1.1 | 0.7 | 59 | 0.34 | 20 | 12.2 | <0.1 | 1.9 | 8 | <0.1 | 0.2 | 230.2 | 113 | 0.05 | 0.026 | 2.4 | 5 | 0.11 | 500 | 0.024 | 0.76 | 0.010 | 0.44 | 0.1 |
| 8268 | 18.9 | >10000 | 7.1 | 157 | 18.1 | 43.4 | 43.9 | 2770 | 2.59 | 31 | 1.1 | <0.1 | 3.0 | 53 | 0.3 | 0.4 | 38.1 | 193 | 3.10 | 0.379 | 55.7 | 43 | 6.20 | 381 | 2.570 | 9.01 | 2.591 | 1.32 | 1.6 |
| 8269 | 1.5 | 129.0 | 7.7 | 123 | <0.1 | 67.8 | 44.9 | 1033 | 8.69 | 12 | 1.7 | <0.1 | 6.4 | 260 | 0.3 | 0.4 | 0.7 | 360 | 5.11 | 0.218 | 41.7 | 87 | 3.51 | 405 | 2.559 | 7.25 | 2.844 | 1.03 | 0.7 |
| 8270 | 0.1 | 51.7 | 3.2 | 20 | <0.1 | 10.8 | 6.1 | 88 | 1.38 | 3 | 1.8 | <0.1 | 7.8 | 88 | <0.1 | 0.2 | 0.2 | 32 | 0.25 | 0.041 | 13.6 | 29 | 1.01 | 1606 | 0.258 | 4.74 | 0.555 | 3.31 | 0.8 |
| 8271 | <0.1 | 7.6 | 6.6 | 18 | <0.1 | 10.9 | 6.0 | 98 | 1.29 | 2 | 1.3 | <0.1 | 7.1 | 68 | 0.1 | 0.2 | 0.2 | 15 | 0.13 | 0.032 | 19.0 | 19 | 0.94 | 1202 | 0.151 | 3.64 | 0.789 | 2.07 | 0.5 |
| 8272 | 1.1 | 66.0 | 23.7 | 110 | 0.1 | 72.8 | 44.3 | 1437 | 8.92 | 16 | 1.5 | <0.1 | 6.3 | 351 | 0.3 | 0.4 | 0.1 | 367 | 4.82 | 0.223 | 42.1 | 90 | 3.60 | 797 | 2.576 | 7.15 | 2.500 | 1.31 | 0.8 |
| 8273 | 1.2 | 75.7 | 8.7 | 107 | 0.1 | 96.0 | 46.6 | 1311 | 8.50 | 14 | 1.3 | <0.1 | 5.8 | 306 | 0.3 | 0.4 | 0.1 | 328 | 4.99 | 0.202 | 39.7 | 125 | 4.04 | 414 | 2.161 | 6.64 | 2.350 | 1.42 | 0.6 |
| 8274 | 0.6 | 75.3 | 8.9 | 113 | 0.1 | 97.1 | 46.6 | 1331 | 8.68 | 16 | 1.3 | <0.1 | 5.6 | 283 | 0.3 | 0.5 | <0.1 | 336 | 5.11 | 0.202 | 39.7 | 127 | 4.02 | 382 | 2.148 | 6.75 | 2.498 | 1.41 | 0.5 |
| 8275 | 1.5 | 158.8 | 24.6 | 121 | 0.2 | 320.6 | 71.7 | 1682 | 10.13 | 75 | 0.8 | <0.1 | 4.7 | 344 | 0.4 | 0.8 | <0.1 | 346 | 4.76 | 0.158 | 32.1 | 835 | 6.53 | 268 | 2.254 | 5.42 | 1.195 | 0.77 | 0.5 |
| 8276 | 0.1 | 7.5 | 41.9 | 33 | <0.1 | 11.4 | 2.7 | 434 | 2.10 | 6 | 2.4 | <0.1 | 9.1 | 108 | 0.1 | 0.3 | 0.1 | 35 | 0.65 | 0.037 | 27.1 | 24 | 1.70 | 496 | 0.201 | 6.22 | 2.260 | 2.22 | 0.8 |
| 8277 | 0.3 | 47.1 | 21.2 | 38 | <0.1 | 75.0 | 15.3 | 491 | 3.26 | 26 | 1.0 | <0.1 | 3.8 | 80 | 0.2 | 0.6 | <0.1 | 77 | 0.72 | 0.082 | 19.0 | 136 | 2.30 | 181 | 0.481 | 3.14 | 0.969 | 0.29 | 0.5 |

| Element | Zr | Ce | Sn | Y | Nb | Ta | Be | Sc | Li | S | Rb | Hf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm |
| MDL | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 | 1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 |
| RPD % | 4.5 | 6.0 | 23.2 | 4.0 | 5.8 | 7.5 | 23.6 | 1.9 | 13.1 | 0.0 | 9.6 | 4.4 |
| RPD count | 27 | 27 | 27 | 27 | 27 | 27 | 20 | 27 | 27 | 7 | 27 | 27 |
| APR % | 94.8 | 92.3 | 104.3 | 91.0 | 120.4 | 83.9 | <MDL | 107.1 | 110.9 | <MDL | 93.0 | 82.0 |
| APR error % | 14.6 | 10.9 | 51.6 | 14.4 | 9.0 | 28.9 | | 11.4 | 33.3 | | 14.8 | 12.5 |
| Sample | | | | | | | | | | | | |
| 8217 | 161.0 | 114 | 1.0 | 22.2 | 15.1 | 0.6 | 2 | 1 | 82.2 | <0.1 | 167.2 | 3.4 |
| 8218 | 31.0 | 47 | 0.6 | 14.1 | 2.7 | 0.2 | <1 | 3 | 34.6 | <0.1 | 33.5 | 1.1 |
| 8220 | 119.4 | 84 | 2.0 | 20.1 | 10.8 | 0.6 | 2 | 11 | 93.1 | <0.1 | 136.9 | 3.6 |
| 8221 | 204.7 | 80 | 2.9 | 25.4 | 24.8 | 1.3 | 1 | 32 | 58.3 | 0.2 | 13.4 | 5.6 |
| 8222 | 231.6 | 85 | 1.7 | 29.0 | 31.7 | 1.2 | 2 | 2 | 15.4 | <0.1 | 89.2 | 5.7 |
| 8223 | 117.6 | 36 | 0.7 | 8.3 | 20.2 | 0.9 | 3 | 1 | 13.5 | <0.1 | 120.1 | 3.6 |
| 8224 | 280.2 | 95 | 1.6 | 22.5 | 40.8 | 1.6 | 3 | 2 | 24.1 | <0.1 | 133.5 | 5.9 |
| 8225 | 212.9 | 95 | 2.3 | 16.4 | 35.6 | 1.1 | 5 | 6 | 32.9 | <0.1 | 215.2 | 6.2 |
| 8226 | 182.6 | 83 | 2.2 | 11.1 | 77.6 | 2.0 | 7 | 3 | 26.6 | <0.1 | 401.4 | 4.2 |
| 8227 | 328.5 | 162 | 2.2 | 21.0 | 83.6 | 3.7 | 6 | 7 | 25.8 | <0.1 | 262.8 | 6.7 |
| 8228 | 272.6 | 105 | 1.6 | 10.1 | 49.9 | 2.9 | 4 | 2 | 9.8 | <0.1 | 165.7 | 6.2 |
| 8246 | 2.1 | 34 | 0.1 | 11.9 | 0.6 | <0.1 | <1 | 6 | 24.8 | <0.1 | 0.5 | <0.1 |
| 8247 | 224.3 | 85 | 2.3 | 37.5 | 36.6 | 1.7 | 1 | 27 | 66.4 | <0.1 | 29.6 | 4.6 |
| 8248 | 136.3 | 79 | 1.9 | 29.4 | 26.0 | 1.3 | 1 | 23 | 103.4 | <0.1 | 6.4 | 3.5 |
| 8249 | 33.9 | 6 | 0.6 | 8.4 | 1.6 | <0.1 | <1 | 3 | 82.9 | <0.1 | 9.3 | 0.9 |
| 8250 | 132.1 | 96 | 0.8 | 49.1 | 21.7 | 0.9 | 1 | 26 | 125.7 | <0.1 | 22.5 | 2.8 |
| 8251 | 266.7 | 52 | 2.0 | 35.8 | 30.2 | 1.5 | <1 | 22 | 69.9 | 0.2 | 36.7 | 5.7 |
| 8252 | 105.0 | 59 | 2.7 | 10.7 | 10.2 | 0.6 | <1 | 8 | 68.7 | <0.1 | 76.9 | 3.0 |
| 8253 | 76.7 | 44 | 2.2 | 8.8 | 8.5 | 0.5 | 1 | 7 | 64.6 | 0.5 | 84.8 | 2.3 |
| 8254 | 92.0 | 61 | 2.8 | 15.1 | 9.9 | 0.6 | 2 | 10 | 72.3 | <0.1 | 88.4 | 2.6 |
| 8255 | 111.9 | 51 | 2.4 | 16.5 | 11.4 | 0.7 | 4 | 10 | 45.3 | <0.1 | 110.4 | 3.2 |
| 8256 | 118.6 | 49 | 2.1 | 24.1 | 9.7 | 0.6 | 2 | 9 | 114.1 | <0.1 | 98.8 | 3.3 |
| 8257 | 255.9 | 80 | 2.6 | 26.4 | 32.6 | 1.8 | 2 | 26 | 60.7 | <0.1 | 49.5 | 7.1 |
| 8258 | 227.7 | 79 | 2.4 | 26.3 | 27.2 | 1.5 | 2 | 22 | 72.3 | <0.1 | 68.4 | 6.0 |
| 8259 | 72.9 | 47 | 4.0 | 22.0 | 6.0 | 0.4 | 1 | 4 | 55.3 | <0.1 | 1.0 | 2.1 |
| 8260 | 256.7 | 83 | 2.6 | 27.5 | 33.6 | 1.8 | 2 | 27 | 59.4 | 0.1 | 25.3 | 7.0 |
| 8261 | 256.3 | 79 | 2.4 | 28.5 | 32.0 | 1.8 | 2 | 29 | 56.3 | <0.1 | 50.9 | 7.8 |
| 8262 | 264.3 | 95 | 3.0 | 32.1 | 40.3 | 2.2 | 2 | 22 | 35.0 | 0.1 | 44.0 | 7.4 |
| 8263 | 98.0 | 64 | 2.0 | 17.6 | 9.2 | 0.6 | 2 | 8 | 91.7 | <0.1 | 102.5 | 2.7 |
| 8264 | 29.8 | 11 | 0.2 | 5.3 | 1.3 | <0.1 | <1 | <1 | 39.8 | 0.2 | 38.0 | 0.9 |
| 8265 | 36.1 | 20 | 0.6 | 6.5 | 2.4 | 0.1 | <1 | 2 | 35.7 | 0.1 | 43.3 | 1.1 |
| 8266 | 22.9 | 6 | 0.4 | 7.7 | 1.1 | <0.1 | <1 | 1 | 7.8 | <0.1 | 17.9 | 0.7 |
| 8267 | 18.8 | 5 | 0.3 | 4.4 | 1.0 | <0.1 | <1 | 1 | 7.3 | <0.1 | 15.7 | 0.6 |
| 8268 | 212.1 | 110 | 2.6 | 37.7 | 42.8 | 2.0 | <1 | 30 | 113.1 | 0.7 | 39.9 | 5.2 |
| 8269 | 318.3 | 90 | 2.3 | 32.4 | 35.3 | 1.9 | 2 | 25 | 68.2 | 0.2 | 35.2 | 8.7 |
| 8270 | 110.8 | 32 | 1.3 | 15.6 | 8.6 | 0.6 | 1 | 6 | 43.6 | <0.1 | 110.3 | 3.2 |
| 8271 | 104.4 | 41 | 0.7 | 13.8 | 4.2 | 0.3 | 1 | 2 | 39.4 | <0.1 | 60.1 | 3.0 |
| 8272 | 330.9 | 90 | 2.8 | 33.6 | 36.3 | 1.9 | 2 | 26 | 38.4 | <0.1 | 49.7 | 9.1 |
| 8273 | 251.5 | 84 | 2.5 | 29.8 | 30.6 | 1.6 | 1 | 26 | 53.3 | 0.1 | 36.5 | 6.9 |
| 8274 | 240.5 | 85 | 2.5 | 29.8 | 31.7 | 1.7 | 2 | 26 | 52.2 | <0.1 | 32.9 | 7.0 |
| 8275 | 274.0 | 71 | 2.5 | 29.7 | 26.3 | 1.4 | 2 | 32 | 76.4 | 0.2 | 33.3 | 7.4 |
| 8276 | 109.8 | 56 | 2.0 | 23.3 | 9.0 | 0.5 | 2 | 7 | 63.5 | <0.1 | 59.0 | 3.6 |
| 8277 | 134.1 | 41 | 0.9 | 15.3 | 11.6 | 0.7 | <1 | 7 | 77.5 | <0.1 | 7.5 | 3.4 |

| Element | Mo | Cu | Pb | Zn | Ag | Ni | Co | Mn | Fe | As | U | Au | Th | Sr | Cd | Sb | Bi | V | Ca | P | La | Cr | Mg | Ba | Ti | Al | Na | K | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | % | ppm | ppm | % | ppm | % | % | % | % | ppm |
| MDL | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 0.1 | 0.2 | 1 | 0.01 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.01 | 0.001 | 0.1 | 1 | 0.01 | 1 | 0.001 | 0.01 | 0.001 | 0.01 | 0.1 |
| RPD % | 28.1 | 6.4 | 11.5 | 11.1 | 23.2 | 6.8 | 10.8 | 4.8 | 2.3 | 29.4 | 11.6 | <MDL | 4.8 | 4.4 | 23.9 | 6.6 | 21.5 | 2.3 | 10.3 | 5.0 | 6.9 | 5.7 | 2.0 | 6.0 | 3.7 | 4.5 | 5.2 | 10.1 | 21.4 |
| RPD count | 27 | 27 | 27 | 27 | 22 | 27 | 27 | 27 | 27 | 25 | 27 | 27 | 27 | 27 | 23 | 26 | 12 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| APR % | 68.8 | 103.4 | 97.8 | 98.2 | 40.0 | 100.3 | 99.8 | 101.6 | 92.0 | 120.0 | 88.6 | <MDL | 99.5 | 97.3 | 82.1 | 75.7 | <MDL | 103.7 | 102.3 | 124.3 | 98.4 | 80.4 | 97.1 | 98.3 | 110.4 | 102.1 | 99.2 | 97.8 | 52.4 |
| APR error % | 69.9 | 6.1 | 21.9 | 13.9 | 0.0 | 9.3 | 11.0 | 5.7 | 3.5 | 58.0 | 34.5 | | 15.6 | 10.8 | 29.7 | 42.4 | | 11.1 | 12.4 | 25.7 | 13.3 | 8.1 | 6.4 | 7.6 | 14.8 | 10.4 | 7.2 | 11.6 | 43.9 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8278 | 0.5 | 181.1 | 7.1 | 118 | 0.2 | 274.6 | 68.4 | 1556 | 9.73 | 11 | 0.6 | <0.1 | 3.9 | 194 | 0.3 | 0.7 | <0.1 | 330 | 5.91 | 0.135 | 28.5 | 851 | 6.58 | 481 | 1.975 | 4.80 | 1.055 | 0.72 | 0.3 |
| 8279 | 1.4 | 158.6 | 28.5 | 132 | 0.3 | 209.1 | 63.4 | 1376 | 9.72 | 35 | 0.8 | <0.1 | 4.4 | 212 | 0.3 | 1.2 | 0.1 | 351 | 4.87 | 0.162 | 32.1 | 702 | 5.11 | 377 | 2.289 | 5.48 | 1.202 | 0.43 | 0.7 |
| 8280 | <0.1 | 139.2 | 104.5 | 33 | 0.2 | 7.3 | 2.4 | 390 | 2.38 | 3 | 4.1 | <0.1 | 13.3 | 117 | <0.1 | 1.0 | 0.3 | 43 | 0.84 | 0.021 | 12.8 | 16 | 2.44 | 1682 | 0.206 | 8.69 | 0.590 | 4.36 | 0.6 |
| 8281 | 3.5 | 21.8 | 70.7 | 55 | 0.1 | 10.4 | 10.1 | 330 | 1.93 | 5 | 3.3 | <0.1 | 9.9 | 24 | <0.1 | 1.1 | 0.2 | 36 | 0.10 | 0.035 | 26.6 | 21 | 0.60 | 359 | 0.225 | 6.25 | 0.600 | 2.73 | 1.8 |
| 8282 | 0.9 | 8.4 | 27.7 | 102 | <0.1 | 7.9 | 11.4 | 1352 | 4.08 | 5 | 2.3 | <0.1 | 4.8 | 207 | 0.4 | 2.0 | <0.1 | 104 | 3.87 | 0.131 | 16.4 | 10 | 0.41 | 1884 | 0.331 | 8.71 | 3.251 | 2.71 | 1.5 |
| 8283 | 0.1 | 10.7 | 20.4 | 98 | <0.1 | 4.7 | 9.5 | 1194 | 3.69 | 3 | 2.2 | <0.1 | 4.3 | 362 | 0.1 | 0.8 | 0.1 | 97 | 3.37 | 0.113 | 22.5 | 9 | 1.03 | 1804 | 0.263 | 8.40 | 3.732 | 2.55 | 0.3 |
| 8284 | 1.6 | 17.6 | 58.4 | 58 | 0.2 | 14.5 | 15.4 | 520 | 2.37 | 15 | 3.5 | <0.1 | 10.0 | 52 | 0.3 | 0.8 | 0.9 | 37 | 0.94 | 0.036 | 29.1 | 21 | 0.93 | 1074 | 0.234 | 6.32 | 0.728 | 3.36 | 1.8 |
| 8285 | 0.3 | 6.6 | 20.6 | 106 | <0.1 | 9.1 | 8.4 | 1172 | 3.76 | 4 | 2.6 | <0.1 | 5.5 | 150 | 0.3 | 1.4 | <0.1 | 102 | 2.19 | 0.127 | 34.5 | 8 | 0.90 | 1360 | 0.340 | 9.55 | 3.387 | 2.70 | 1.2 |
| 8286 | 0.5 | 702.4 | 214.0 | 32 | 0.9 | 11.6 | 7.0 | 682 | 2.17 | 2 | 8.6 | <0.1 | 16.6 | 1610 | 0.2 | 1.3 | 2.7 | 42 | 1.93 | 0.047 | 22.4 | 18 | 2.01 | 2058 | 0.256 | 6.62 | 1.128 | 3.09 | 1.7 |
| 8287 | 0.3 | 230.7 | >10000 | >10000 | 26.5 | 15.6 | 35.9 | 1357 | 4.88 | 3 | 0.3 | <0.1 | 0.2 | 73 | 411.0 | 7.6 | 0.2 | 2 | 14.61 | 0.003 | 1.4 | 6 | 7.79 | 8 | 0.003 | 0.15 | 0.016 | 0.11 | 0.3 |
| 8288 | 0.5 | 17.7 | 79.0 | 704 | 1.0 | 2.3 | 1.3 | 1296 | 1.16 | <1 | 0.3 | <0.1 | 0.3 | 157 | 6.2 | 0.3 | <0.1 | 3 | 24.70 | 0.003 | 2.3 | 6 | 9.86 | 13 | 0.002 | 0.07 | 0.020 | 0.06 | 0.9 |
| 8289 | 0.1 | 40.5 | 17.3 | >10000 | 2.9 | 3.5 | 4.6 | 1305 | 1.00 | <1 | 0.1 | <0.1 | 0.2 | 165 | 26.8 | 0.1 | <0.1 | 2 | 24.27 | 0.002 | 1.7 | 7 | 9.79 | 6 | 0.001 | 0.05 | 0.018 | 0.04 | 0.2 |
| 8290 | 0.3 | 183.9 | >10000 | >10000 | 51.3 | 6.1 | 22.3 | 1225 | 2.59 | 2 | 0.5 | <0.1 | 0.4 | 77 | 275.2 | 7.7 | <0.1 | 3 | 14.26 | 0.004 | 1.5 | 8 | 8.29 | 5 | 0.006 | 0.21 | 0.020 | 0.16 | 0.7 |
| 8291 | 0.2 | 73.3 | >10000 | >10000 | 73.1 | 4.1 | 14.1 | 1231 | 1.97 | 1 | 0.5 | <0.1 | 0.3 | 81 | 111.1 | 12.8 | <0.1 | 3 | 15.00 | 0.004 | 1.5 | 9 | 8.45 | 10 | 0.005 | 0.23 | 0.020 | 0.19 | 1.1 |
| 8292 | 1.5 | 91.6 | 83.5 | 69 | 0.7 | 9.7 | 4.4 | 74 | 2.59 | 7 | 2.3 | <0.1 | 8.4 | 22 | 0.1 | 0.7 | 0.3 | 42 | 0.09 | 0.018 | 24.3 | 32 | 1.18 | 403 | 0.185 | 4.87 | 0.332 | 2.51 | 1.0 |
| 8293 | 1.8 | 1967.4 | 7017.8 | 413 | 2.1 | 44.7 | 23.0 | 1663 | 7.73 | 29 | 1.4 | <0.1 | 3.1 | 52 | 0.8 | 0.4 | 5.4 | 181 | 3.78 | 0.353 | 24.7 | 48 | 8.42 | 858 | 2.176 | 8.57 | 0.994 | 0.64 | 0.5 |
| 8294 | 45.8 | 12.2 | 25.5 | 47 | 0.8 | 128.8 | 0.9 | 24 | 0.57 | 9 | 12.4 | <0.1 | 4.7 | 29 | 0.4 | 28.1 | 0.2 | 2024 | 0.22 | 0.014 | 17.9 | 50 | 0.36 | 228 | 0.174 | 3.84 | 0.103 | 3.44 | 0.6 |
| 8295 | 59.0 | 12.2 | 27.2 | 50 | 0.4 | 160.9 | 1.6 | 17 | 0.66 | 12 | 8.8 | <0.1 | 3.2 | 15 | 0.1 | 18.7 | 0.2 | 1355 | 0.10 | 0.013 | 13.4 | 42 | 0.27 | 131 | 0.149 | 2.95 | 0.097 | 2.36 | 0.5 |
| 8296 | 110.0 | 138.5 | 23.5 | 3621 | 0.2 | 1363.0 | 92.9 | 429 | 4.11 | 74 | 71.9 | <0.1 | 8.7 | 90 | 50.4 | 20.3 | 0.2 | 142 | 3.34 | 0.682 | 40.2 | 76 | 1.03 | 280 | 0.328 | 8.46 | 0.175 | 3.20 | 1.2 |
| 8297 | 17.8 | 25.2 | 43.6 | 537 | 0.1 | 109.2 | 2.2 | 4 | 2.48 | 22 | 13.4 | <0.1 | 14.4 | 66 | 4.3 | 6.7 | 1.1 | 52 | 0.34 | 0.077 | 9.3 | <1 | 2.20 | 176 | 0.064 | 9.94 | 0.049 | 5.66 | <0.1 |
| 8298 | 2.3 | 193.3 | 8.5 | 11 | <0.1 | 6.9 | 2.9 | 187 | 0.62 | 5 | <0.1 | <0.1 | 0.7 | 6 | <0.1 | 0.1 | 0.4 | 25 | 1.22 | 0.002 | 2.1 | 12 | 0.52 | 10 | 0.004 | 0.34 | 0.016 | 0.01 | <0.1 |
| 8299 | 2.4 | 69.7 | 38.3 | 149 | 0.1 | 50.1 | 49.3 | 1492 | 9.85 | 34 | 0.6 | <0.1 | 2.9 | 310 | 0.3 | 0.3 | <0.1 | 190 | 4.66 | 0.335 | 43.8 | 45 | 3.18 | 812 | 2.677 | 7.66 | 1.957 | 1.68 | 0.5 |
| 8300 | 1.9 | 81.5 | 13.9 | 156 | 0.1 | 66.2 | 41.5 | 1904 | 10.53 | 5 | 0.5 | <0.1 | 3.3 | 334 | 0.4 | 0.1 | <0.1 | 215 | 5.23 | 0.327 | 43.0 | 67 | 2.95 | 1008 | 2.807 | 7.79 | 1.856 | 2.17 | 0.6 |
| 8301 | 2.0 | 74.0 | 10.6 | 163 | <0.1 | 53.0 | 50.1 | 1865 | 11.42 | 3 | 0.4 | <0.1 | 2.9 | 399 | 0.2 | <0.1 | <0.1 | 186 | 5.20 | 0.314 | 41.5 | 54 | 2.84 | 1020 | 2.603 | 7.86 | 1.980 | 2.28 | 0.5 |
| 8302 | 0.7 | 139.5 | 2190.1 | 2058 | 1.0 | 8.7 | 2.7 | 62 | 1.79 | 15 | 2.2 | <0.1 | 7.5 | 36 | 12.4 | 1.3 | 0.5 | 55 | 0.08 | 0.051 | 18.4 | 37 | 1.25 | 545 | 0.272 | 5.27 | 0.662 | 4.60 | 1.4 |
| 8303 | 0.4 | 159.6 | 1736.1 | 5497 | 1.0 | 7.8 | 2.4 | 53 | 1.89 | 16 | 2.0 | <0.1 | 8.1 | 38 | 33.8 | 1.3 | 0.5 | 54 | 0.07 | 0.051 | 19.2 | 35 | 1.32 | 558 | 0.273 | 5.03 | 0.647 | 4.05 | 1.2 |
| 8304 | 122.9 | 146.2 | 23.3 | 3425 | 0.1 | 1465.2 | 91.0 | 355 | 4.39 | 86 | 68.3 | <0.1 | 7.3 | 85 | 42.1 | 21.4 | 0.3 | 146 | 2.59 | 0.840 | 29.3 | 86 | 1.04 | 280 | 0.387 | 7.50 | 0.199 | 4.77 | 1.4 |
| 8305 | 122.9 | 143.6 | 32.1 | 3658 | 0.2 | 1374.3 | 103.3 | 438 | 4.18 | 76 | 65.5 | <0.1 | 6.9 | 77 | 46.5 | 20.3 | 0.2 | 140 | 2.53 | 0.758 | 27.6 | 81 | 1.05 | 271 | 0.356 | 7.45 | 0.185 | 4.87 | 1.4 |
| 8306 | 1.3 | 336.7 | 16.8 | 149 | 0.2 | 94.5 | 48.9 | 1613 | 9.81 | 2 | 1.0 | <0.1 | 2.7 | 219 | 0.3 | 0.7 | <0.1 | 513 | 7.19 | 0.102 | 16.7 | 206 | 3.40 | 239 | 1.631 | 7.56 | 1.707 | 0.74 | 0.4 |
| 8307 | 0.9 | 344.6 | 15.5 | 143 | 0.2 | 93.8 | 46.6 | 1638 | 9.65 | 2 | 0.7 | <0.1 | 2.7 | 221 | 0.4 | 0.8 | <0.1 | 518 | 6.85 | 0.101 | 17.3 | 204 | 3.36 | 235 | 1.658 | 7.51 | 1.662 | 0.73 | 0.3 |
| 8308 | 0.7 | 333.1 | 16.5 | 143 | 0.2 | 89.5 | 46.8 | 1558 | 9.50 | 3 | 0.9 | <0.1 | 2.8 | 225 | 0.4 | 0.7 | <0.1 | 498 | 7.25 | 0.101 | 16.6 | 202 | 3.32 | 236 | 1.601 | 7.37 | 1.670 | 0.73 | 0.3 |

| Element | Zr | Ce | Sn | Y | Nb | Ta | Be | Sc | Li | S | Rb | Hf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX | 1EX |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm |
| MDL | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 | 1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 |
| RPD % | 4.5 | 6.0 | 23.2 | 4.0 | 5.8 | 7.5 | 23.6 | 1.9 | 13.1 | 0.0 | 9.6 | 4.4 |
| RPD count | 27 | 27 | 27 | 27 | 27 | 27 | 20 | 27 | 27 | 7 | 27 | 27 |
| APR % | 94.8 | 92.3 | 104.3 | 91.0 | 120.4 | 83.9 | <MDL | 107.1 | 110.9 | <MDL | 93.0 | 82.0 |
| APR error % | 14.6 | 10.9 | 51.6 | 14.4 | 9.0 | 28.9 | | 11.4 | 33.3 | | 14.8 | 12.5 |
| Sample | | | | | | | | | | | | |
| 8278 | 210.2 | 63 | 1.9 | 28.6 | 21.4 | 1.2 | 2 | 37 | 56.9 | 0.1 | 17.5 | 6.2 |
| 8279 | 250.9 | 72 | 3.2 | 27.3 | 26.3 | 1.4 | 2 | 32 | 80.5 | 0.3 | 11.6 | 6.3 |
| 8280 | 236.4 | 34 | 6.8 | 31.3 | 18.4 | 1.3 | 4 | 9 | 107.3 | <0.1 | 130.1 | 8.3 |
| 8281 | 123.7 | 56 | 3.2 | 18.8 | 10.2 | 0.6 | 3 | 7 | 34.6 | <0.1 | 103.9 | 4.0 |
| 8282 | 117.4 | 39 | 1.0 | 14.6 | 11.0 | 0.4 | 2 | 8 | 26.4 | <0.1 | 70.1 | 3.1 |
| 8283 | 105.1 | 50 | 1.0 | 13.6 | 8.7 | 0.3 | 2 | 7 | 17.7 | <0.1 | 67.3 | 2.7 |
| 8284 | 137.0 | 60 | 3.4 | 28.6 | 11.2 | 0.7 | 3 | 8 | 22.3 | 0.1 | 132.7 | 4.6 |
| 8285 | 128.3 | 59 | 0.9 | 31.1 | 11.6 | 0.4 | 2 | 8 | 21.2 | <0.1 | 78.3 | 3.4 |
| 8286 | 354.1 | 44 | 4.6 | 70.5 | 14.9 | 1.0 | 3 | 9 | 55.8 | <0.1 | 103.0 | 11.0 |
| 8287 | 2.2 | 2 | 5.3 | 1.4 | 0.2 | <0.1 | <1 | <1 | 0.3 | 4.3 | 2.3 | <0.1 |
| 8288 | 1.0 | 3 | 0.2 | 2.9 | 0.2 | <0.1 | <1 | <1 | 0.4 | 0.1 | 1.6 | <0.1 |
| 8289 | 0.6 | 2 | 0.4 | 1.8 | 0.2 | <0.1 | <1 | <1 | 0.4 | 0.3 | 1.3 | <0.1 |
| 8290 | 3.4 | 2 | 3.0 | 1.6 | 0.5 | <0.1 | <1 | <1 | 0.6 | 5.1 | 3.9 | 0.1 |
| 8291 | 3.1 | 2 | 1.6 | 1.6 | 0.4 | <0.1 | <1 | <1 | 1.1 | 4.1 | 4.3 | 0.1 |
| 8292 | 79.5 | 48 | 1.6 | 14.6 | 7.9 | 0.5 | 1 | 7 | 45.4 | <0.1 | 96.5 | 2.5 |
| 8293 | 160.1 | 56 | 1.4 | 40.6 | 35.0 | 1.7 | 3 | 25 | 311.2 | 0.2 | 13.1 | 4.6 |
| 8294 | 46.4 | 28 | 1.3 | 10.6 | 5.7 | 0.4 | 1 | 5 | 25.7 | 0.3 | 85.6 | 1.4 |
| 8295 | 40.4 | 20 | 0.9 | 6.2 | 5.0 | 0.3 | 1 | 4 | 23.2 | 0.2 | 63.8 | 1.2 |
| 8296 | 84.7 | 61 | 3.1 | 108.2 | 15.5 | 0.7 | 6 | 15 | 93.4 | <0.1 | 108.6 | 2.5 |
| 8297 | 78.4 | 23 | 6.0 | 62.4 | 2.0 | 0.1 | 3 | 4 | 85.8 | 0.5 | 159.7 | 3.4 |
| 8298 | 4.4 | 5 | <0.1 | 2.0 | 0.2 | <0.1 | <1 | <1 | 12.3 | <0.1 | 0.2 | 0.1 |
| 8299 | 270.4 | 94 | 1.7 | 40.9 | 36.6 | 1.8 | 2 | 28 | 49.9 | <0.1 | 48.6 | 7.1 |
| 8300 | 286.1 | 91 | 2.4 | 42.3 | 36.9 | 1.8 | 2 | 29 | 44.3 | <0.1 | 51.5 | 7.6 |
| 8301 | 266.6 | 87 | 1.9 | 39.9 | 35.3 | 1.7 | 2 | 27 | 39.0 | 0.1 | 55.6 | 6.7 |
| 8302 | 84.7 | 41 | 2.4 | 9.1 | 9.5 | 0.6 | 1 | 7 | 84.2 | 0.5 | 71.6 | 2.5 |
| 8303 | 86.1 | 43 | 2.6 | 9.1 | 9.4 | 0.6 | 2 | 7 | 80.5 | 0.5 | 59.0 | 2.5 |
| 8304 | 99.9 | 50 | 3.5 | 98.0 | 17.3 | 0.8 | 8 | 14 | 121.6 | <0.1 | 102.5 | 2.8 |
| 8305 | 92.5 | 46 | 12.6 | 96.8 | 15.8 | 0.7 | 7 | 15 | 104.3 | <0.1 | 125.8 | 2.5 |
| 8306 | 149.0 | 39 | 2.1 | 33.4 | 12.4 | 0.7 | 1 | 41 | 18.9 | <0.1 | 19.7 | 4.2 |
| 8307 | 147.6 | 38 | 2.1 | 33.0 | 13.6 | 0.7 | <1 | 39 | 18.7 | <0.1 | 23.1 | 4.2 |
| 8308 | 150.4 | 38 | 2.1 | 34.0 | 13.2 | 0.6 | 1 | 40 | 15.6 | <0.1 | 20.3 | 4.2 |

Appendix 4F

| Element | | Sb | As | Ba | Br | Ca | Ce | Cs | Cr | Co | Eu | Au | Hf | Ir | Fe | La | Lu | Hg | Mo | Nd | Ni | Rb | Sm | Sc | Se | Ag | Na | Sr | Ta | Tb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Wgt | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A |
| Units | grams | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppb | ppm | ppb | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| MDL | | 0.1 | 0.5 | 50 | 0.5 | 1 | 3 | 1 | 5 | 1 | 0.2 | 2 | 1 | 5 | 0.01 | 0.5 | 0.05 | 1 | 1 | 5 | 100 | 15 | 0.1 | 0.1 | 3 | 5 | 0.01 | 500 | 0.5 | 0.5 |
| RPD % | | 14.5 | 27.6 | 15.2 | 33.7 | 5.9 | 3.3 | 9.6 | 2.7 | 9.2 | 10.5 | 13.3 | 6.6 | <MDL | 2.2 | 2.0 | 3.8 | 44.4 | 6.2 | 11.0 | 20.4 | 20.4 | 2.2 | 1.8 | <MDL | <MDL | 2.3 | 7.9 | 33.1 | 15.5 |
| RPD count | | 18 | 21 | 21 | 15 | 15 | 21 | 13 | 21 | 21 | 21 | 3 | 21 | 21 | 21 | 21 | 21 | 3 | 3 | 21 | 6 | 21 | 21 | 21 | 21 | 21 | 21 | 3 | 14 | 15 |
| APR % | | 81.7 | 104.0 | 95.4 | 135.0 | 107.8 | 97.2 | NA | 100.9 | 97.2 | 88.1 | 166.7 | 100.0 | <MDL | 101.1 | 101.0 | 99.4 | NA | <MDL | 98.6 | <MDL | 106.5 | 103.9 | 107.1 | <MDL | <MDL | 98.3 | <MDL | 120.0 | 95.0 |
| APR error % | | 51.6 | 82.7 | 46.3 | 40.0 | 15.9 | 10.5 | | 6.6 | 9.2 | 19.6 | 36.6 | 10.0 | | 4.7 | 12.7 | 13.8 | | | 35.0 | | 53.6 | 3.7 | 9.1 | | | 7.4 | | 40.3 | 30.5 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8175 | 17.88 | 0.3 | 33.0 | 1500 | 1.9 | 2 | 17 | <1 | 15 | <1 | 1.7 | 7 | <1 | <5 | 0.28 | 6.9 | 0.14 | <1 | 58 | 6 | <100 | <15 | 10.5 | 0.7 | <3 | 10 | 0.03 | <500 | <0.5 | 1.4 |
| 8176 | 18.91 | 0.2 | 13.0 | 340 | <0.5 | 6 | 86 | <1 | 320 | 44 | 3.0 | <2 | 8 | <5 | 9.04 | 37.0 | 0.34 | <1 | <5 | 48 | <100 | 24 | 10.4 | 26.6 | <3 | <5 | 2.21 | <500 | 2.1 | 1.5 |
| 8177 | 16.43 | 0.2 | 21.0 | 500 | <0.5 | 6 | 94 | 1 | 320 | 44 | 3.1 | <2 | 9 | <5 | 9.64 | 40.0 | 0.37 | <1 | <5 | 51 | <100 | 47 | 11.3 | 28.1 | <3 | <5 | 1.86 | <500 | 3.0 | 1.2 |
| 8178 | 15.89 | 0.6 | 2.7 | 1200 | <0.5 | <1 | 87 | 5 | 42 | 11 | 1.5 | <2 | 10 | <5 | 3.92 | 41.0 | 0.71 | <1 | <4 | 35 | <100 | 120 | 8.1 | 10.3 | <3 | <5 | 0.23 | <500 | 0.9 | 1.2 |
| 8179 | 16.27 | 0.8 | 24.0 | 140 | <0.5 | 7 | 82 | <1 | 310 | 39 | 3.1 | <2 | 8 | <5 | 8.80 | 35.0 | 0.32 | <1 | <3 | 44 | <100 | 17 | 10.0 | 25.4 | <3 | <5 | 2.52 | 1000 | 2.1 | 1.1 |
| 8180 | 15.48 | 0.3 | 1.1 | 460 | 2.1 | <1 | 43 | 1 | 15 | 2 | 0.6 | <2 | 2 | <5 | 1.61 | 19.0 | 0.15 | <1 | <2 | 23 | <100 | 29 | 4.2 | 3.9 | <3 | <5 | 0.04 | <500 | <0.5 | <0.5 |
| 8181 | 16.55 | 0.2 | 2.1 | 870 | 1.5 | <1 | 22 | <1 | 14 | 20 | 0.7 | <2 | 1 | <5 | 5.18 | 10.0 | 0.16 | <1 | <1 | 12 | <100 | <15 | 3.2 | 2.6 | <3 | <5 | 0.03 | <500 | <0.5 | 0.9 |
| 8182 | 17.38 | 0.6 | 61.5 | 600 | 1.4 | 6 | 78 | <1 | 280 | 60 | 2.4 | <2 | 8 | <5 | 9.84 | 33.0 | 0.36 | <1 | <3 | 47 | 190 | 32 | 10.0 | 38.8 | <3 | <5 | 1.72 | <500 | 1.2 | 1.4 |
| 8183 | 16.84 | 0.7 | 1.1 | 200 | 2.5 | 7 | 40 | <1 | 250 | 46 | 1.9 | <2 | 5 | <5 | 10.70 | 17.0 | 0.54 | <1 | <3 | 23 | <100 | 22 | 6.2 | 39.0 | <3 | <5 | 1.70 | <500 | 0.8 | 1.2 |
| 8185 | 14.85 | 0.9 | 3.0 | 190 | 2.3 | 8 | 41 | 1 | 260 | 47 | 1.9 | 12 | 5 | <5 | 10.80 | 18.0 | 0.54 | <1 | <3 | 24 | <100 | 17 | 6.3 | 39.6 | <3 | <5 | 1.73 | <500 | <0.5 | 1.1 |
| 8186 | 17.35 | 1.1 | 8.5 | 740 | 1.5 | <1 | 88 | 10 | 43 | 5 | 1.2 | <2 | 5 | <5 | 2.38 | 38.0 | 0.53 | <1 | <4 | 42 | <100 | 150 | 7.3 | 11.7 | <3 | <5 | 0.50 | <500 | 1.6 | 0.7 |
| 8187 | 17.17 | 0.4 | 21.0 | 830 | <0.5 | 7 | 80 | <1 | 350 | 59 | 3.2 | <2 | 8 | <5 | 10.20 | 34.0 | 0.34 | <1 | <3 | 43 | <100 | 17 | 10.1 | 33.6 | <3 | <5 | 2.27 | <500 | 1.7 | 1.4 |
| 8188 | 15.32 | 0.9 | 4.1 | 280 | 2.6 | 8 | 39 | 1 | 260 | 46 | 2.0 | 8 | 5 | <5 | 10.60 | 17.0 | 0.51 | <1 | <3 | 18 | <100 | 32 | 6.2 | 38.7 | <3 | <5 | 1.67 | <500 | 0.9 | <0.5 |
| 8189 | 16.29 | 0.5 | 22.0 | 1100 | 4.0 | 4 | 130 | <1 | 8 | 33 | 3.6 | <2 | 11 | <5 | 9.18 | 56.5 | 0.46 | <1 | <3 | 69 | <100 | 63 | 13.8 | 19.4 | <3 | <5 | 3.44 | <500 | 3.2 | 1.2 |
| 8190 | 17.23 | 0.6 | 47.0 | 420 | 0.9 | 6 | 96 | 2 | 170 | 56 | 3.0 | <2 | 9 | <5 | 10.20 | 41.0 | 0.37 | <1 | <5 | 51 | <100 | 27 | 10.9 | 30.6 | <3 | <5 | 2.06 | <500 | 2.5 | 1.0 |
| 8191 | 17.26 | 5.0 | 17.0 | 240 | <0.5 | <1 | 83 | 6 | 11 | 1 | 1.8 | <2 | 4 | 6 | 4.08 | 41.0 | 0.38 | <1 | <4 | 40 | <100 | 250 | 7.0 | 4.4 | <3 | <5 | 0.17 | <500 | 1.2 | 0.9 |
| 8192 | 17.12 | 11.1 | 90.9 | 170 | <0.5 | <1 | 120 | <1 | 25 | <1 | 1.5 | 19 | 58 | <5 | 2.16 | 53.8 | 0.90 | <1 | <5 | 45 | <100 | 44 | 10.4 | 3.9 | <3 | <5 | 0.03 | <500 | <0.5 | 1.0 |
| 8193 | 14.97 | 6.0 | 9.3 | 670 | <0.5 | <1 | 87 | 10 | 13 | 12 | 2.3 | <2 | 5 | <5 | 3.74 | 37.0 | 0.40 | <1 | <4 | 39 | <100 | 250 | 7.8 | 4.4 | <3 | <5 | 1.01 | <500 | <0.5 | 1.0 |
| 8194 | 15.37 | 0.6 | 4.9 | 1500 | <0.5 | 4 | 84 | 9 | 11 | 4 | 2.5 | <2 | 4 | 9 | 3.21 | 41.0 | 0.36 | <1 | <5 | 39 | <100 | 78 | 7.1 | 3.8 | <3 | <5 | 3.75 | <500 | <0.5 | 0.9 |
| 8195 | 16.19 | 0.4 | 3.5 | 980 | <0.5 | 2 | 74 | 4 | 7 | 6 | 1.9 | <2 | 5 | <5 | 2.82 | 37.0 | 0.38 | <1 | 6 | 29 | <100 | 74 | 5.8 | 5.4 | <3 | <5 | 3.58 | <500 | <0.5 | 0.7 |
| 8196 | 15.35 | 1.2 | 7.2 | 440 | <0.5 | <1 | 120 | 12 | 61 | 11 | 1.4 | 61 | 8 | <5 | 2.83 | 63.8 | 0.83 | <1 | 69 | 50 | <100 | 220 | 8.4 | 16.6 | <3 | <5 | 0.77 | <500 | 1.2 | 1.1 |
| 8197 | 16.43 | 0.3 | 3.3 | 1000 | <0.5 | 3 | 77 | 3 | 9 | 4 | 1.8 | <2 | 5 | <5 | 3.12 | 39.0 | 0.37 | <1 | <4 | 31 | <100 | 52 | 5.8 | 4.6 | <3 | <5 | 4.88 | <500 | 0.7 | 0.9 |
| 8198 | 17.36 | 0.6 | 7.5 | 1100 | <0.5 | 3 | 79 | 4 | 9 | 4 | 1.6 | <2 | 4 | <5 | 3.06 | 40.0 | 0.38 | <1 | <1 | 31 | <100 | 89 | 5.9 | 4.8 | <3 | <5 | 3.69 | <500 | <0.5 | 0.8 |
| 8199 | 15.52 | 1.0 | 2.7 | 380 | <0.5 | <1 | 93 | 11 | 58 | 10 | 1.1 | <2 | 6 | <5 | 2.91 | 49.0 | 0.67 | <1 | <4 | 36 | <100 | 180 | 6.9 | 13.4 | <3 | <5 | 1.13 | <500 | 1.2 | 0.9 |
| 8200 | 16.7 | 0.3 | 1.8 | 960 | 3.6 | 3 | 74 | <1 | 33 | 43 | 3.4 | <2 | 8 | 8 | 11.10 | 30.0 | 0.57 | <1 | <2 | 39 | <100 | 38 | 10.2 | 26.9 | <3 | <5 | 2.34 | <500 | 1.6 | 1.2 |
| 8201 | 15.73 | 0.4 | 13.0 | 360 | 2.3 | 1 | 43 | <1 | 12 | 5 | 0.5 | <2 | 2 | <5 | 1.46 | 20.0 | 0.18 | <1 | <3 | 16 | <100 | 28 | 3.1 | 1.6 | <3 | <5 | 0.04 | <500 | <0.5 | <0.5 |
| 8202 | 15.85 | 0.7 | 34.0 | 830 | 1.5 | 2 | 14 | <1 | 12 | 20 | 0.3 | <2 | 2 | <5 | 1.09 | 6.3 | 0.12 | <1 | 3 | 9 | <100 | 41 | 1.9 | 2.0 | <3 | <5 | 0.18 | <500 | <0.5 | <0.5 |
| 8203 | 15.13 | 1.2 | 12.0 | 750 | 1.2 | <1 | 88 | 10 | 44 | 6 | 1.0 | <2 | 6 | <5 | 2.44 | 38.0 | 0.54 | <1 | <3 | 38 | <100 | 140 | 7.5 | 11.6 | <3 | <5 | 0.51 | <500 | 1.3 | 0.8 |
| 8204 | 14.87 | 0.5 | 20.0 | 650 | 2.1 | 7 | 84 | 1 | 350 | 60 | 2.8 | <2 | 8 | <5 | 10.50 | 35.0 | 0.36 | <1 | <2 | 44 | 160 | 23 | 10.5 | 33.5 | <3 | <5 | 2.28 | <500 | 1.2 | 1.0 |
| 8205 | 16.47 | 0.1 | 3.0 | 1700 | 1.8 | 1 | 50 | 1 | 67 | 12 | 0.8 | <2 | 4 | <5 | 2.77 | 25.0 | 0.31 | <1 | <3 | 23 | <100 | 46 | 4.2 | 8.5 | <3 | <5 | 0.50 | <500 | 0.5 | 0.5 |
| 8206 | 15.47 | 0.4 | 12.0 | 1100 | 1.9 | 6 | 77 | 1 | 460 | 62 | 2.7 | <2 | 8 | <5 | 10.40 | 32.0 | 0.33 | <1 | <2 | 45 | <100 | 33 | 10.0 | 35.7 | <3 | <5 | 1.75 | <500 | 1.5 | 1.2 |
| 8207 | 15.85 | 0.4 | 11.0 | 890 | 2.1 | 6 | 73 | <1 | 490 | 64 | 2.6 | <2 | 8 | <5 | 10.40 | 32.0 | 0.34 | <1 | <2 | 42 | <100 | 35 | 10.0 | 36.3 | <3 | <5 | 1.67 | <500 | 1.7 | 1.0 |
| 8208 | 17.24 | <0.1 | 0.8 | 370 | 2.5 | <1 | 9 | <1 | 11 | 2 | <0.2 | <2 | 1 | <5 | 0.38 | 4.3 | 0.06 | <1 | <1 | <5 | <100 | <15 | 1.3 | 0.5 | <3 | <5 | 0.02 | <500 | <0.5 | <0.5 |
| 8209 | 14.91 | 0.4 | 5.8 | 150 | 0.9 | <1 | 89 | 2 | 18 | 5 | 0.8 | <2 | 3 | <5 | 2.19 | 42.0 | 0.33 | <1 | <3 | 37 | <100 | 51 | 6.2 | 5.5 | <3 | <5 | 0.03 | <500 | <0.5 | 0.7 |
| 8210 | 15.88 | 0.2 | 2.3 | 570 | 2.0 | <1 | 24 | <1 | 16 | 22 | 0.6 | <2 | 2 | <5 | 4.88 | 11.0 | 0.19 | <1 | <1 | 13 | <100 | 18 | 3.0 | 2.8 | <3 | <5 | 0.02 | <500 | <0.5 | 0.6 |
| 8211 | 15.12 | 0.1 | 2.4 | <50 | 1.2 | <1 | 11 | <1 | 12 | 2 | 0.2 | <2 | <1 | <5 | 0.85 | 5.0 | 0.06 | <1 | 2 | 5 | <100 | <15 | 1.0 | 0.5 | <3 | <5 | 0.02 | <500 | <0.5 | <0.5 |
| 8212 | 15.7 | 0.2 | 1.3 | 220 | 2.3 | <1 | 19 | <1 | 12 | 7 | 0.6 | <2 | 1 | <5 | 2.37 | 8.7 | 0.13 | <1 | <1 | 9 | <100 | <15 | 2.4 | 1.6 | <3 | <5 | 0.02 | <500 | <0.5 | <0.5 |
| 8213 | 15.35 | 0.2 | 2.8 | 280 | 3.0 | <1 | 14 | <1 | 10 | <1 | 0.3 | <2 | <1 | <5 | 0.81 | 6.1 | 0.07 | <1 | <1 | 6 | <100 | <15 | 1.4 | 1.1 | <3 | <5 | 0.03 | <500 | <0.5 | <0.5 |
| 8214 | 14.98 | 0.5 | 7.4 | 3000 | 1.1 | 3 | 120 | 14 | 11 | 4 | 2.9 | <2 | 4 | <5 | 3.25 | 56.7 | 0.39 | <1 | <4 | 51 | <100 | 100 | 10.0 | 1.8 | <3 | <5 | 3.96 | 1600 | 1.0 | 0.8 |
| 8215 | 15.16 | 0.4 | 3.3 | 2000 | <0.5 | 3 | 76 | 3 | 10 | 5 | 1.6 | <2 | 4 | <5 | 3.17 | 39.0 | 0.35 | <1 | <4 | 34 | <100 | 73 | 5.9 | 4.7 | <3 | <5 | 4.00 | <500 | 0.9 | 0.6 |
| 8216 | 16.42 | 0.5 | 3.9 | 3000 | 1.3 | 3 | 120 | 7 | 11 | 4 | 3.0 | <2 | 4 | <5 | 3.14 | 54.5 | 0.36 | <1 | <4 | 53 | <100 | 100 | 9.4 | 1.9 | <3 | <5 | 4.33 | 1300 | <0.5 | 0.9 |

Appendix 4F

| Element | Th | Sn | W | U | Yb | Zn |
|---|---|---|---|---|---|---|
| Method | 5A | 5A | 5A | 5A | 5A | 5A |
| Units | ppm | ppm | ppm | ppm | ppm | ppm |
| MDL | 0.2 | 100 | 1 | 0.5 | 0.2 | 50 |
| RPD % | 5.8 | <MDL | 38.9 | 16.4 | 3.6 | 16.7 |
| RPD count | 21 | 21 | 9 | 19 | 21 | 21 |
| APR % | 106.8 | <MDL | <MDL | 106.7 | 97.1 | 120.4 |
| APR error % | 17.5 | | | 54.8 | 15.5 | 17.6 |
| Sample | | | | | | |
| 8175 | 1.8 | <100 | <1 | 8.4 | 1.0 | <50 |
| 8176 | 5.3 | <100 | <1 | 0.9 | 2.4 | 140 |
| 8177 | 6.1 | <100 | <1 | 1.3 | 2.6 | 130 |
| 8178 | 14.0 | <100 | 2 | 3.6 | 4.3 | 55 |
| 8179 | 5.2 | <100 | 2 | 0.9 | 2.2 | 110 |
| 8180 | 2.8 | <100 | <1 | 0.8 | 1.0 | <50 |
| 8181 | 2.7 | <100 | <1 | 0.6 | 1.0 | <50 |
| 8182 | 4.2 | <100 | 2 | 1.1 | 2.3 | 150 |
| 8183 | 2.9 | <100 | 2 | 1.3 | 3.4 | 190 |
| 8185 | 3.0 | <100 | <1 | 1.5 | 3.3 | 210 |
| 8186 | 11.0 | <100 | 3 | 2.6 | 3.1 | 68 |
| 8187 | 4.8 | <100 | <1 | 1.1 | 2.5 | 160 |
| 8188 | 2.5 | <100 | 2 | 1.0 | 3.5 | 170 |
| 8189 | 7.3 | <100 | <1 | 1.2 | 3.0 | 160 |
| 8190 | 4.9 | <100 | 4 | 0.8 | 2.5 | 110 |
| 8191 | 7.3 | <100 | 23 | 2.4 | 2.3 | 300 |
| 8192 | 36.8 | <100 | 59 | 7.0 | 4.9 | 65 |
| 8193 | 6.9 | <100 | 15 | 3.3 | 2.5 | 310 |
| 8194 | 6.2 | <100 | <1 | 2.8 | 2.1 | 94 |
| 8195 | 6.3 | <100 | <1 | 3.5 | 2.4 | 150 |
| 8196 | 18.0 | <100 | 4 | 5.2 | 5.0 | 80 |
| 8197 | 6.4 | <100 | <1 | 2.6 | 2.3 | 120 |
| 8198 | 6.2 | <100 | 1 | 2.8 | 2.3 | 170 |
| 8199 | 16.0 | <100 | 4 | 4.5 | 3.8 | 100 |
| 8200 | 3.0 | <100 | <1 | <0.5 | 3.8 | 190 |
| 8201 | 3.4 | <100 | <1 | 6.8 | 1.0 | <50 |
| 8202 | 1.7 | <100 | <1 | 0.7 | 0.7 | <50 |
| 8203 | 12.0 | <100 | 3 | 3.3 | 3.2 | 65 |
| 8204 | 4.8 | <100 | 2 | <0.5 | 2.5 | 160 |
| 8205 | 6.4 | <100 | 1 | 1.5 | 2.0 | 65 |
| 8206 | 4.2 | <100 | <1 | <0.5 | 2.4 | 140 |
| 8207 | 4.2 | <100 | <1 | <0.5 | 2.4 | 150 |
| 8208 | 1.6 | <100 | <1 | <0.5 | 0.4 | <50 |
| 8209 | 5.2 | <100 | <1 | 2.3 | 2.1 | <50 |
| 8210 | 3.2 | <100 | <1 | 1.1 | 1.2 | <50 |
| 8211 | 1.1 | <100 | <1 | <0.5 | 0.4 | <50 |
| 8212 | 2.3 | <100 | <1 | 0.6 | 0.8 | <50 |
| 8213 | 1.2 | <100 | <1 | <0.5 | 0.4 | <50 |
| 8214 | 8.2 | <100 | <1 | 2.8 | 2.4 | 140 |
| 8215 | 6.4 | <100 | 1 | 1.8 | 2.1 | 120 |
| 8216 | 7.8 | <100 | 2 | 2.9 | 2.3 | 110 |

| Element | | Sb | As | Ba | Br | Ca | Ce | Cs | Cr | Co | Eu | Au | Hf | Ir | Fe | La | Lu | Hg | Mo | Nd | Ni | Rb | Sm | Sc | Se | Ag | Na | Sr | Ta | Tb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Wgt | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A |
| Units | grams | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppb | ppm | ppb | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| MDL | | 0.1 | 0.5 | 50 | 0.5 | 1 | 3 | 1 | 5 | 1 | 0.2 | 2 | 1 | 5 | 0.01 | 0.5 | 0.05 | 1 | 1 | 5 | 100 | 15 | 0.1 | 0.1 | 3 | 5 | 0.01 | 500 | 0.5 | 0.5 |
| RPD % | | 14.5 | 27.6 | 15.2 | 33.7 | 5.9 | 3.3 | 9.6 | 2.7 | 9.2 | 10.5 | 13.3 | 6.6 | <MDL | 2.2 | 2.0 | 3.8 | 44.4 | 6.2 | 11.0 | 20.4 | 20.4 | 2.2 | 1.8 | <MDL | <MDL | 2.3 | 7.9 | 33.1 | 15.5 |
| RPD count | | 18 | 21 | 21 | 15 | 15 | 21 | 13 | 21 | 21 | 21 | 3 | 21 | 21 | 21 | 21 | 21 | 3 | 3 | 21 | 6 | 21 | 21 | 21 | 21 | 21 | 21 | 3 | 14 | 15 |
| APR % | | 81.7 | 104.0 | 95.4 | 135.0 | 107.8 | 97.2 | NA | 100.9 | 97.2 | 88.1 | 166.7 | 100.0 | <MDL | 101.1 | 101.0 | 99.4 | NA | <MDL | 98.6 | <MDL | 106.5 | 103.9 | 107.1 | <MDL | <MDL | 98.3 | <MDL | 120.0 | 95.0 |
| APR error % | | 51.6 | 82.7 | 46.3 | 40.0 | 15.9 | 10.5 | | 6.6 | 9.2 | 19.6 | 36.6 | 10.0 | | 4.7 | 12.7 | 13.8 | | | 35.0 | | 53.6 | 3.7 | 9.1 | | | 7.4 | | 40.3 | 30.5 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8217 | 15.82 | 1.1 | 3.4 | 2800 | <0.5 | 2 | 110 | 3 | 7 | 3 | 2.8 | <2 | 4 | <5 | 3.24 | 55.5 | 0.37 | <1 | <4 | 52 | <100 | 150 | 9.1 | 1.6 | <3 | <5 | 2.96 | 640 | 0.6 | 0.9 |
| 8218 | 14.92 | 2.0 | 52.3 | 180 | 0.9 | 27 | 50 | 2 | 9 | 12 | 0.6 | <2 | 2 | <5 | 0.94 | 24.0 | 0.22 | <1 | <3 | 22 | <100 | 34 | 3.7 | 2.9 | <3 | <5 | 0.24 | <500 | <0.5 | 0.6 |
| 8220 | 15.47 | 1.1 | 5.9 | 710 | 1.4 | <1 | 91 | 10 | 44 | 4 | 1.0 | <2 | 6 | <5 | 2.44 | 39.0 | 0.54 | <1 | <4 | 42 | <100 | 150 | 7.5 | 11.8 | <3 | <5 | 0.51 | <500 | 0.6 | 0.7 |
| 8221 | 16.51 | 0.6 | 21.0 | 930 | <0.5 | 6 | 83 | <1 | 360 | 59 | 3.0 | <2 | 8 | <5 | 10.50 | 35.0 | 0.37 | <1 | <3 | 44 | <100 | 38 | 10.3 | 34.2 | <3 | <5 | 2.20 | <500 | 1.7 | 1.2 |
| 8222 | 15.36 | 0.2 | 0.8 | 2200 | 1.1 | 13 | 93 | 2 | 9 | <1 | 3.2 | <2 | 6 | <5 | 3.15 | 42.0 | 0.56 | <1 | <4 | 56 | <100 | 86 | 11.3 | 2.4 | <3 | <5 | 2.11 | 2200 | 0.7 | 0.9 |
| 8223 | 14.84 | <0.1 | 0.9 | 3100 | <0.5 | 1 | 39 | <1 | 6 | 2 | 1.0 | <2 | 4 | <5 | 2.10 | 20.0 | 0.15 | <1 | <3 | 22 | <100 | 150 | 3.7 | 1.1 | <3 | <5 | 4.32 | 1700 | 1.1 | 0.5 |
| 8224 | 14.96 | 0.7 | 6.9 | 3500 | <0.5 | 2 | 100 | 1 | 13 | 2 | 2.4 | <2 | 7 | <5 | 3.12 | 55.1 | 0.43 | <1 | <5 | 52 | <100 | 120 | 8.9 | 2.1 | <3 | <5 | 4.13 | 2200 | 1.4 | 0.8 |
| 8225 | 17.15 | 0.3 | 1.1 | 3300 | <0.5 | 2 | 100 | 9 | 6 | 11 | 1.9 | <2 | 7 | <5 | 5.10 | 51.3 | 0.30 | <1 | <2 | 41 | <100 | 220 | 7.6 | 5.9 | <3 | <5 | 1.68 | 1400 | 0.8 | 0.5 |
| 8226 | 15.6 | 0.6 | 1.5 | 3700 | <0.5 | 2 | 89 | 6 | 7 | 9 | 1.1 | <2 | 5 | <5 | 4.70 | 49.0 | 0.19 | <1 | <4 | 31 | <100 | 450 | 5.0 | 3.2 | <3 | <5 | 0.81 | 1400 | 2.3 | <0.5 |
| 8227 | 16.44 | 0.7 | 6.4 | 2700 | <0.5 | 4 | 170 | 3 | 24 | 17 | 2.5 | <2 | 8 | 7 | 5.32 | 89.4 | 0.33 | <1 | <5 | 64 | <100 | 250 | 10.0 | 7.1 | <3 | <5 | 1.52 | 2000 | 3.9 | <0.5 |
| 8228 | 14.99 | 0.3 | 1.6 | 2100 | 1.0 | 2 | 110 | 14 | <5 | 12 | 1.3 | <2 | 7 | <5 | 4.49 | 53.3 | 0.18 | <1 | <4 | 38 | <100 | 170 | 5.7 | 2.4 | <3 | <5 | 3.46 | 1600 | 3.3 | <0.5 |
| 8246 | 16.79 | <0.1 | 3.0 | <50 | 2.4 | 17 | 35 | <1 | 8 | 2 | 1.7 | <2 | <1 | <5 | 1.31 | 14.0 | 0.09 | <1 | <1 | 18 | <100 | <15 | 3.5 | 6.4 | <3 | <5 | 0.03 | <500 | <0.5 | <0.5 |
| 8247 | 22.78 | 0.5 | 50.0 | 550 | <0.5 | 2 | 84 | 1 | 50 | 42 | 2.7 | <2 | 7 | <5 | 10.50 | 40.0 | 0.56 | <1 | <3 | 42 | <100 | 29 | 9.2 | 25.8 | <3 | <5 | 2.13 | <500 | 1.5 | 1.3 |
| 8248 | 18.63 | <0.1 | 14.0 | <50 | <0.5 | 2 | 83 | 1 | 44 | 31 | 2.0 | <2 | 7 | <5 | 7.61 | 40.0 | 0.52 | <1 | <3 | 43 | <100 | <15 | 8.3 | 22.2 | <3 | <5 | 2.67 | <500 | 2.9 | 1.3 |
| 8249 | 17.96 | 0.4 | 21.0 | 130 | 1.0 | <1 | 6 | <1 | 16 | 4 | <0.2 | <2 | 2 | <5 | 2.55 | 2.7 | 0.18 | <1 | 9 | <5 | <100 | <15 | 1.2 | 3.4 | <3 | <5 | 0.04 | <500 | <0.5 | 0.5 |
| 8250 | 21.41 | 0.6 | 109.0 | <50 | 0.7 | 5 | 100 | 1 | 54 | 38 | 2.0 | <2 | 8 | <5 | 3.78 | 48.0 | 0.68 | <1 | <3 | 47 | <100 | <15 | 11.2 | 27.9 | <3 | <5 | 3.46 | <500 | 2.2 | 2.0 |
| 8251 | 16.11 | 0.3 | 1.5 | 320 | 0.9 | 5 | 53 | <1 | 47 | 13 | 2.2 | <2 | 7 | <5 | 6.51 | 24.0 | 0.51 | <1 | 24 | 31 | <100 | 92 | 8.0 | 22.4 | <3 | <5 | 0.08 | <500 | 1.6 | 1.3 |
| 8252 | 19.27 | 1.4 | 21.0 | 480 | 0.9 | <1 | 89 | 3 | 49 | <1 | 0.8 | <2 | 11 | <5 | 1.63 | 44.0 | 0.47 | 1 | <3 | 35 | <100 | 120 | 6.4 | 8.3 | <3 | <5 | 0.54 | <500 | 1.1 | 0.6 |
| 8253 | 16.94 | 1.3 | 12.0 | 530 | 1.6 | <1 | 60 | 3 | 40 | 3 | 0.5 | <2 | 6 | <5 | 1.68 | 28.0 | 0.33 | 2 | <3 | 25 | <100 | 110 | 4.5 | 8.0 | <3 | <5 | 0.54 | <500 | 0.6 | <0.5 |
| 8254 | 15.26 | 1.5 | 34.0 | 970 | 1.2 | 1 | 80 | 4 | 55 | 4 | 0.8 | <2 | 7 | <5 | 2.21 | 38.0 | 0.44 | <1 | <3 | 36 | <100 | 130 | 6.2 | 10.6 | <3 | <5 | 0.48 | <500 | 1.1 | 0.7 |
| 8255 | 16.71 | 1.7 | 3.4 | 530 | 0.8 | <1 | 93 | 6 | 68 | 8 | 1.1 | <2 | 7 | <5 | 3.66 | 48.0 | 0.53 | <1 | <4 | 37 | <100 | 190 | 7.2 | 12.3 | <3 | <5 | 0.38 | <500 | 0.8 | 1.0 |
| 8256 | 15.07 | 1.1 | 20.0 | 410 | 1.6 | 3 | 57 | 8 | 33 | 6 | 0.6 | <2 | 5 | <5 | 2.22 | 27.0 | 0.45 | <1 | <3 | 25 | <100 | 110 | 5.0 | 8.9 | <3 | <5 | 0.39 | <500 | 0.8 | 0.6 |
| 8257 | 22.48 | 0.4 | 4.1 | 460 | 0.6 | 6 | 82 | 3 | 310 | 39 | 2.7 | <2 | 8 | <5 | 8.26 | 35.0 | 0.33 | <1 | <2 | 47 | <100 | 52 | 10.2 | 25.2 | <3 | <5 | 1.76 | <500 | 2.4 | 1.0 |
| 8258 | 17.99 | 0.4 | 3.3 | 960 | 0.8 | 5 | 89 | 5 | 240 | 33 | 2.4 | <2 | 7 | <5 | 6.79 | 39.0 | 0.38 | <1 | <4 | 45 | <100 | 68 | 9.2 | 22.1 | <3 | <5 | 1.71 | <500 | 1.3 | 1.0 |
| 8259 | 16.39 | 0.3 | 1.9 | <50 | <0.5 | 13 | 51 | <1 | 15 | 4 | 0.4 | <2 | 3 | <5 | 3.30 | 24.0 | 0.40 | <1 | <3 | 20 | <100 | <15 | 4.3 | 4.1 | <3 | <5 | 0.23 | <500 | <0.5 | 0.5 |
| 8260 | 18.79 | 0.3 | 2.2 | 170 | <0.5 | 6 | 84 | 2 | 330 | 42 | 2.5 | <2 | 9 | <5 | 8.78 | 36.0 | 0.31 | <1 | <2 | 47 | <100 | 15 | 10.4 | 26.1 | <3 | <5 | 1.71 | <500 | 1.9 | 1.2 |
| 8261 | 17.99 | <0.1 | <0.5 | 300 | 1.0 | 5 | 78 | 1 | 420 | 44 | 2.5 | <2 | 7 | <5 | 8.82 | 32.0 | 0.32 | <1 | <2 | 41 | <100 | 45 | 10.0 | 28.3 | <3 | <5 | 1.69 | <500 | 1.6 | 1.1 |
| 8262 | 16.68 | 0.3 | 2.3 | 440 | 3.4 | 5 | 100 | <1 | 26 | 37 | 3.2 | <2 | 10 | <5 | 9.31 | 42.0 | 0.38 | <1 | <3 | 57 | <100 | 44 | 12.0 | 21.9 | <3 | <5 | 2.55 | <500 | 2.7 | 1.3 |
| 8263 | 14.42 | 0.8 | 5.0 | 1200 | 0.8 | <1 | 63 | 7 | 34 | 4 | 0.6 | <2 | 4 | <5 | 2.04 | 29.0 | 0.35 | <1 | <3 | 27 | <100 | 110 | 5.2 | 8.0 | <3 | <5 | 0.57 | <500 | 0.6 | 0.6 |
| 8264 | 17.14 | 0.9 | 46.0 | 670 | 1.9 | <1 | 10 | <1 | 15 | 9 | <0.2 | <2 | 2 | <5 | 0.94 | 5.1 | 0.10 | <1 | 3 | 6 | <100 | 32 | 1.1 | 0.7 | <3 | <5 | 0.32 | <500 | <0.5 | <0.5 |
| 8265 | 16.87 | 6.5 | 427.0 | 3000 | 1.0 | <1 | 20 | 1 | 12 | 40 | 0.3 | 24 | 2 | <5 | 5.37 | 11.0 | 0.14 | <1 | 59 | 11 | <100 | 38 | 1.7 | 2.1 | <3 | 5 | 0.15 | <500 | <0.5 | <0.5 |
| 8266 | 14.94 | 0.2 | 41.0 | 230 | 1.2 | <1 | 6 | <1 | 14 | <1 | 0.4 | 5 | 1 | <5 | 0.50 | 2.6 | 0.11 | <1 | <9 | 8 | <100 | <15 | 2.3 | 1.1 | <3 | 5 | 0.01 | <500 | <0.5 | <0.5 |
| 8267 | 16.69 | 0.2 | 20.0 | 550 | 0.7 | <1 | 6 | <1 | 13 | <1 | 0.2 | 3 | 1 | <5 | 0.35 | 2.5 | 0.07 | <1 | <4 | <5 | <100 | <15 | 1.3 | 1.0 | <3 | 9 | 0.01 | <500 | <0.5 | <0.5 |
| 8268 | 16.92 | 0.4 | 36.0 | 450 | <0.5 | 3 | 120 | <1 | 59 | 38 | 1.8 | 56 | 9 | <5 | 2.42 | 51.1 | 0.64 | <1 | 19 | 54 | <100 | 39 | 11.4 | 28.8 | <3 | 16 | 2.38 | <500 | 1.5 | 0.8 |
| 8269 | 16.85 | 0.4 | 12.0 | 390 | 1.2 | 5 | 90 | <1 | 96 | 37 | 2.8 | <2 | 8 | <5 | 8.44 | 38.0 | 0.35 | <1 | <3 | 43 | <100 | 37 | 10.7 | 24.2 | <3 | <5 | 2.45 | <500 | 2.7 | 0.9 |
| 8270 | 14.08 | 0.2 | 3.0 | 1800 | 2.0 | <1 | 37 | 1 | 47 | 5 | 0.6 | <2 | 11 | <5 | 1.39 | 15.0 | 0.36 | <1 | <3 | 13 | <100 | 100 | 3.1 | 6.6 | <3 | <5 | 0.56 | <500 | 0.8 | <0.5 |
| 8271 | 16.15 | 0.2 | 1.5 | 1400 | 0.6 | <1 | 44 | 1 | 37 | 6 | 0.8 | <2 | 13 | <5 | 1.35 | 19.0 | 0.33 | <1 | <3 | 19 | <100 | 59 | 3.9 | 2.8 | <3 | <5 | 0.79 | <500 | 0.9 | 0.6 |
| 8272 | 16.71 | 0.5 | 17.0 | 900 | 1.3 | 5 | 92 | <1 | 110 | 39 | 2.9 | <2 | 9 | <5 | 9.05 | 39.0 | 0.35 | <1 | <3 | 49 | <100 | 49 | 11.2 | 25.8 | <3 | <5 | 2.35 | <500 | 2.6 | 1.2 |
| 8273 | 18.2 | 0.4 | 15.0 | 420 | 0.7 | 6 | 88 | <1 | 160 | 42 | 2.6 | <4 | 8 | <5 | 8.75 | 37.0 | 0.34 | <1 | <2 | 45 | <100 | 46 | 10.7 | 26.6 | <3 | <5 | 2.21 | <500 | 2.5 | 0.9 |
| 8274 | 18.25 | 0.6 | 18.0 | 350 | 2.1 | 5 | 87 | <1 | 160 | 41 | 2.5 | <4 | 9 | <5 | 8.76 | 37.0 | 0.34 | <1 | <2 | 51 | <100 | 22 | 10.7 | 26.6 | <3 | <5 | 2.36 | <500 | 2.1 | 0.7 |
| 8275 | 18.32 | 0.7 | 88.7 | 310 | <0.5 | 5 | 72 | 4 | 996 | 67 | 2.9 | <4 | 8 | <5 | 10.50 | 31.0 | 0.32 | <1 | <2 | 44 | 230 | 48 | 10.1 | 32.2 | <3 | <5 | 1.17 | <500 | 2.0 | 0.8 |
| 8276 | 16.32 | 0.3 | 6.7 | 500 | <0.5 | <1 | 59 | 2 | 35 | 1 | 1.0 | <2 | 6 | <5 | 2.00 | 28.0 | 0.56 | <1 | <3 | 28 | <100 | 61 | 6.1 | 7.5 | <3 | <5 | 2.07 | <500 | 0.6 | 0.8 |
| 8277 | 17.08 | 0.6 | 27.0 | 170 | 1.6 | <1 | 42 | <1 | 170 | 14 | 1.1 | <2 | 5 | <5 | 3.26 | 17.0 | 0.22 | <1 | <1 | 24 | <100 | <15 | 5.2 | 7.4 | <3 | <5 | 0.92 | <500 | 1.0 | 0.5 |

| Element | Th | Sn | W | U | Yb | Zn |
|---|---|---|---|---|---|---|
| Method | 5A | 5A | 5A | 5A | 5A | 5A |
| Units | ppm | ppm | ppm | ppm | ppm | ppm |
| MDL | 0.2 | 100 | 1 | 0.5 | 0.2 | 50 |
| RPD % | 5.8 | <MDL | 38.9 | 16.4 | 3.6 | 16.7 |
| RPD count | 21 | 21 | 9 | 19 | 21 | 21 |
| APR % | 106.8 | <MDL | <MDL | 106.7 | 97.1 | 120.4 |
| APR error % | 17.5 | | | 54.8 | 15.5 | 17.6 |
| Sample | | | | | | |
| 8217 | 8.4 | <100 | <1 | 3.0 | 2.2 | 150 |
| 8218 | 3.3 | <100 | <1 | 1.3 | 1.4 | 81 |
| 8220 | 11.0 | <100 | 4 | 2.9 | 3.1 | 62 |
| 8221 | 4.6 | <100 | 3 | 1.1 | 2.7 | 130 |
| 8222 | 5.1 | <100 | <1 | 3.4 | 3.5 | <50 |
| 8223 | 7.4 | <100 | <1 | 1.5 | 0.9 | 87 |
| 8224 | 10.0 | <100 | <1 | 5.4 | 2.5 | 87 |
| 8225 | 15.0 | <100 | 2 | 1.5 | 1.8 | 110 |
| 8226 | 19.0 | <100 | 6 | 4.1 | 1.1 | 97 |
| 8227 | 22.4 | <100 | 4 | 4.2 | 1.9 | 110 |
| 8228 | 17.0 | <100 | 2 | <0.5 | 0.9 | 120 |
| 8246 | <0.2 | <100 | <1 | <0.5 | 0.5 | 67 |
| 8247 | 3.0 | <100 | <1 | <0.5 | 3.7 | 280 |
| 8248 | 4.7 | <100 | <1 | <0.5 | 3.3 | 400 |
| 8249 | 5.2 | <100 | <1 | 1.4 | 1.0 | 150 |
| 8250 | 3.5 | <100 | <1 | 1.2 | 4.3 | 940 |
| 8251 | 2.7 | <100 | <1 | 3.8 | 3.3 | 220 |
| 8252 | 12.0 | <100 | 2 | 2.8 | 2.6 | 1100 |
| 8253 | 8.9 | <100 | 2 | 2.8 | 1.9 | 2700 |
| 8254 | 12.0 | <100 | 2 | 2.9 | 2.5 | 770 |
| 8255 | 12.0 | <100 | 3 | 4.5 | 3.1 | <50 |
| 8256 | 10.0 | <100 | 2 | 3.5 | 2.6 | <50 |
| 8257 | 5.5 | <100 | 3 | 1.1 | 2.2 | 130 |
| 8258 | 7.1 | <100 | 2 | 2.1 | 2.4 | 110 |
| 8259 | 6.9 | <100 | <1 | 3.0 | 2.4 | 96 |
| 8260 | 5.4 | <100 | <1 | 1.6 | 2.2 | 100 |
| 8261 | 4.5 | <100 | <1 | <0.5 | 1.9 | 120 |
| 8262 | 6.2 | <100 | <1 | 0.9 | 2.5 | 120 |
| 8263 | 8.1 | <100 | 2 | 2.5 | 2.0 | <50 |
| 8264 | 1.9 | <100 | <1 | <0.5 | 0.6 | <50 |
| 8265 | 2.9 | <100 | <1 | 1.9 | 0.8 | <50 |
| 8266 | 2.2 | <100 | <1 | 26.0 | 0.9 | <50 |
| 8267 | 2.0 | <100 | <1 | 13.0 | 0.6 | <50 |
| 8268 | 3.6 | <100 | 4 | 1.0 | 3.9 | 190 |
| 8269 | 5.9 | <100 | <1 | 1.4 | 2.2 | 110 |
| 8270 | 8.4 | <100 | <1 | 1.9 | 2.0 | <50 |
| 8271 | 7.4 | <100 | <1 | 1.9 | 1.8 | <50 |
| 8272 | 6.1 | <100 | <1 | 1.6 | 2.4 | 130 |
| 8273 | 5.9 | <100 | <1 | 1.4 | 2.2 | 190 |
| 8274 | 5.6 | <100 | <1 | 1.5 | 2.2 | 160 |
| 8275 | 4.7 | <100 | <1 | <0.5 | 2.2 | 160 |
| 8276 | 9.4 | <100 | 2 | 2.5 | 3.3 | 74 |
| 8277 | 4.2 | <100 | <1 | 0.9 | 1.4 | <50 |

| Element | | Sb | As | Ba | Br | Ca | Ce | Cs | Cr | Co | Eu | Au | Hf | Ir | Fe | La | Lu | Hg | Mo | Nd | Ni | Rb | Sm | Sc | Se | Ag | Na | Sr | Ta | Tb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Wgt | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A | 5A |
| Units | grams | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppb | ppm | ppb | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| MDL | | 0.1 | 0.5 | 50 | 0.5 | 1 | 3 | 1 | 5 | 1 | 0.2 | 2 | 1 | 5 | 0.01 | 0.5 | 0.05 | 1 | 1 | 5 | 100 | 15 | 0.1 | 0.1 | 3 | 5 | 0.01 | 500 | 0.5 | 0.5 |
| RPD % | | 14.5 | 27.6 | 15.2 | 33.7 | 5.9 | 3.3 | 9.6 | 2.7 | 9.2 | 10.5 | 13.3 | 6.6 | <MDL | 2.2 | 2.0 | 3.8 | 44.4 | 6.2 | 11.0 | 20.4 | 20.4 | 2.2 | 1.8 | <MDL | <MDL | 2.3 | 7.9 | 33.1 | 15.5 |
| RPD count | | 18 | 21 | 21 | 15 | 15 | 21 | 13 | 21 | 21 | 21 | 3 | 21 | 21 | 21 | 21 | 21 | 3 | 3 | 21 | 6 | 21 | 21 | 21 | 21 | 21 | 21 | 3 | 14 | 15 |
| APR % | | 81.7 | 104.0 | 95.4 | 135.0 | 107.8 | 97.2 | NA | 100.9 | 97.2 | 88.1 | 166.7 | 100.0 | <MDL | 101.1 | 101.0 | 99.4 | NA | <MDL | 98.6 | <MDL | 106.5 | 103.9 | 107.1 | <MDL | <MDL | 98.3 | <MDL | 120.0 | 95.0 |
| APR error % | | 51.6 | 82.7 | 46.3 | 40.0 | 15.9 | 10.5 | | 6.6 | 9.2 | 19.6 | 36.6 | 10.0 | | 4.7 | 12.7 | 13.8 | | | 35.0 | | 53.6 | 3.7 | 9.1 | | | 7.4 | | 40.3 | 30.5 |
| Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8278 | 17.82 | 0.7 | 13.0 | 480 | <0.5 | 6 | 62 | 2 | 1040 | 66 | 2.4 | <2 | 7 | <5 | 10.00 | 27.0 | 0.30 | <1 | <2 | 38 | 180 | 20 | 9.2 | 37.3 | <3 | <5 | 1.06 | <500 | 1.2 | 0.8 |
| 8279 | 18.66 | 1.1 | 44.0 | 330 | <0.5 | 6 | 73 | 3 | 830 | 60 | 2.7 | <2 | 8 | <5 | 10.00 | 30.0 | 0.32 | <1 | <2 | 44 | <100 | <15 | 10.1 | 32.4 | <3 | <5 | 1.18 | <500 | 1.7 | 1.0 |
| 8280 | 14.67 | 1.0 | 4.7 | 1900 | 0.8 | 1 | 54 | 12 | 19 | <1 | 0.9 | <2 | 14 | <5 | 2.35 | 21.0 | 1.20 | <1 | <4 | 23 | <100 | 200 | 5.6 | 10.7 | <3 | <5 | 0.55 | <500 | 1.7 | 1.2 |
| 8281 | 14.13 | 1.2 | 6.3 | 380 | <0.5 | <1 | 69 | 9 | 30 | 8 | 0.8 | <2 | 8 | <5 | 1.87 | 31.0 | 0.56 | <1 | 4 | 29 | <100 | 130 | 6.3 | 7.3 | <3 | <5 | 0.60 | <500 | 0.9 | 0.8 |
| 8282 | 12.63 | 1.9 | 6.2 | 2000 | 0.6 | 3 | 69 | 6 | 9 | 9 | 1.2 | <2 | 4 | <5 | 3.96 | 35.0 | 0.28 | <1 | <4 | 31 | <100 | 80 | 5.7 | 8.6 | <3 | <5 | 3.03 | <500 | <0.5 | 0.5 |
| 8283 | 14.24 | 0.7 | 2.8 | 2000 | 0.6 | 3 | 64 | 6 | 12 | 8 | 1.4 | <2 | 4 | <5 | 3.72 | 32.0 | 0.29 | <1 | <4 | 29 | <100 | 89 | 5.5 | 7.7 | <3 | <5 | 3.52 | <500 | 0.9 | 0.7 |
| 8284 | 13.24 | 0.8 | 15.0 | 2100 | <0.5 | 1 | 71 | 7 | 27 | 13 | 0.9 | <2 | 8 | <5 | 2.29 | 34.0 | 0.61 | <1 | <4 | 33 | <100 | 130 | 7.0 | 7.7 | <3 | <5 | 0.69 | <500 | 0.9 | 0.7 |
| 8285 | 12.68 | 1.4 | 4.4 | 1500 | <0.5 | 2 | 75 | 9 | 12 | 5 | 2.2 | <2 | 4 | <5 | 3.72 | 45.0 | 0.39 | <1 | <2 | 44 | <100 | 62 | 8.3 | 8.1 | <3 | <5 | 3.20 | <500 | 1.5 | 0.9 |
| 8286 | 14.44 | 1.2 | 3.8 | 26400 | <0.5 | 2 | 47 | 4 | 31 | 4 | 1.2 | <2 | 13 | <5 | 2.12 | 22.0 | 1.40 | <1 | <5 | 9 | <100 | 96 | 5.5 | 9.3 | <3 | <5 | 1.10 | 1100 | 1.1 | 1.8 |
| 8287 | 18.87 | 7.3 | 5.2 | <50 | 2.6 | 12 | <3 | <1 | <5 | 34 | <0.2 | <2 | <1 | <5 | 4.70 | 1.4 | <0.05 | 5 | <3 | <5 | <100 | <15 | 0.3 | 0.4 | <3 | 28 | 0.02 | <500 | <0.5 | <0.5 |
| 8288 | 15.44 | 0.3 | 2.6 | <50 | 1.0 | 22 | 3 | <1 | <5 | 1 | <0.2 | <2 | <1 | <5 | 1.29 | 2.2 | <0.05 | <1 | <1 | <5 | <100 | <15 | 0.5 | 0.3 | <3 | <5 | 0.03 | <500 | <0.5 | <0.5 |
| 8289 | 16.4 | <0.1 | 1.2 | <50 | 1.0 | 22 | <3 | <1 | <5 | 4 | <0.2 | <2 | <1 | <5 | 1.06 | 1.4 | <0.05 | <1 | <1 | <5 | <100 | <15 | 0.3 | 0.3 | <3 | <5 | 0.03 | <500 | <0.5 | <0.5 |
| 8290 | 17.43 | 7.8 | 5.3 | <50 | 2.3 | 13 | <3 | <1 | <5 | 22 | <0.2 | <2 | <1 | <5 | 2.52 | 1.5 | <0.05 | 4 | <3 | 5 | <100 | <15 | 0.2 | 0.5 | <3 | 53 | 0.03 | <500 | <0.5 | <0.5 |
| 8291 | 16.64 | 12.1 | 4.5 | <50 | 1.1 | 13 | <3 | <1 | <5 | 14 | <0.2 | <2 | <1 | <5 | 1.92 | 1.6 | <0.05 | 2 | <2 | <5 | <100 | <15 | 0.2 | 0.6 | <3 | 33 | 0.03 | <500 | <0.5 | <0.5 |
| 8292 | 13.61 | 0.6 | 6.9 | 420 | <0.5 | <1 | 53 | 5 | 36 | 4 | 0.7 | <2 | 4 | <5 | 2.53 | 27.0 | 0.34 | <1 | <3 | 24 | <100 | 99 | 3.6 | 7.4 | <3 | <5 | 0.32 | <500 | <0.5 | <0.5 |
| 8293 | 15.22 | 0.3 | 30.0 | 1000 | 1.0 | 4 | 63 | 5 | 55 | 21 | 1.4 | <2 | 8 | <5 | 8.17 | 27.0 | 0.73 | <1 | <5 | 31 | <100 | <15 | 8.8 | 26.7 | <3 | <5 | 1.00 | <500 | 2.4 | 1.4 |
| 8294 | 14.78 | 26.9 | 16.0 | 250 | 0.9 | <1 | 29 | 6 | 66 | <1 | 0.4 | <2 | 1 | <5 | 0.55 | 19.0 | 0.18 | <1 | 47 | 15 | 160 | 79 | 2.5 | 5.8 | 13 | <5 | 0.10 | <500 | 0.5 | <0.5 |
| 8295 | 15.29 | 19.0 | 18.0 | 120 | 1.0 | <1 | 23 | 4 | 54 | 1 | <0.2 | 6 | 2 | <5 | 0.72 | 15.0 | 0.13 | <1 | 66 | 11 | 170 | 67 | 1.4 | 4.4 | 11 | <5 | 0.10 | <500 | <0.5 | <0.5 |
| 8296 | 13.51 | 20.8 | 78.7 | 240 | 1.2 | 3 | 70 | 10 | 83 | 90 | 2.3 | 7 | 4 | <5 | 4.16 | 46.0 | 1.00 | <1 | 112 | 38 | 1300 | 160 | 11.2 | 15.9 | 5 | <5 | 0.18 | <500 | <0.5 | 2.6 |
| 8297 | 12.8 | 9.1 | 24.0 | 330 | <0.5 | <1 | 52 | 12 | 7 | <1 | 2.1 | <2 | 7 | <5 | 2.49 | 23.0 | 0.52 | <1 | 14 | 32 | 130 | 170 | 12.0 | 4.5 | 5 | <5 | 0.11 | <500 | 2.2 | 2.5 |
| 8298 | 16.19 | 0.2 | 3.7 | <50 | 2.7 | 1 | 5 | <1 | 15 | 3 | <0.2 | <2 | <1 | <5 | 0.63 | 2.3 | <0.05 | <1 | <1 | 5 | <100 | <15 | 0.7 | 0.6 | <3 | <5 | 0.02 | <500 | <0.5 | <0.5 |
| 8299 | 16.38 | 0.4 | 39.0 | 900 | 2.8 | 6 | 110 | 3 | 62 | 49 | 2.8 | <2 | 8 | <5 | 11.10 | 48.0 | 0.64 | <1 | <3 | 49 | <100 | 48 | 11.0 | 29.1 | <3 | <5 | 2.03 | <500 | 2.6 | 1.6 |
| 8300 | 17.43 | 0.2 | 4.0 | 1100 | 3.6 | 6 | 95 | 4 | 83 | 39 | 2.7 | <2 | 8 | <5 | 10.80 | 44.0 | 0.63 | <1 | <3 | 51 | <100 | 43 | 10.2 | 27.9 | <3 | <5 | 1.77 | <500 | 2.0 | 1.4 |
| 8301 | 15.94 | 0.2 | 1.4 | 1200 | 4.6 | 5 | 91 | 3 | 67 | 49 | 2.8 | <2 | 7 | <5 | 12.10 | 42.0 | 0.60 | <1 | <3 | 46 | <100 | 63 | 10.0 | 27.0 | <3 | <5 | 1.90 | <500 | 2.2 | 1.3 |
| 8302 | 14.03 | 1.3 | 14.0 | 560 | 0.8 | <1 | 60 | 3 | 47 | 2 | 0.6 | <2 | 6 | <5 | 1.78 | 28.0 | 0.34 | 2 | <1 | 27 | <100 | 120 | 4.5 | 8.5 | <3 | <5 | 0.56 | <500 | 1.1 | 0.7 |
| 8303 | 16.43 | 1.2 | 13.0 | 570 | 0.5 | <1 | 62 | 3 | 44 | 2 | 0.7 | <2 | 6 | <5 | 1.77 | 29.0 | 0.34 | 4 | <3 | 27 | <100 | 120 | 4.6 | 8.1 | <3 | <5 | 0.55 | <500 | 0.6 | 0.6 |
| 8304 | 11.91 | 19.3 | 78.0 | 260 | 1.8 | 3 | 70 | 10 | 83 | 79 | 2.3 | 7 | 3 | <5 | 4.23 | 45.0 | 1.00 | <1 | 122 | 37 | 1300 | 160 | 11.4 | 16.1 | <3 | <5 | 0.17 | <500 | 0.8 | 2.7 |
| 8305 | 11.65 | 19.1 | 72.8 | 280 | 2.2 | 3 | 64 | 8 | 84 | 90 | 2.2 | <2 | 3 | <5 | 4.05 | 43.0 | 1.00 | <1 | 123 | 40 | 1300 | 170 | 10.6 | 16.0 | <3 | <5 | 0.17 | <500 | 1.0 | 2.8 |
| 8306 | 14.83 | 0.9 | 1.9 | 160 | 3.5 | 7 | 39 | <1 | 250 | 45 | 1.9 | <5 | 5 | <5 | 10.40 | 17.0 | 0.51 | <1 | <3 | 23 | <100 | 21 | 6.2 | 38.2 | <3 | <5 | 1.64 | <500 | 1.0 | 1.0 |
| 8307 | 14.71 | 0.6 | 2.4 | 280 | 2.1 | 7 | 40 | <1 | 250 | 45 | 1.5 | 11 | 5 | <5 | 10.20 | 17.0 | 0.51 | <1 | <3 | 19 | <100 | 22 | 6.2 | 37.6 | <3 | <5 | 1.63 | <500 | 1.2 | 1.0 |
| 8308 | 16.82 | 0.9 | 3.1 | 270 | 3.2 | 7 | 40 | <1 | 250 | 45 | 1.9 | 11 | 5 | <5 | 10.40 | 17.0 | 0.49 | <1 | <3 | 29 | <100 | 33 | 6.3 | 38.2 | <3 | <5 | 1.66 | <500 | 0.9 | 1.4 |

| Element | Th | Sn | W | U | Yb | Zn |
|---|---|---|---|---|---|---|
| Method | 5A | 5A | 5A | 5A | 5A | 5A |
| Units | ppm | ppm | ppm | ppm | ppm | ppm |
| MDL | 0.2 | 100 | 1 | 0.5 | 0.2 | 50 |
| RPD % | 5.8 | <MDL | 38.9 | 16.4 | 3.6 | 16.7 |
| RPD count | 21 | 21 | 9 | 19 | 21 | 21 |
| APR % | 106.8 | <MDL | <MDL | 106.7 | 97.1 | 120.4 |
| APR error % | 17.5 | | | 54.8 | 15.5 | 17.6 |
| Sample | | | | | | |
| 8278 | 4.0 | <100 | <1 | <0.5 | 1.9 | 110 |
| 8279 | 4.7 | <100 | <1 | <0.5 | 2.2 | 130 |
| 8280 | 20.0 | <100 | <1 | 5.6 | 7.1 | <50 |
| 8281 | 11.0 | <100 | 2 | 3.8 | 3.1 | 60 |
| 8282 | 5.7 | <100 | 2 | 3.6 | 1.9 | 130 |
| 8283 | 5.8 | <100 | <1 | 3.8 | 1.6 | 120 |
| 8284 | 11.0 | <100 | 2 | 4.2 | 3.5 | 56 |
| 8285 | 6.0 | <100 | 2 | 2.4 | 2.4 | 100 |
| 8286 | 17.0 | <100 | 1 | 8.9 | 8.4 | <50 |
| 8287 | <0.2 | <220 | <1 | <0.5 | <0.2 | 118000 |
| 8288 | 0.4 | <100 | 1 | <0.5 | <0.2 | 760 |
| 8289 | <0.2 | <100 | <1 | <0.5 | <0.2 | 10000 |
| 8290 | 0.5 | <230 | <1 | <0.5 | <0.2 | 94500 |
| 8291 | <0.2 | <100 | <1 | 0.7 | <0.2 | 43000 |
| 8292 | 8.6 | <100 | 1 | 2.6 | 2.0 | 65 |
| 8293 | 4.1 | <100 | 3 | 2.2 | 4.6 | 450 |
| 8294 | 4.4 | <100 | 1 | 13.0 | 1.0 | <50 |
| 8295 | 3.5 | <100 | <1 | 9.4 | 0.8 | <50 |
| 8296 | 9.2 | <280 | <1 | 88.6 | 6.8 | 3400 |
| 8297 | 28.2 | <100 | <1 | 17.0 | 3.8 | 550 |
| 8298 | 0.8 | <100 | <1 | <0.5 | 0.2 | <50 |
| 8299 | 3.6 | <100 | <1 | <0.5 | 4.1 | 170 |
| 8300 | 3.3 | <100 | <1 | 0.9 | 3.9 | 170 |
| 8301 | 2.9 | <100 | 2 | <0.5 | 3.7 | 180 |
| 8302 | 9.5 | <100 | 2 | 2.5 | 1.9 | 1800 |
| 8303 | 10.0 | <100 | <1 | 2.5 | 1.9 | 4700 |
| 8304 | 10.0 | <280 | <1 | 88.0 | 6.8 | 2900 |
| 8305 | 9.2 | <100 | 2 | 82.5 | 6.7 | 3100 |
| 8306 | 3.0 | <100 | 3 | 1.0 | 3.3 | 170 |
| 8307 | 2.9 | <200 | <1 | 0.7 | 3.0 | 190 |
| 8308 | 3.0 | <200 | <1 | 0.9 | 3.3 | 190 |

Appendix 4G

| Element | B | Cr | Cu | Fe | Nb | Ni | Sn | Ta | W | Zn | Pb |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | 7PF | 7PF | 7PF | 7PF | 7PF | 7PF | 7PF | 7PF | 7PF | 7PF | 7TD |
| Units | % | % | % | % | % | % | % | % | % | % | % |
| MDL | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| RPD % | 43.3 | 51.7 | 0.1 | 4.7 | <MDL | 0.0 | <MDL | <MDL | <MDL | 36.9 | 1.1 |
| RPD count | 4 | 4 | 8 | 8 | 8 | 3 | 8 | 8 | 8 | 6 | 2 |
| APR % | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| APR error % | | | | | | | | | | | |
| Sample | | | | | | | | | | | |
| 8175 | 0.03 | <0.01 | 1.17 | 0.24 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | NA |
| 8251 | <0.01 | <0.01 | 0.55 | 6.33 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | NA |
| 8252 | 0.01 | 0.02 | 0.01 | 1.41 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.12 | NA |
| 8253 | <0.01 | <0.01 | 0.01 | 1.39 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.30 | NA |
| 8254 | 0.01 | 0.01 | <0.01 | 2.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.08 | NA |
| 8263 | <0.01 | <0.01 | 0.11 | 1.82 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | NA |
| 8264 | <0.01 | <0.01 | 0.05 | 0.58 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | NA |
| 8265 | <0.01 | 0.02 | 0.07 | 4.82 | <0.01 | <0.01 | 0.08 | <0.01 | <0.01 | <0.01 | NA |
| 8266 | <0.01 | <0.01 | 0.69 | 0.10 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | NA |
| 8267 | <0.01 | <0.01 | 0.81 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | NA |
| 8268 | <0.01 | 0.01 | 3.60 | 2.43 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | NA |
| 8287 | <0.01 | 0.02 | 0.02 | 4.89 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 13.11 | 3.50 |
| 8288 | <0.01 | 0.04 | <0.01 | 1.23 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.08 | NA |
| 8289 | <0.01 | <0.01 | <0.01 | 1.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 1.03 | NA |
| 8290 | <0.01 | 0.01 | 0.02 | 2.51 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 9.89 | 11.19 |
| 8291 | <0.01 | <0.01 | <0.01 | 1.94 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 4.57 | 17.78 |
| 8293 | <0.01 | 0.02 | 0.19 | 7.64 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.04 | NA |
| 8296 | 0.01 | 0.01 | 0.01 | 3.94 | <0.01 | 0.13 | <0.01 | <0.01 | <0.01 | 0.36 | NA |
| 8302 | <0.01 | 0.01 | 0.01 | 1.45 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.19 | NA |
| 8303 | <0.01 | 0.01 | 0.01 | 1.51 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.52 | NA |
| 8304 | 0.02 | 0.03 | 0.01 | 4.01 | <0.01 | 0.13 | <0.01 | <0.01 | <0.01 | 0.31 | NA |
| 8305 | 0.01 | 0.02 | 0.01 | 3.95 | <0.01 | 0.13 | <0.01 | <0.01 | <0.01 | 0.34 | NA |

## Appendix 5 – Portable X-Ray Fluorescence Geochemical Analyses

A Fisher Scientific® Niton XL3t 900S portable X-ray fluorescence (PXRF) analyzer was used for in situ geochemical analyses of 34 elements in a spot measuring <1 cm in diameter on an uncrushed rock surface (e.g., outcrop, grab sample, etc.) during examination of outcrops. The PXRF analyzer operated in the manufacturer-calibrated Mining Mode (Cu-Zn)® using all four available energy filters and 60 seconds total time per run.

For quality control of the PXRF data, we analyzed seven certified and noncertified reference materials (MP-1b, NCS DC 73308, Till-4, NIST 2780, RCRA and blank silica) (Appendix 6). These reference materials were provided with the instrument in the form of pulverized samples packed in plastic sample cups and sealed with the X-ray Mylar® film. All of the reference materials were analyzed after the internal calibration of the PXRF analyzer's detector at the beginning of each analytical day.

Appendix 6 lists the expected concentrations of the reference materials reported in their certificates of analysis, and the estimated precision and accuracy of our PXRF data, based on multiple analyses of these reference materials between July 2009 and March 2010. The accuracy and 95.5% confidence-level precision of the PXRF data are estimated in terms of the APR and 2RSD values, respectively, as discussed in Appendix 3. However, the 2RSD values in Appendix 6 include propagated errors of the expected concentrations in the reference materials, similar to the APR error values for whole-rock laboratory data. Therefore, the 2RSD values also represent uncertainties in the accuracy estimates.

The instrumental minimum detection limit (MDL), accuracy and precision of the PXRF data vary both for different elements and for the same element in different reference materials, depending on the chemical composition of analyzed sample. Based on the average APR and 2RSD values for all analyzed reference materials, our PXRF analyzer produced accurate results for As, Ba, Bi, Cd, Cr, Cu, Fe, K, Mn, Mo, Nb, Pb, S, Sb, Se, Si, Sn, Sr, Ti, W, Zn and Zr. The average 95.5% confidence-level precision of the results is ±15% (total range is between 2% and 41%), which is similar to the quality for the laboratory-generated whole-rock data (Appendix 4).

Concentrations of Au, Co, Mg, Ni and Pd in the reference materials were either unknown or lower than the PXRF analyzer's MDL for these elements. The PXRF had an unexplained bias for Ag results (APR = 205%–222 %) on reference materials with ~30–50 ppm Ag, or <MDL on reference materials with ~0.2–0.3 ppm Ag, but produced accurate results for the RCRA reference material with 500 ppm Ag (Appendix 6). Other elements that produced inaccurate results relative to the reference materials used include Al, Ca, Cl, P, Rb and V.

The minimum detection limits, accuracy and precision of the PXRF analyzer for some of the elements can be improved by purging the air from the analyzer's detector with helium and/or using the manufacturer-calibrated Soil Mode® of analysis in addition to the Mining Mode®. The Soil Mode® is based on different a X-ray fluorescence method than the Mining Mode® and provides determinations of Cs, Hg, Te, Th and U, which are not determined by the Mining Mode®. However, we used neither helium nor the Soil Mode® during our fieldwork in 2009.

Although the PXRF analyses of prepared (i.e., ground and packed in plastic cups) samples can provide data for some elements that are as accurate and precise as the laboratory whole-rock methods, it should be kept in mind that the individual in situ analyses of heterogeneous samples will not be representative of the bulk-rock compositions determined on large, homogenized (i.e., pulverized and dissolved) samples in laboratory. Nonetheless, the in situ PXRF analyses can provide rapid detection and useful geochemical characteristics of mineralization in outcrop, which may be difficult or impossible to identify by other field methods.

# Appendix 6 – Accuracy and Precision of Portable X-Ray Fluorescence Data

| Standard | MP-1b (18 runs) | | | NCSDC73308 (20 runs) | | | NIST2780 (19 runs) | | | RCRA (19 runs) | | | Till-4 (23 runs) | | | $SiO_2$ (20 runs) | | Average (all stds) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PPM | APR | 2RSD | PPM | APR | 2RSD | PPM | APR | 2RSD | PPM | APR | 2RSD | PPM | APR | 2RSD | PPM | APR | APR | 2RSD |
| Ag | 47 | 205 | 38 | 0.27 | <MDL | | 27 | 222 | 30 | 500 | 100 | 21 | 0.2 | <MDL | | <MDL | <MDL | 176 | 30 |
| Al | 34650 | 179 | 13 | n/a | | | 88700 | 48 | 15 | n/a | | | 76231 | 43 | 20 | n/a | <MDL | 90 | 16 |
| As | 23000 | 60 | 5 | 25 | 89 | 21 | 48.8 | <MDL | | 500 | 75 | 20 | 111 | 82 | 6 | <MDL | <MDL | 77 | 13 |
| Au | n/a | <MDL | | n/a | <MDL | | 0.18 | <MDL | | n/a | | | 0.005 | <MDL | | n/a | <MDL | <MDL | |
| Ba | n/a | <MDL | | 42 | <MDL | | 993 | 82 | 11 | n/a | | | 395 | 96 | 14 | <MDL | <MDL | 89 | 12 |
| Bi | 954 | 79 | 9 | 0.38 | <MDL | | n/a | | | n/a | <MDL | | 40 | 163 | 10 | n/a | <MDL | 121 | 9 |
| Ca | 24700 | 148 | 4 | 2800 | 285 | 4 | 1950 | 211 | 11 | n/a | | | 8935 | 129 | 3 | n/a | | 193 | 6 |
| Cd | 527 | 95 | 8 | 1.12 | <MDL | | 12.1 | <MDL | | 500 | 97 | 20 | 0.2 | <MDL | | <MDL | <MDL | 96 | 14 |
| Cl | n/a | | | 53 | 2094 | 75 | n/a | | | n/a | | | n/a | | | n/a | <MDL | 2094 | 75 |
| Co | 4 | <MDL | | 15.3 | <MDL | | 2.2 | <MDL | | n/a | <MDL | | 8 | <MDL | | <MDL | <MDL | <MDL | |
| Cr | n/a | | | 136 | 85 | 33 | 44 | 163 | 37 | 500 | 93 | 41 | 53 | 188 | 22 | <MDL | <MDL | 132 | 33 |
| Cu | 30690 | 87 | 3 | 22.6 | <MDL | | 215.5 | 79 | 16 | n/a | | | 248 | 101 | 9 | <MDL | <MDL | 89 | 9 |
| Fe | 81900 | 104 | 3 | 2700 | 1043 | 2 | 27840 | 103 | 4 | n/a | | | 39371 | 108 | 2 | <MDL | <MDL | 340 | 3 |
| K | 2000 | <MDL | | 1041 | <MDL | | 33800 | 106 | 10 | n/a | | | 26971 | 98 | 7 | n/a | <MDL | 102 | 8 |
| Mg | 240 | <MDL | | n/a | <MDL | | 5330 | <MDL | | n/a | <MDL | | 7600 | <MDL | | n/a | <MDL | <MDL | |
| Mn | 480 | 135 | 12 | 1010 | 114 | 9 | 462 | 120 | 15 | n/a | | | 465 | 119 | 14 | <MDL | <MDL | 122 | 12 |
| Mo | 285 | 106 | 11 | 1.2 | <MDL | | 11 | 88 | 21 | n/a | <MDL | | 16 | 96 | 16 | <MDL | <MDL | 97 | 16 |
| Nb | n/a | | | 6.8 | 114 | 32 | 18 | 98 | 13 | n/a | | | 15 | 126 | 13 | <MDL | <MDL | 113 | 20 |
| Ni | n/a | <MDL | | 30 | <MDL | | 12 | <MDL | | n/a | <MDL | | 17 | <MDL | | <MDL | <MDL | <MDL | |
| P | 200 | <MDL | | 271 | 1357 | 46 | 427 | 720 | 42 | n/a | | | 873 | 463 | 19 | n/a | | 846 | 36 |
| Pb | 20910 | 81 | 3 | 27 | 48 | 50 | 5770 | 100 | 7 | 500 | 117 | 20 | 50 | 70 | 19 | <MDL | <MDL | 83 | 20 |
| Pd | n/a | <MDL | | n/a | <MDL | | n/a | <MDL | | n/a | <MDL | | n/a | <MDL | | <MDL | <MDL | <MDL | |
| Rb | n/a | | | 9.2 | 33 | 31 | 175 | 47 | 3 | n/a | | | 161 | 46 | 3 | <MDL | <MDL | 42 | 12 |
| S | 137900 | 109 | 3 | 90 | <MDL | | 12630 | 138 | 8 | n/a | <MDL | | 800 | 153 | 22 | n/a | <MDL | 133 | 11 |
| Sb | 54 | <MDL | | 6.3 | <MDL | | 160 | 91 | 12 | <MDL | <MDL | | 1 | <MDL | | <MDL | <MDL | 91 | 12 |
| Se | n/a | <MDL | | 0.28 | <MDL | | 5 | <MDL | | 500 | 92 | 20 | n/a | <MDL | | <MDL | <MDL | 92 | 20 |
| Si | 167900 | 120 | 4 | 415500 | 78 | 8 | 310000 | 64 | 8 | n/a | | | 303880 | 67 | 10 | n/a | | 82 | 7 |
| Sn | 16100 | 111 | 5 | 1.4 | <MDL | | n/a | <MDL | | <MDL | <MDL | | n/a | <MDL | | <MDL | <MDL | 111 | 5 |
| Sr | n/a | <MDL | | 25 | 82 | 14 | 217 | 90 | 9 | n/a | | | 109 | 94 | 4 | <MDL | <MDL | 89 | 9 |
| Ti | 752 | 78 | 15 | 1270 | 73 | 8 | 6990 | 75 | 5 | n/a | | | 4856 | 72 | 2 | <MDL | <MDL | 74 | 8 |
| V | n/a | | | 107 | 146 | 16 | 268 | 194 | 12 | n/a | | | 67 | 358 | 10 | <MDL | <MDL | 233 | 12 |
| W | 1100 | <MDL | | 1.6 | <MDL | | 24 | <MDL | | n/a | <MDL | | 204 | 124 | 18 | <MDL | <MDL | 124 | 18 |
| Zn | 166700 | 90 | 2 | 46 | 80 | 19 | 2570 | 76 | 9 | n/a | | | 70 | 91 | 14 | <MDL | <MDL | 84 | 11 |
| Zr | 150 | 94 | 17 | 70 | 94 | 14 | 176 | 89 | 3 | n/a | | | 385 | 89 | 3 | <MDL | <MDL | 92 | 9 |

Abbreviations: PPM, expected concentration (parts per million); APR, accuracy in terms of average percentage recovery relative to expected concentration in reference material; 2RSD, 95.5% confidence-level precision in terms of twice relative standard deviation (%) of all runs combined with error of expected concentration; MDL, minimum detection limit by Niton XL3t 900S portable X-ray fluorescence (PXRF) analyzer.

Notes: Estimated accuracy and precision of the PXRF analyses are based on multiple runs of the certified and noncertified reference materials analyzed as packed powders. Total number of analyses for each reference material is given in parentheses. Results that are accurate within the average 95.5% confidence-level analytical uncertainty (±15 %) are in bold.

## Appendix 7 – Quantitative Mineralogical Analysis Methods, Activation Laboratories Ltd.

For the quantitative mineralogical analyses, the rock samples were crushed to nominally pass a 2 mm screen. For each sample, a 50 g split of crushed material was pulverized for the Rietveld X-ray diffraction (XRD) analysis. Another 50–100 g split was stage-crushed to pass a 0.85 mm screen, and a 30 mm diameter polished section was prepared from the crushed material for mineral liberation analyses (MLA).

The Actlabs MLA is a quantitative mineralogical technology based on an FEI Quanta600F scanning electron microscope (SEM). The method involves a combined image analysis employing atomic-number contrast imaging from backscattered-electron (BSE) signal intensity and energy-dispersive spectrometry (EDS) using two Bruker 5010 SDD detectors. The MLA directly identifies mineral phases and quantifies their relative proportions in polished sections using both X-ray BSE particle analysis and modal analysis by linear intercept measurements, in which points are spaced close together in the X-scanning direction, and scan lines are typically set farther apart. Based on comparisons of semiquantitative EDS and literature data, chemical compositions of each mineral were assigned and assays calculated by the MLA. The identified minerals and their proportions were verified by quantitative Rietveld XRD analysis.

For the quantitative XRD analyses, portions of pulverized samples were mixed with 10 wt. % corundum and packed into standard holders. Corundum was used as an internal standard to determine the X-ray amorphous content of the samples. The quantities of the crystalline mineral phases were determined using the Rietveld method, which is based on the calculation of the full diffraction pattern from crystal structure information. The XRD analyses were performed on a Panalytical X’Pert PRO diffractometer equipped with Cu X-ray source and operating under the following parameters: 40 kV voltage, 40 mA current, 4–80° 2θ range, 0.02° 2θ step, 2 seconds per step, 1° fixed-angle divergence slit, 0.2 mm receiving slit, and 1 revolution/second sample rotation.

# Appendix 8 – Quantitative Rietveld X-Ray Diffraction Data

| Mineral | Sample Number | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8175 | 8191 | 8192 | 8196 | 8253 | 8265 | 8267 | 8268 | 8287 | 8290 | 8296 |
| Quartz | 81.5 | n.d. | 77.0 | 19.0 | 26.0 | 66.7 | 76.7 | 3.6 | 0.3 | n.d. | 17.5 |
| Microcline/orthoclase | n.d. | 50.0 | 1.8 | n.d. | 18.3 | 4.3 | n.d. | n.d. | n.d. | n.d. | 5.3 |
| Albite | n.d. | n.d. | n.d. | 6.8 | 5.7 | 1.9 | n.d. | 17.9 | n.d. | n.d. | n.d. |
| Muscovite/illite | n.d. | 13.1 | n.d. | 31.9 | 2.9 | n.d. | n.d. | 4.7 | n.d. | n.d. | 34.0 |
| Chlorite | n.d. | n.d. | n.d. | 3.0 | 1.4 | n.d. | n.d. | 13.8 | n.d. | n.d. | n.d. |
| Calcite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 1.3 | 0.3 | n.d. | 4.8 |
| Dolomite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 6.4 | 70.6 | 74.1 | n.d. |
| Smithsonite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 14.1 | 3.7 | n.d. |
| Jarosite | n.d. | n.d. | n.d. | n.d. | n.d. | 0.6 | n.d. | n.d. | n.d. | n.d. | n.d. |
| Apatite | 3.6 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 1.4 |
| Pyrite | n.d. | n.d. | n.d. | n.d. | 0.6 | n.d. | n.d. | n.d. | 2.4 | 2.3 | n.d. |
| Galena | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 1.0 | 6.4 | n.d. |
| Sphalerite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 2.9 | 7.9 | n.d. |
| Covellite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 1.0 | 8.5 | n.d. | n.d. |
| Rutile | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.5 | n.d. | n.d. | n.d. |
| Goethite | n.d. | 0.9 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. |
| X-ray amorphous | 14.9 | 36.0 | 21.2 | 39.3 | 45.0 | 26.4 | 23.3 | 50.9 | n.d. | 5.6 | 37.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 99.9 | 99.9 | 100.0 | 100.1 | 100.1 | 100.0 | 100.0 |

Abbreviations: n.d., not determined.

Notes: Mineral abundances are in wt. %. The X-ray amorphous component includes poorly crystalline mineral phases (e.g., smectite).

# Appendix 9 – Quantitative Mineral Liberation Data

| Mineral | Sample Number | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8191 | 8268 | 8175 | 8192 | 8196 | 8253 | 8265 | 8267 | 8296 | 8287 | 8290 |
| Albite | <0.1 | 22.54 | n.d. | n.d. | 5.89 | 4.84 | 1.20 | <0.1 | 0.90 | n.d. | n.d. |
| Amphibole | n.d. | 1.03 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. |
| Apatite | <0.1 | 2.21 | 3.66 | n.d. | 0.15 | 0.07 | n.d. | 0.12 | 3.32 | n.d. | n.d. |
| Barite | n.d. | n.d. | 0.16 | n.d. | n.d. | n.d. | 0.08 | 0.08 | n.d. | n.d. | n.d. |
| Biotite | 0.68 | 2.22 | <0.1 | 0.05 | 0.20 | 0.45 | 0.10 | <0.1 | 0.44 | n.d. | n.d. |
| Calcite | n.d. | 0.43 | 0.10 | n.d. | n.d. | n.d. | n.d. | n.d. | 2.1 * | 0.70 | 0.37 |
| Cerrusite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.62 | 1.11 |
| Cerussite (Fe-rich) | n.d. | n.d. | n.d. | n.d. | n.d. | 0.06 | 0.18 | n.d. | <0.1 | n.d. | n.d. |
| Chlorite | 0.76 | 28.66 | 0.14 | 0.17 | 1.37 | 1.33 | 0.58 | <0.1 | 2.42 | n.d. | n.d. |
| Covellite | n.d. | 1.83 | 0.07 | n.d. | n.d. | <0.1 | n.d. | <0.1 | n.d. | n.d. | n.d. |
| Cu-oxide | n.d. | 0.39 | 0.25 | n.d. | n.d. | n.d. | n.d. | 0.34 | n.d. | n.d. | n.d. |
| Cu-sulphate | n.d. | 1.98 | 1.15 | n.d. | n.d. | n.d. | n.d. | 0.86 | n.d. | n.d. | n.d. |
| Dolomite | n.d. | 2.44 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 67.60 | 72.35 |
| Fe-sulphate | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 1.06 | 1.63 |
| Fe-sulphate/clay | 0.31 | n.d. | <0.1 | 0.14 | <0.1 | 0.08 | 1.11 | <0.1 | 0.24 | n.d. | n.d. |
| Galena | n.d. | n.d. | n.d. | n.d. | <0.1 | 0.15 | <0.1 | n.d. | n.d. | 1.69 | 5.44 |
| Goethite | 4.73 | n.d. | <0.1 | 1.67 | 0.13 | 0.16 | 3.62 | <0.1 | 2.32 ** | 4.07 | 0.99 |
| Hematite | 0.14 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. |
| Illite | 24.08 | 6.19 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. |
| Illitic clay | 5.11 | 20.60 | 1.07 | 1.29 | 45.60 | 20.90 | 6.20 | 2.34 | 55.90 | n.d. | n.d. |
| Jarosite | 0.05 | <0.1 | <0.1 | 0.15 | n.d. | <0.1 | 0.60 | <0.1 | 0.16 | n.d. | n.d. |
| K-feldspar | 60.42 | 0.26 | <0.1 | 3.37 | 0.89 | 21.66 | 7.39 | 0.55 | 2.75 | 1.03 | 1.33 |
| K-feldspar/clay | 2.59 | <0.1 | <0.1 | 0.31 | 0.43 | 1.06 | 0.87 | 0.19 | 1.98 | n.d. | n.d. |
| Kaolinite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0.10 | 0.38 |
| Muscovite/illite | n.d. | n.d. | 0.13 | 0.92 | 30.85 | 7.47 | 0.52 | 3.50 | 14.74 | n.d. | n.d. |
| Mn-oxides | <0.1 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. |
| Phosphates | 0.10 | n.d. | n.d. | n.d. | n.d. | <0.1 | n.d. | n.d. | 0.44 | n.d. | n.d. |
| Plagioclase | <0.1 | 0.34 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. |
| Pyrite | n.d. | n.d. | n.d. | n.d. | n.d. | 0.18 | n.d. | n.d. | <0.1 | 2.96 | 1.68 |
| Quartz | 0.17 | 3.41 | 92.49 | 90.19 | 10.32 | 36.20 | 70.93 | 90.71 | 5.94 | 0.45 | 0.29 |
| Rutile | 0.52 | 4.46 | n.d. | 0.21 | 0.35 | 0.36 | 0.07 | <0.1 | 0.17 | 0.05 | 0.06 |
| Silica | 0.32 | 1.04 | 0.80 | 1.41 | 3.80 | 5.00 | 6.54 | 1.30 | 6.21 | n.d. | n.d. |
| Smithsonite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 14.02 | 3.65 |
| Sphalerite | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 5.65 | 10.72 |
| Zircon | n.d. | n.d. | <0.1 | 0.09 | <0.1 | <0.1 | <0.1 | n.d. | <0.1 | n.d. | n.d. |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 95.6 | 100.00 | 100.00 |

* includes dolomite

** includes globular Zn-goethite

Abbreviations: n.d., not determined.

Notes: Mineral abundances are in wt %. Silica includes amorphous Si-rich material; some quartz determined by the MLA may include amorphous silica. K-Feldspar/clay includes altered feldspar. Illitic clay includes mostly poorly crystalline to X-ray amorphous clay, compositionally similar to illite-smectite. Cu-oxide includes copper carbonate. Phosphates include iron phosphates and crandalllite. In addition, sample 8175 contains accessory copper phosphate associated with apatite, and accessory Cu-Bi-arsenate occurs in sample 8267.