Geochronological and Lead Isotopic Constraints on the Age and Origin of the Laidman Gold Prospect, Central British Columbia

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INTRODUCTION

Mineralization at the Laidman Gold Prospect occurs in quartz veins and quartz breccias hosted within granitic rocks of the Laidman Lake batholith (Figure 1). The Laidman property occurs in the general vicinity of several other precious metal epithermal, skarn, and porphyry prospects in the Fawnie Creek map area (Figure 1).

This study focuses on the 110 Zone of the Laidman property where granitic rocks have been affected by an extensive east-west trending zone of sericitic to argillic alteration that hosts locally gold-bearing quartz veins and quartz breccias. The purposes of this study are to describe the different phases within the Laidman property, place constraints on the timing of magmatism and mineraliza-

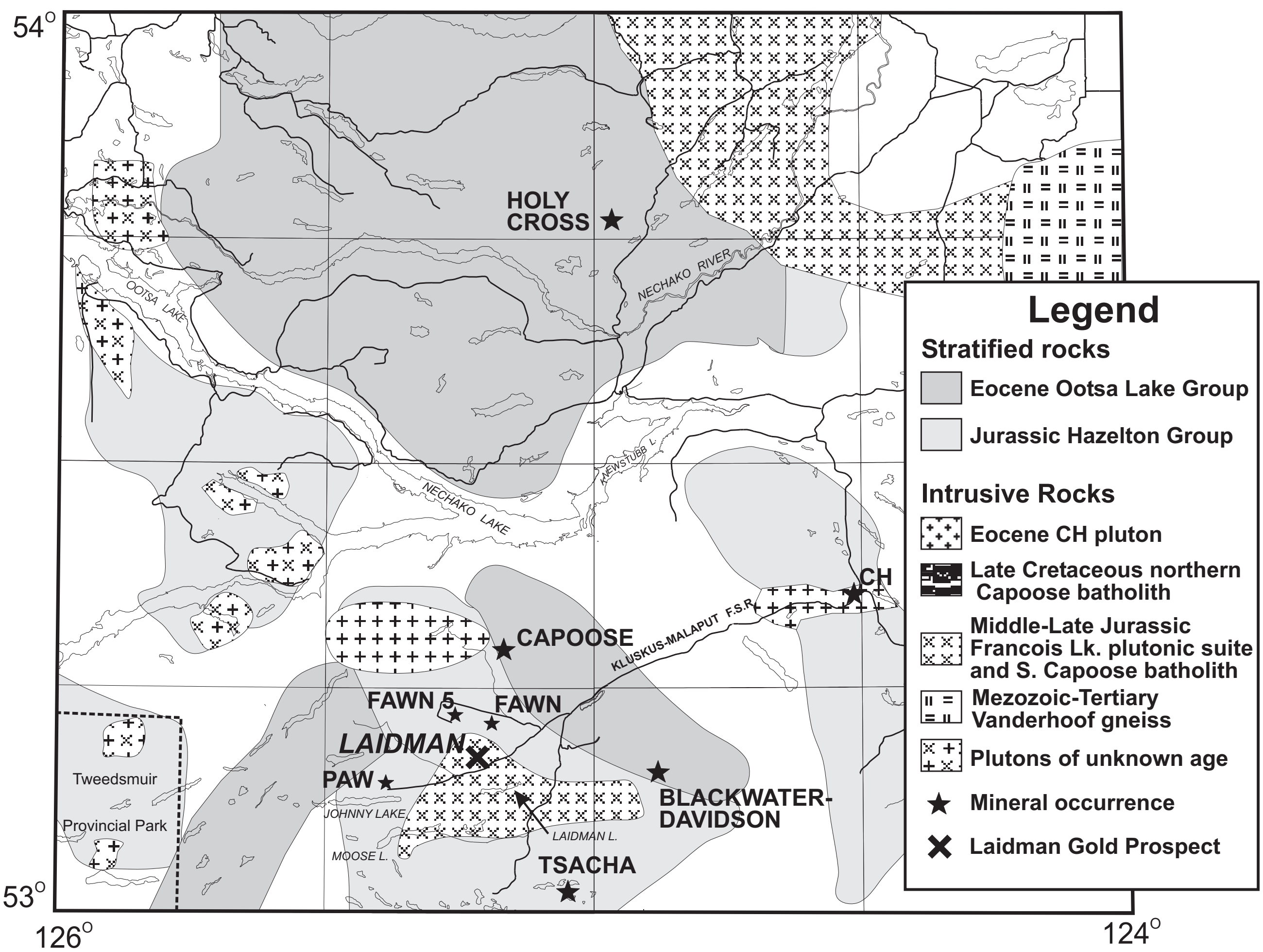

Figure 1. Compilation geological map of the Nechako River map area (93F), modified from Lane and Schroeter (1997), Diakow and Webster (1994), Tipper (1963), and Friedman *et al.* (in prep.).

tion using U-Pb dating and Pb isotopic analyses, and use this data to assess possible relationships with other mineral deposits and occurrences in the region.

Location and Access

The Laidman gold prospect is located on the gently sloping south face of the Entiako Spur, a topographically elevated ridge which intersects the northwest trending Fawnie Range. The claims are within the Fawnie Creek map area (NTS 93 F/3), 155 kilometers southwest of Vanderhoof in the plateau region of central British Columbia. Access to the property from Vanderhoof is via the Kluskus-Ootsa Forest Service road for about 140 kilometers, then southwest along the Kluskus-Malaput Forest Service road for 15 kilometers. Local spur roads built for clear-cut logging purposes and four wheel drive roads to drill sites allow access to the central portion of the claim blocks.

Exploration History

Until recently the Nechako River region has been relatively under-explored although the favourable geology of the area suggests the potential to host many different styles of mineralization. Past exploration efforts were hampered by a lack of bedrock exposure, poor road access, and a generally out-of-date geoscience database (Lane and Schroeter, 1997).

Access to the area has greatly improved since the completion of the Kluskus Forestry road in 1977. As part of the Interior Plateau Project, ongoing geologic mapping, geochemical, geochronological, and metallogenic studies by the British Columbia Geologic Survey Branch and Geologic Survey of Canada has greatly increased the database of knowledge for the interior plateau region of British Columbia. With the release of this new data to the public, a significant increase in staking and exploration has ensued (Lane and Schroeter, 1997). Targets of recent exploration efforts include precious metal-bearing epithermal veins, skarns, and porphyry deposits.

Based on cross-cutting relationships and existing geochronological data associated with specific suites of intrusions, Lane and Schroeter (1997) have recognized three mineralizing events in the interior plateau:

A Late Jurassic-Early Cretaceous event associated with the emplacement of the plutons of the Francois Lake Plutonic Suite which includes the Endako porphyry Mo deposit, the largest molybdenum deposit known in Canada (Woodsworth *et al.*, 1991). Within the Nechako River map area (NTS 93F) Late Jurassic-Early Cretaceous prospects include porphyry (Paw), vein and porphyry related (Laidman), skarn (Fawn 5), and epithermal vein (Fawn) showings (Figure 1);

Late Cretaceous felsic dikes and sills which intrude Hazelton Group rocks are the likely source of mineralization for the Capoose porphyry(?)-related silver (±gold), and the Blackwater-Davidson precious and base metal prospect;

Mineralization of Eocene (or younger) age consists mainly of epithermal precious metal prospects. These include the Wolf, Holy Cross, Trout, Uduk Lake, Loon, and Oboy prospects. Porphyry-style mineralization of Eocene age also occurs at the CH Cu-Au-Mo deposit (Figure 1). The Equity Silver Mine (4.3 million tonnes grading 135 g/t Ag, 0.45 % Cu, and 1.3 g/t Au in Main Zone), 38 kilometers southeast of Houston, B.C., is a classic high sulphidation vein deposit associated with intrusive activity at approximately 60 Ma (Cyr *et al.*, 1984, and Friedman, pers. comm., 1998).

Regional Geology

The Laidman gold prospect lies within the Nechako Arch, a zone of regional uplift in the Stikine terrane near the western margin of the Intermontane Superterrane. Pre-Tertiary rocks exposed in the Nechako Arch include arc-related calc-alkaline volcanic and volcaniclastic rocks of the Middle Jurassic Hazelton Group, and easterly-derived clastic rocks of the Lower Cretaceous Skeena Group. Intrusive rocks include augite porphyry plugs of Middle Jurassic age, likely coeval with similar volcanic rocks of the Hazelton Group, Late Jurassic to Early Cretaceous quartz monzonite to granitic plutons of the Francois Lake Plutonic Suite, and Late Cretaceous quartz diorite and quartz porphyry dikes, plugs, and stocks (Diakow & Webster, 1994).

Rocks of Tertiary and younger age include rhyolitic to dacitic tuff, flows and breccias of the Ootsa Lake Group, and Miocene Chilcotin Group plateau basalt flows (Diakow &Webster, 1994). Tertiary and younger intrusive rocks include the CH granodiorite pluton of Eocene age (Friedman, pers. comm., 1998.).

The oldest rock unit observed in the Fawnie Creek map area (NTS 93 F/3) forms the lowest part of the Hazelton Group. It has been informally named the Naglico formation by Diakow & Webster (1994) and consists of flows and volcaniclastic rocks interbedded with Middle Jurassic sedimentary strata. The Naglico formation underlies the entire Fawnie Creek map area although exposure is less continuous on the Entiako Spur. In this area it comprises a relatively thin blanket of thermally altered rocks in intrusive contact with the Laidman Lake batholith (Diakow & Webster, 1994).

Mesozoic rocks which dominate the Fawnie and Nechako ranges terminate abruptly to the north and south, where younger volcanic successions underlie much of the subdued topography. These dramatic changes in physiography and stratigraphy delineate a broad horst, called the Nechako uplift. The timing of structural uplift may be contemporaneous with Late Cretaceous deformation that imparted a pervasive penetrative cleavage and local mylonitic fabric on Jurassic strata in the Nechako Range. The structural fabric is cut by undated diorite plutons and the Eocene CH pluton (Diakow *et al.*, 1995). Regional metamorphism in the Nechako River map area is limited to low grade greenschist facies (Wetherup, pers. comm., 1998).

PROPERTY GEOLOGY

The western part of the Laidman property is underlain by southwest-dipping sedimentary and volcaniclastic rocks of the Middle Jurassic Naglico formation. Lapillistone and tuff units of the Naglico formation have been intruded and contact metamorphosed by the Laidman Lake batholith, which has converted them to hornfels and local small bodies of skarn (Fox, 1996 unpublished report). During the 1997 field season the author and Steve Wetherup mapped an 800 by 800 metre area surrounding the '110 Zone' on the Laidman property at a scale of 1:2500 (Figure 2). The majority of the 110 Zone map area is underlain by two granite phases of the Laidman Lake batholith. Parallel trending rhyolite and dacite dikes cut the granites and are themselves cut by younger plugs of diorite and monzodiorite. A series of south-facing scarps may be the result of Tertiary extension or movement along the Top Lake lineament immediately north of the Laidman prospect.

Alteration in the 110 Zone map area occurs as extensive east-west trending zones of phyllic to argillic alteration aureoles around quartz veins and stockworks which locally contain chalcedonic quartz and clay-altered feldspar. Quartz veins are white to translucent, massive to vuggy and contain disseminated aggregates of pyrite and arsenopyrite. Rocks within these zones are locally brecciated, containing fragments of granite, dacite, and rhyolite.

Intrusive Phases

Five phases of intrusions were identified during detailed surface mapping and logging of drill core. A suite of least altered samples was collected to determine textural, compositional and petrological variations between phases. Samples were examined petrographically, and a subset of the samples were analyzed for major, trace and rare earth elements (REE).

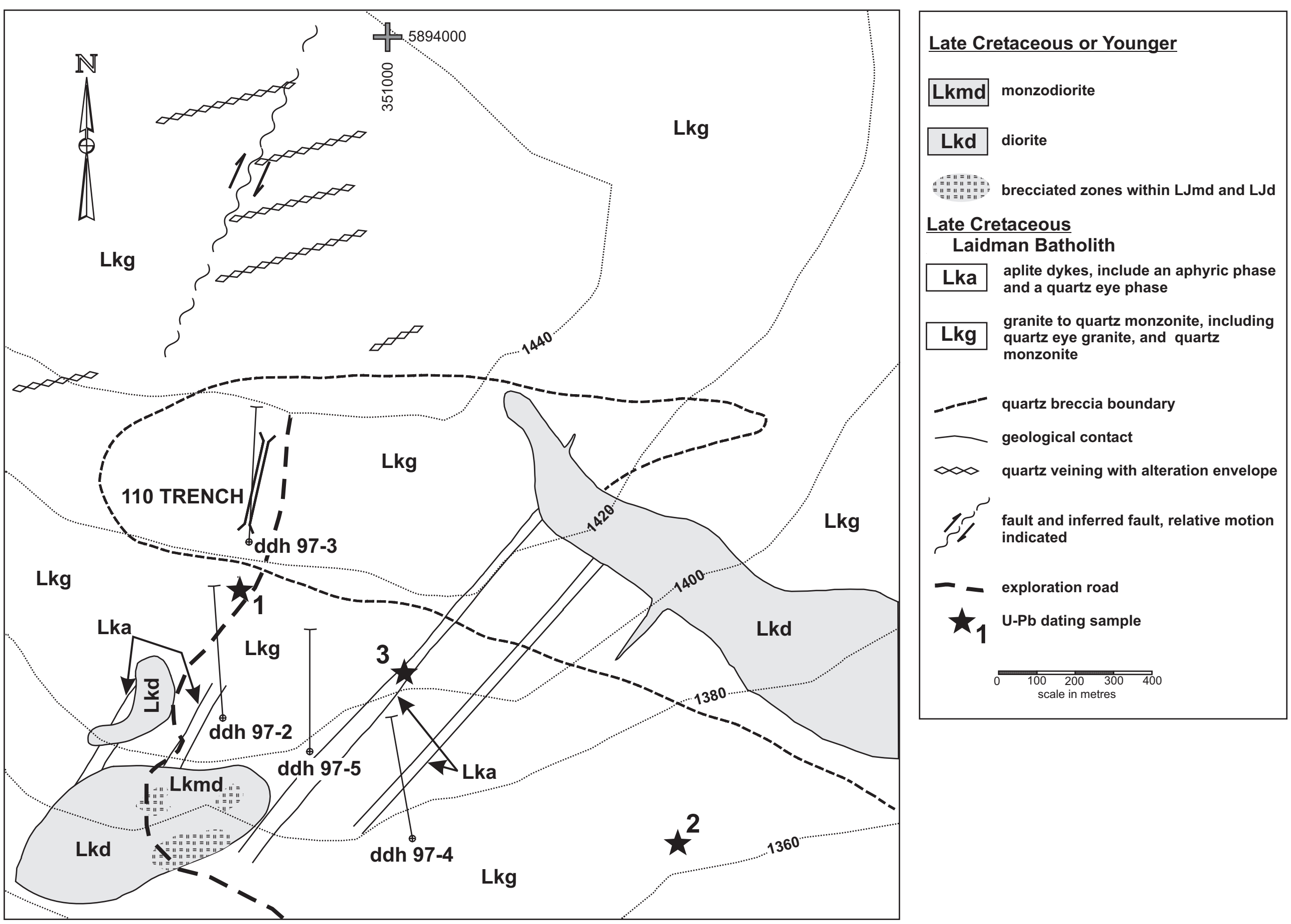

Figure 2. Detailed geology map of the 110 Zone of the Laidman property (after Fox, 1998).

Quartz Eye Granite

The quartz eye granite phase crops out sporadically in the southern portion of the map area . It is light pink where fresh and brown to grey on weathered surfaces. The lack of outcrop in the southern part of the map area obscures the contact relationship with the hypidiomorphic granite phase which surrounds it. The main distinguishing feature of this granite are 2 to 3 mm quartz eyes which occur as agglomeracrysts up to 1.5 cm in size. The agglomeracrysts are surrounded by a hypidiomorphic growth texture of K-feldspar up to 3 mm in size, plagioclase crystals up to 1.5 mm, and quartz grains less than 1 mm in size. The mode of the rock is quartz 35%, K-feldspar 45%, plagioclase 28%, and biotite approximately 2% of the rock. The quartz eye granite ranges from fresh to phyllicly altered, with feldspar minerals partially altered to sericite and biotite partially altered to chlorite.

Granite

The hypidiomorphic granite phase underlies the majority of the map area and surrounds the quartz eye granite phase. The colours of the fresh and weathered surface vary with alteration and proximity to east-west trending quartz veins. Fresh granite is light pink to buff, and weathered surfaces are grey with white plagioclase grains. Where affected by alteration, the feldspars are pale green to chalky white imparting a lighter overall colour to the rock. The modal mineralogy ranges throughout the map area with quartz (up to 3.5 mm in size) 25-35%, K-feldspar (up to 12 mm in size) 40-45%, plagioclase (up to 5 mm) 20-30%, 5-10% biotite, and up to 2% hornblende. Alteration ranges from sericitic to argillic around quartz veins with iron stained argillic alteration prevalent near the monzodiorite plug (see below).

Rhyolitic and Dacitic Quartz-feldspar Porphyry Dikes

Parallel, northeast-trending sets of rhyolite and quartz feldspar porphyry dikes of dacitic composition cross cut the quartz eye granite and hypidiomorphic granite phases (Figure 2). Clasts of both rock types are locally found in quartz breccias and are observed in drill core as xenoliths in the monzodiorite. Relatively fresh rhyolite from drill core is dull grey and aphanitic. Fresh quartz feldspar porphyry dacite from drill core is fine-grained and medium-grey with approximately 20% quartz, 20% K-feldspar, 50% plagioclase, 15% biotite, minor hornblende, and locally up to 5% euhedral pyrite. In thin section the plagioclase crystals show strong zoning, and mafic minerals are partially to completely altered to chlorite.

Hornblende-biotite Diorite

A plug of hornblende-biotite diorite intrudes into the granite and cross-cuts the rhyolite and porphyritic dacite dikes in the central portion of the 110 Zone. The diorite is medium-grained with a salt-and-pepper appearance, with fine-grained border phases near the sharp contact with the granite. Locally the diorite has pervasive carbonate alteration with 1-2 mm calcite veins and is generally weakly to moderately magnetic. Mineral abundances include 15-20% quartz, 10-15% K-feldspar, 45-50% plagioclase, 15% biotite, 10% hornblende and locally up to 10% pyrite. Fresh to weakly chloritized mafic minerals indicate that the diorite has not been extensively altered.

Monzodiorite

Fine to medium-grained olive-coloured monzodiorite occurs as a small plug that intrudes granite in the south-west portion of the map area. The extreme western portion of this plug is similar to the hornblende-biotite diorite unit indicating that there may be a gradational contact between the diorite and the monzodiorite. Breccia zones within the plug contain clasts of granite, quartz monzonite, rhyolite, dacite and diorite surrounded by a monzodiorite matrix. The monzodiorite is fine to medium-grained, and comprises 10-15% quartz, 10-15% K-feldspar, and approximately 45% plagioclase. Mafic minerals include 15% biotite and 10% hornblende with pyrite and other opaque minerals making up the remainder of the rock.

Mineralization

Extensive argillic alteration and quartz stockwork zones were discovered in 1995 along logging roads and within clear-cut blocks. Subsequent work lead to the 'Discovery Zone', a zone of quartz veinlets bearing up to 19.6 g/t gold from bedrock and rubble crop exposures. Geochemical soil sampling and prospecting during the 1996 field season defined a continuous gold anomaly (the 110 Zone) with peak gold contents reaching 5640 ppb. Coincident with the gold anomaly are locally high levels of silver, arsenic, and bismuth (up to 23832 ppb Ag, 465 ppm As, and 57 ppm Bi). Initial work indicated that this anomaly coincided with a partially exposed quartz breccia zone which graded up to 1440 ppb (Fox, 1996 unpublished report).

During the 1997 field season, the 110 Zone was mapped at a scale of 1:2500 in preparation for a diamond drill program, which consisted of five holes, totaling 1004.5 metres. Drill hole 97-1 tested mineralization in the original Discovery Zone, and holes 97-2 through 97-5 tested the 110 Zone. The drilling intersected mainly granite and diorite with lesser monzodiorite and dacitic to rhyolitic dikes. The rock were commonly argillic to chloritic altered with local sericitization and silicification. Mineralization consisted of abundant pyrite as disseminations, clots, fracture fillings, and veinlets with rare traces of chalcopyrite and arsenopyrite. Gold content was generally low with the best results from DDH 97-5 where a heavily silicified interval between two dacite dykes averaged 643 ppb gold over 4.1 metres and DDH 97-4 which had an interval of 18 metres averaging 116.7 ppb gold (Fox, 1997 unpublished report).

Polished sections were made from a float sample of quartz breccia with rust coloured granitic fragments (sample LP-203), which assayed 19760 ppb gold, as well as mineralized samples from drill core. Two phases of pyrite are visible in polished section with the first being highly fractured and partially to completely altered to limonite. Less abundant euhedral galena up to 2.5 mm and fine-grained sphalerite are common. The sphalerite has been partially to completely replaced by pyrargyrite which also occurs as fine disseminations in the quartz. Microscopic subhedral to euhedral (cubic) grains of gold are commonly observed in close association with arsenopyrite which has been partially to completely altered to scorodite and limonite. Pyrite from polished section in drill core is euhedral and medium to coarse-grained. Trace chalcopyrite exsolutions from sphalerite are locally observed.

Whole Rock Geochemistry

Whole rock chemical compositions and rare earth element (REE) data for the complete intrusive rock suite are given in Tables 1 and 2 . An Irvine and Barager (1971) plot of Na_2O+K_2O versus SiO_2 is shown in Figure 3. All rocks from the sample suite are calc-alkaline and peraluminous. They plot in the subalkaline field in Figure 3 and define an array with the more felsic rocks having only a slight increase in Na_2O+K_2O with increasing SiO_2. High field strength and rare earth element abundances for rocks in the rhyolite/granite field from Figure 3 were plotted on a normative graph (Figure 4) . All samples follow a similar pattern throughout the element series, plotting for the most part on top of one another. A normative plot of representative samples from each rock type shows a general correlation of peaks and troughs for the element abundances with the exception of Sr which shows a substantial variation within the sample suite (Figure 5).

U-Pb GEOCHRONOLOGY

Studies undertaken by the British Columbia Geological Survey Branch and the Geological Survey of Canada, in conjunction with researchers in universities and industry, have significantly increased the geochronological database for the Nechako River map area. As a result, new intrusive phases and sub-phases have been recognized within the area. Dating of igneous rock units at the Laidman property was undertaken to help determine the relative timing of emplacement of intrusions and allow correlation with other intrusions in the area.

The southern portion of the Capoose batholith, approximately 40 kilometers northeast of the Laidman property, has previously yielded a K-Ar age of 141 Ma (Diakow *et al.*, 1995). A new U-Pb age of 148.1± 0.6 Ma has since been determined (Friedman, pers. comm., 1998) and suggests that the Capoose batholith is age equivalent to the Francois Lake Plutonic suite to the north. The Francois Lake Plutonic suite is interpreted to have crystallized in two main pulses. The Glenannan phase and its subphases were emplaced during the first pulse at 157-154 Ma, and the Endako phase, its subphases, and the Casey phase were emplaced during the second pulse at 148-145 Ma (Whalen *et al.*, 1998).

TABLE 1
RARE EARTH ELEMENT DATA FROM THE LAIDMAN PROSPECT
110 ZONE INTRUSIVE SUITE

Sample Name	Rock Type	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
61266	granite	6.4	12.8	22.7	2.3	8.1	1.3	0.3	0.7	0	0.9	0.2	0.6	0.4	0.7	0
61267	granite	12.1	26.1	48.9	4.7	16.7	2.8	0.4	1.8	0.3	1.6	0.6	1	0.4	1.2	0.2
61268	granite altered	6.4	20.8	33.2	3.2	12.3	1.8	0.4	1	0	0.6	0.4	0.7	0.3	0.6	0
61269	granite	2.3	4.4	9.6	1.1	4.6	0.7	0	0	0	0.3	0	0.6	0.2	0	0
61270	rhyolite	4.2	8.4	14.5	1.4	6.3	1	0.2	0.4	0	0.4	0.2	0.4	0.2	0.4	0
71031	granite	9.6	21.5	40.7	4	14.5	2.2	0.5	1.4	0.3	1.1	0.5	1	0.4	0.9	0.2
71032	diorite	14	23.6	45.1	5.5	22.8	4	1.3	3.2	0.3	1.5	0.8	1.6	0.5	0.9	0.2
71033	diorite	13.1	19.4	38.1	4.6	20.3	3.8	1.3	2.9	0.4	1.5	1	1.4	0.5	0.9	0.2
71034	granite	6.4	22.5	43.9	4	13.3	1.9	0.4	1.1	0.2	0.9	0.4	0.7	0.3	0.6	0
71036	diorite	11.2	23.7	44.6	4.9	20.4	3.4	1.1	2.1	0.3	0.6	0.5	1.3	0.5	0.7	0
71037	dacite altered	10.2	20.8	34.8	4.1	16.8	2.9	1	2.2	0.5	1.2	0.4	1.3	0.5	0.8	0
71038	granite altered	3.3	15.1	23	2.4	8.5	1.3	0.3	0.7	0	0.4	0.3	0.4	0.2	0.4	0
71039	dacite	9.5	23.4	35.8	3.8	15.4	2.5	0.7	1.5	0.2	1.1	0.6	1	0.4	0.9	0.2
71040	rhyolite	4.7	26.2	37.9	3.8	11.4	1.4	0.4	0.8	0	0.6	0.2	0.4	0.3	0.5	0
71041	monzonit	13.8	20.1	44.3	5.8	23.7	4.7	1.6	3.4	0.5	1.6	1	1.8	0.5	0.8	0

TABLE 2
WHOLE ROCK GEOCHEMICAL DATA FROM THE LAIDMAN PROSPECT
100 ZONE INTRUSIVE SUITE

Sample Name	Rock Type	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	Cr_2O_3	Ba	Sr	Zr	LOI	S	SUM
61266	granite	74.92	12.76	1.41	0.38	0.38	3.92	4.71	0.21	0.08	0.01	0.013	962	105	102	1	300	99.74
61267	granite	75.5	12.77	1.41	0.66	0.66	3.76	4.43	0.19	0.06	0.05	0.007	999	87	104	0.7	0	99.92
61268	granite	75.46	12.72	1.55	0.46	0.46	3.43	4.7	0.2	0.07	0.06	0.01	1141	101	82	0.9	0	99.8
61269	altered granite	84.3	2.9	6.35	0.12	0.12	0.16	0.83	0.09	0.28	0.01	0.007	484	31	10	3.2	28900	98.42
61270	rhyolite	75.2	11.81	2.34	0.65	0.65	1.55	5.63	0.19	0.05	0.03	0.01	1344	65	89	1.7	12300	99.52
71031	granite	75.49	12.59	1.75	0.76	0.76	3.74	4.15	0.19	0.03	0.05	0.006	1085	96	111	0.5	0	99.66
71032	diorite	61.1	16.17	6.11	5.02	5.02	4.01	2.63	0.75	0.38	0.13	0.007	1441	857	83	1.2	0	100.5
71033	diorite	61.02	16.23	6.4	5.56	5.56	3.73	2.79	0.78	0.28	0.12	0.01	1544	843	100	0.8	300	100.6
71034	granite	76.08	12.78	1.78	0.34	0.34	3.58	4.56	0.2	0.06	0.02	0.011	1078	105	99	0.9	200	100.6
71036	diorite	56.09	15.96	5.1	5.12	5.12	0.17	5.19	0.65	0.29	0.22	0.004	911	223	113	9.2	1600	100.6
71037	dacite	64.96	14.96	5.51	3.05	3.05	3.39	3.61	0.5	0.23	0.08	0.008	1465	583	104	1.9	6000	100.3
71038	altered granite	80.46	10.61	0.77	0.27	0.27	0.71	4.88	0.12	0	0.02	0.01	842	77	48	1.5	1000	99.62
71039	altered dacite	63.45	14.54	4.91	2.19	2.19	2.9	4.99	0.46	0.22	0.06	0.011	1673	355	133	4.1	24500	99.61
71040	rhyolite	76.82	12.29	1.25	0.07	0.07	1.15	6.27	0.1	0.01	0.01	0.011	1288	116	60	1.2	200	99.62
71041	monzonite	55.75	16.62	7.62	7.39	7.39	4.07	2.22	1	0.43	0.15	0.011	1407	1041	74	1.3	100	100.5

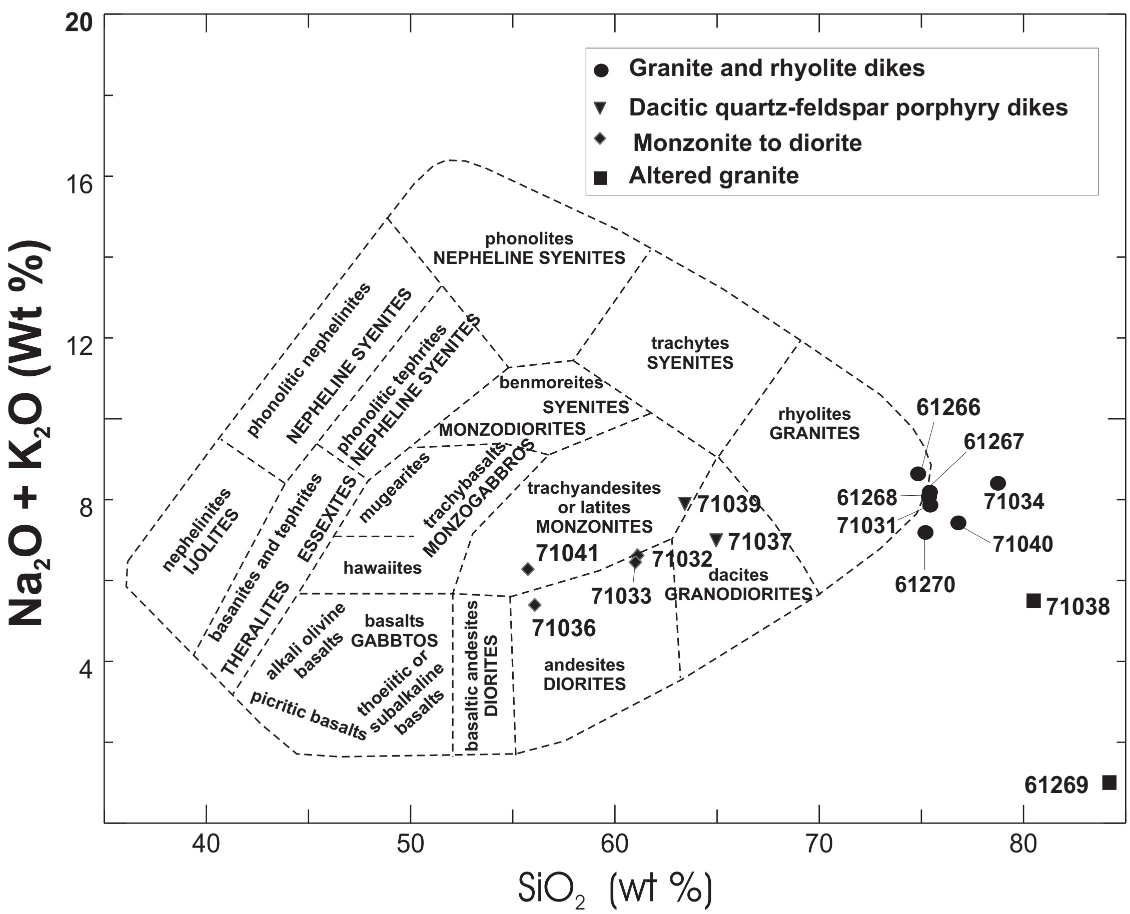

Figure 3. Classification of intrusive rock in the 110 Zone of the Laidman property based on their silica and alkali contents (after Irvine and Barager, 1971 and Cox *et al*., 1979).

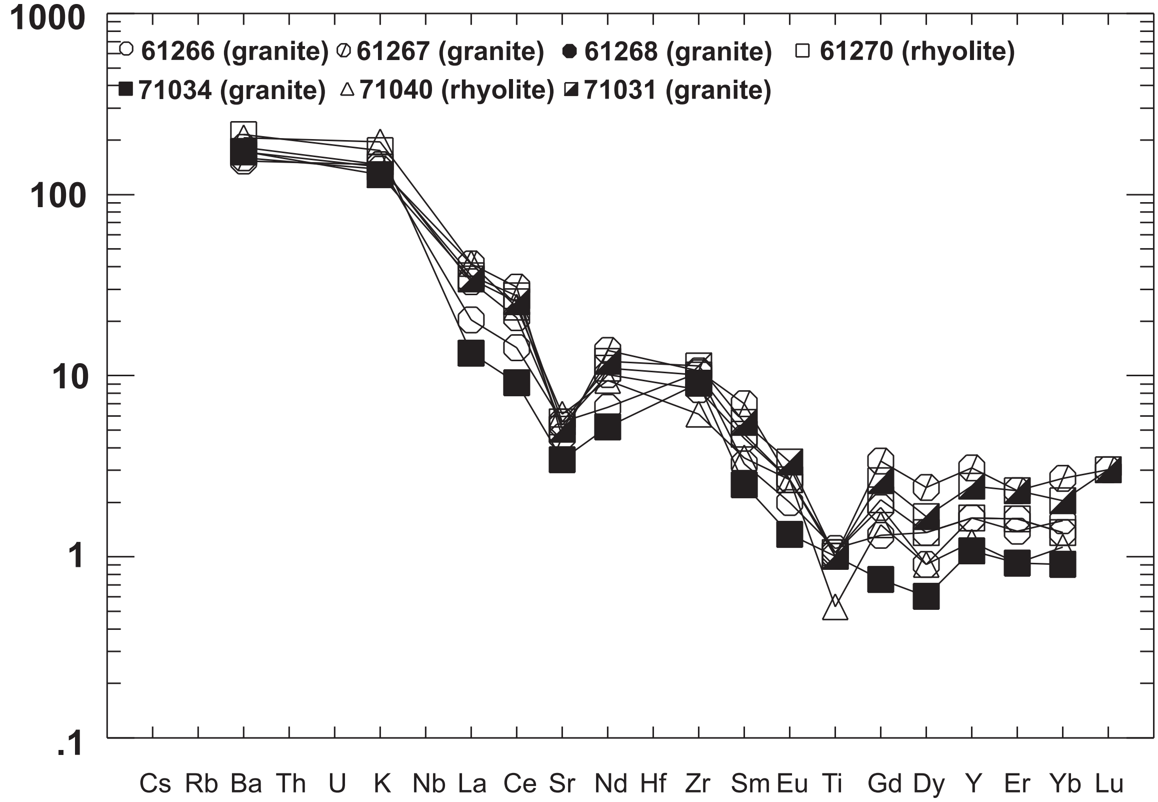

Figure 4. Plot of high field strength and rare earth element abundances normalized to primitive compositions.

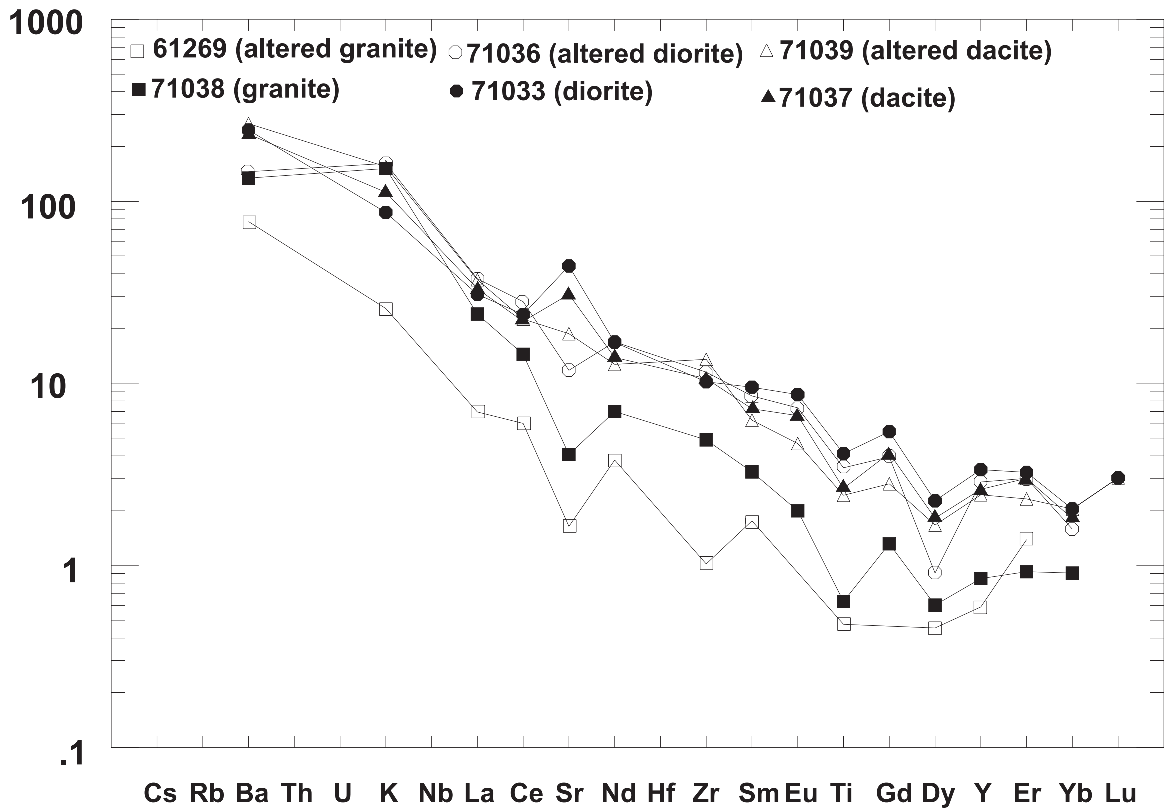

Figure 5. Plot of high field strength and rare earth element abundances normalized to primitive conditions comparing abundances in unaltered and altered rocks.

TABLE 3
U-PB ANALYTICAL DATA

Sample Description	Wt (mg)	U content (ppm)	Pb content* (ppm)	$^{206}Pb/^{204}Pb$ (meas)**	Total Common Pb (pg)	%^{208}Pb***	$^{206}Pb/^{238}U$****	$^{207}Pb/^{235}U$****	$^{207}Pb/^{206}Pb$****	$^{206}Pb/^{238}U$ age***** (Ma)	$^{207}Pb/^{206}Pb$ age***** (Ma)
LP-dacite											
A: N2,+134,abr	0.067	276	5.4	1775	13	12.8	0.02310(0.11)	0.1561(0.25)	0.04899(0.19)	147.2(0.3)	147.4(8.9)
B: N2,+134,abr	0.036	186	4.1	666	13	13.1	0.02031(0.13)	0.1370(0.52)	0.04893(0.46)	129.6(0.3)	144.2(21.7)
C: N2,+134,abr	0.046	152	3.6	806	12	13.7	0.02235(0.14)	0.1510(0.34)	0.04899(0.26)	142.5(0.4)	147.5(12.2)
D: N2,+134,abr	0.04	94	2.2	567	9	15.7	0.02226(0.14)	0.1503(0.58)	0.04899(0.51)	141.9(0.4)	147.4(24.0)
LP-monzonite											
A: N2,+134,abr	0.059	164	3.9	160	100	11.2	.02363(0.27)	0.1638(1.08)	0.05027(0.91)	150.5(0.8)	207.6(42.1)
B: N2,+134,abr	0.024	133	3.3	601	80	16.4	0.02325(0.24)	0.1588(0.82)	0.04954(0.72)	148.2(0.7)	173.4(33.5)
C: N2,+134,abr	0.041	191	4.2	187	62	12.7	0.02151(0.30)	0.1454(1.17)	0.04904(1.01)	137.2(0.8)	149.6(47.2)
D: N2,+134,abr	0.058	189	4.5	853	19	10.9	0.02326(0.10)	0.1572(0.31)	0.04902(0.24)	148.3(0.3)	148.6(11.2)
LP-granite											
A: N1,+134,abr	0.06	262	6.1	2727	8	9.9	0.02317(0.12)	0.1566(0.21)	0.04901(0.15)	147.7(0.3)	148.3(6.9)
B: N1,+134,abr	0.062	220	5.2	3106	6	9.9	0.02337(0.10)	0.1580(0.20)	0.04903(0.14)	148.9(0.3)	149.0(6.6)
C: N1,+134,abr	0.055	132	3.3	1245	9	13.1	0.02330(0.11)	0.1575(0.25)	0.04902(0.18)	148.5(0.3)	148.8(8.4)
D: N1,+134,abr	0.039	93	2.1	894	6	11.5	0.02314(0.14)	0.1563(0.37)	0.04900(0.30)	147.5(0.4)	147.8(14.2)

Footnotes: *N1, N2 = non-magnetic at given degrees side slope on Frantz isodynamic magnetic separator, grain size in microns; **radiogenic Pb, corrected for blank, initial common Pb and spike; ***corrected for spike and fractionation; ****corrected for blank Pb and U and common Pb errors at 1 sigma, *****errors at 2 sigma

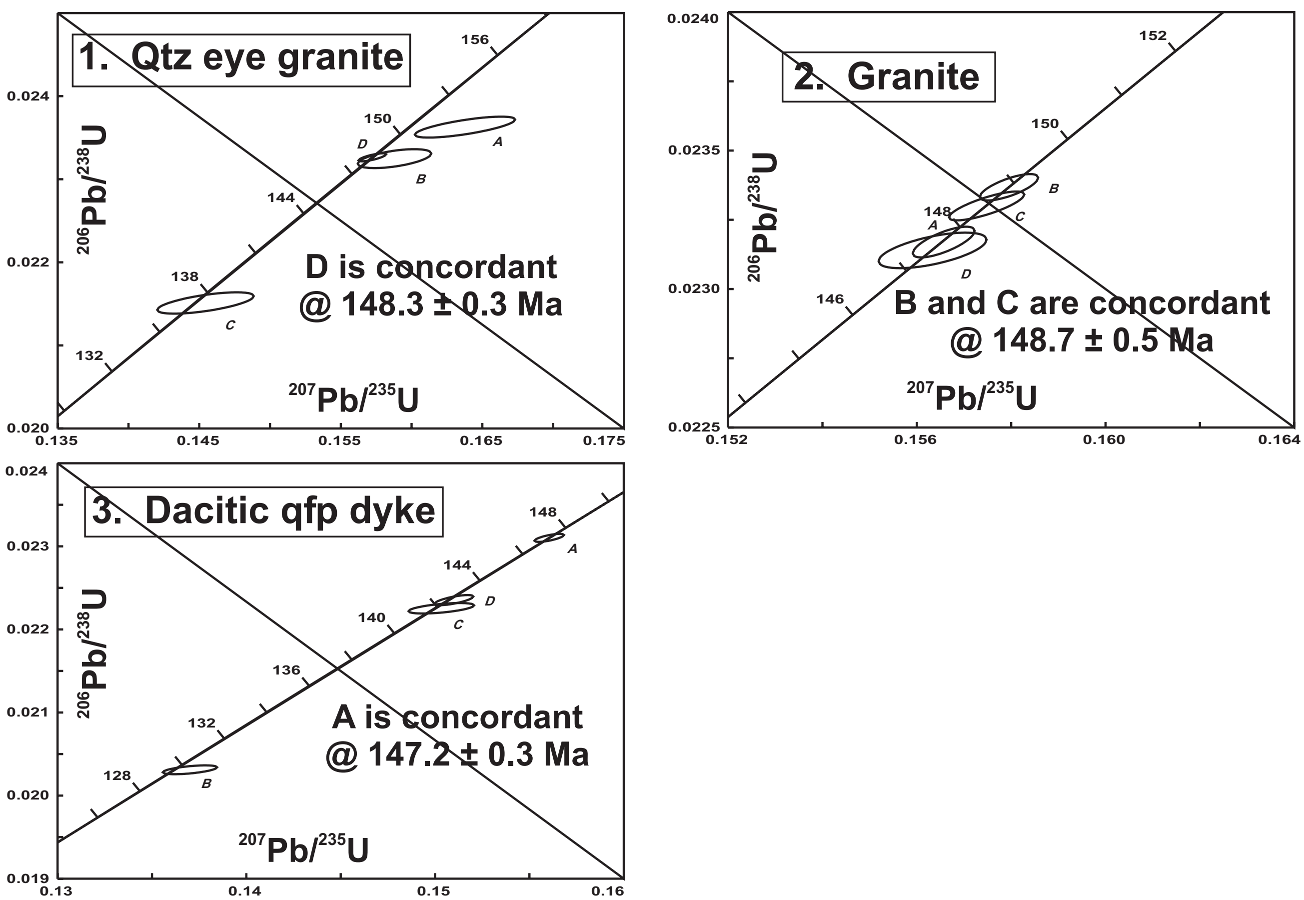

Figure 6. U-Pb concordia diagram for the quartz eye granite, hypidiomorphic granite, and the dacitic quartz-feldspar porphyry.

Molybdenum mineralization at Endako is thought to be associated with the later phase.

Analytical Results

Pb-U zircon ages were determined for the quartz eye granite, hypidiomorphic granite, and dacitic quartz-feldspar porphyry. Mineral separation and isotopic analysis were carried out in the University of British Columbia Geochronology Laboratory, using the methods described in Mortensen *et al.* (1995). Sample locations are indicated on the 110 Zone geologic map (Figure 2), analytical results are shown in Table 3, and a U-Pb concordia diagram for the three samples is shown in Figure 6.

Quartz Eye Granite

Zircons recovered from sample 1 (Figure 2) comprise clear, colourless to pale yellow stubby prismatic grains. No growth zoning or inherited cores were visible. Zircon grains contained rare to abundant bubbles and rod-shaped inclusions. The best quality grains were picked from the coarsest, least magnetic fraction and then strongly abraded. The abraded grains were split into four fractions, from the coarsest, best quality grains (fraction A) to the finest, poorest quality grains (fraction D). All of the analyses are concordant. Fractions B and C yield the oldest ages. The total range of $^{206}Pb/^{238}U$ ages for these two fractions is 148.7± 0.5 Ma which is taken as the best estimate for the crystallization age of the rock. The other two fractions yield slightly younger $^{206}Pb/^{238}U$ ages reflecting minor post-crystallization Pb loss.

Granite

Zircon grains recovered from sample 2 (Figure 2) are very similar in appearance to those in the previous sample. Four abraded zircon fractions were analyzed. Three of the fractions yielded concordant ages. The oldest of these (fraction D) has a $^{206}Pb/^{238}U$ age of 148.3±0.3 Ma which is considered as the best estimate for the crystallization age for this rock. The analysis of fractions B and C reflect minor Pb loss. Fraction A yields a slightly older 207Pb/206Pb age and appears to have incorporated a minor inherited zircon component.

Dacitic Quartz-feldspar Porphyry

Zircons recovered from sample 3 (Figure 2) are similar in appearance to the previous samples. All four fractions of abraded zircons are concordant with the oldest $^{206}Pb/^{238}U$ age at 147.2± 0.3 Ma, which is considered to be the best estimate for crystallization age of the rock. The other three fractions yielded younger $^{206}Pb/^{238}U$ ages reflecting post crystallization Pb loss.

Discussion

The ages of the quartz eye granite and hypidiomorphic granite of the Laidman Lake batholith are similar to the U-Pb age of 148.1± 0.6 Ma for the southern Capoose batholith. The dacite dikes (and presumably the spatially associated rhyolite dikes) are slightly younger than the quartz monzonite and possibly represent a later stage, more differentiated magma, likely derived from the main Laidman batholith.

Pb Isotopic Analysis

Pb isotopic compositions were determined for galena, pyrite, and igneous feldspar, from samples taken from float, outcrop, and drill core. The analytical data from the Laidman property are listed in Table 4 along with Pb isotopic data from other deposits and prospects in the vicinity. The resulting plots of $^{208}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ are shown in Figure 7 and Figure 8. Several important conclusions may be drawn from the data set:

The Laidman sulphide Pb isotope data plot together in Figure 7 and Figure 8 indicating that the high grade (19760 ppb gold) LP-203 float sample is likely genetically related to mineralization found in drill core.

The quartz eye granite has more radiogenic Pb isotope compositions and likely represents a more evolved intrusive phase relative to the hypidiomorphic granite which plots near the radiogenic end of the Laidman sulphide sample array. The isotopic data is consistent with the source of sulphide Pb being derived from or genetically related to the hypidiomorphic granite phase.

The analyses from the Capoose Creek, Buck (Christmas Cake) and Blackwater-Davidson (PEM) properties give distinctly more radiogenic values relative to the Laidman data and appear to reflect a younger (~70 Ma) mineralizing event (Friedman *et al.*, in prep.). One of the Buck (Christmas Cake) analyses is non-radiogenic compared to the rest of the samples; the reason for this is uncertain.

Galena Pb isotopic data from the Tascha deposit plots with the Laidman data suggesting that it may be of similar age as the Laidman mineralization.

DISCUSSION AND CONCLUSIONS

The presence of vuggy quartz veining, quartz breccias, and extensive alteration of host rocks suggests that mineralization on the Laidman property is associated with a high level porphyry system. U-Pb zircon ages determined for the quartz eye granite, granite, and the dacitic quartz-feldspar porphyry are identical to the U-Pb age of the Capoose batholith approximately 40 kilometers to the north. These dates correspond with the Late Jurassic (148 Ma) Endako phase of the Francois Lake

TABLE 4
LEAD ISOTOPIC COMPOSITIONS FOR SULPHIDES AND FELDSPAR SAMPLES FROM THE LAIDMAN PROPERTY AND OTHER MINERAL OCCURENCES IN THE VICINITY

Laidman Property Samples

Sample Number	Description/Occurrence	Mineral	$^{206}Pb/^{204}Pb$	% error	$^{207}Pb/^{204}Pb$	% error	$^{208}Pb/^{204}Pb$	% error	$^{207}Pb/^{206}Pb$	% error	$^{208}Pb/^{206}Pb$	% error
LP-203	>15g/t quartz breccia float 100m southwest of central 110 zone	galena	18.7711	0.006	15.5529	0.014	38.2857	0.016	0.8286	0.006	2.0396	0.003
LP-204	Coarse-grained pyrite (minor chalcopyrite) mineralization in granitic host (DDH 97-2)	pyrite	18.7812	0.011	15.5655	0.008	38.3114	0.014	0.8288	0.008	2.0399	0.009
LP-208	Medium - grained euhedral pyrite in fractures in a dacitic dike (DDH 97-4) in a dacitic dike (DDH 97-4)	pyrite	18.8268	0.018	15.5962	0.014	38.4193	0.019	0.8284	0.011	2.0407	0.006
LP-57799	Vuggy, quartz breccia with up to 30% pyrite 200 m east of the central 110 zone	pyrite	18.7874	0.053	15.5327	0.053	38.2535	0.053	0.8268	0.007	2.0361	0.005
LP-59888	Vuggy, quartz breccia with up to 30% pyrite 200 m east of the central 110 zone	pyrite	18.8041	0.138	15.5744	0.137	38.3441	0.138	0.8282	0.02	2.0391	0.007
Hypidiomorphic granite	Fresh granite from bulk sample used for U-Pb age dating	feldspar	18.8372	0.0112	15.5877	0.011	38.4069	0.012	0.8275	0.003	2.0389	0.005
Quartz eye granite	Fresh to slightly altered granite from bulk sample used for U-Pb age dating	feldspar	18.9373	0.0075	15.6120	0.006	38.4916	0.008	0.8244	0.004	2.0326	0.003

Deposits and Prospects in the Vicinity of the Laidman Property

Property name	$^{206}Pb/^{204}Pb$	% error	$^{207}Pb/^{204}Pb$	% error	$^{208}Pb/^{204}Pb$	% error	$^{207}Pb/^{206}Pb$	% error	$^{208}Pb/^{206}Pb$	% error
Blackwater-Davidson (PEM)	18.8700	0.010	15.6060	0.010	38.4760	0.020	0.8270	0.000	2.0390	0.010
Blackwater-Davidson (PEM)	18.8590	0.010	15.5890	0.010	38.4210	0.020	0.8266	0.000	2.0373	0.010
Tascha	18.7903	0.008	15.6006	0.006	38.4168	0.009	0.8303	0.005	2.0445	0.005
Buck (Christmas Cake)	18.9157	0.000	15.5973	0.000	38.4798	0.000	0.8245	0.001	2.0341	0.001
Buck (Christmas Cake)	18.6931	0.120	15.4187	0.120	38.0255	0.120	0.8248	0.021	2.0341	0.014
Capoose Creek	18.9030	0.000	15.6010	0.010	38.4820	0.000	0.8253	0.000	2.0358	0.000
Capoose Creek	18.8980	0.000	15.5880	0.010	38.4310	0.000	0.8248	0.000	2.0336	0.000
Capoose Creek	18.9000	0.000	15.5940	0.010	38.4560	0.000	0.8251	0.000	2.0347	0.000
Capoose	18.9070	0.010	15.6030	0.010	38.5060	0.000	0.8253	0.000	2.0367	0.010

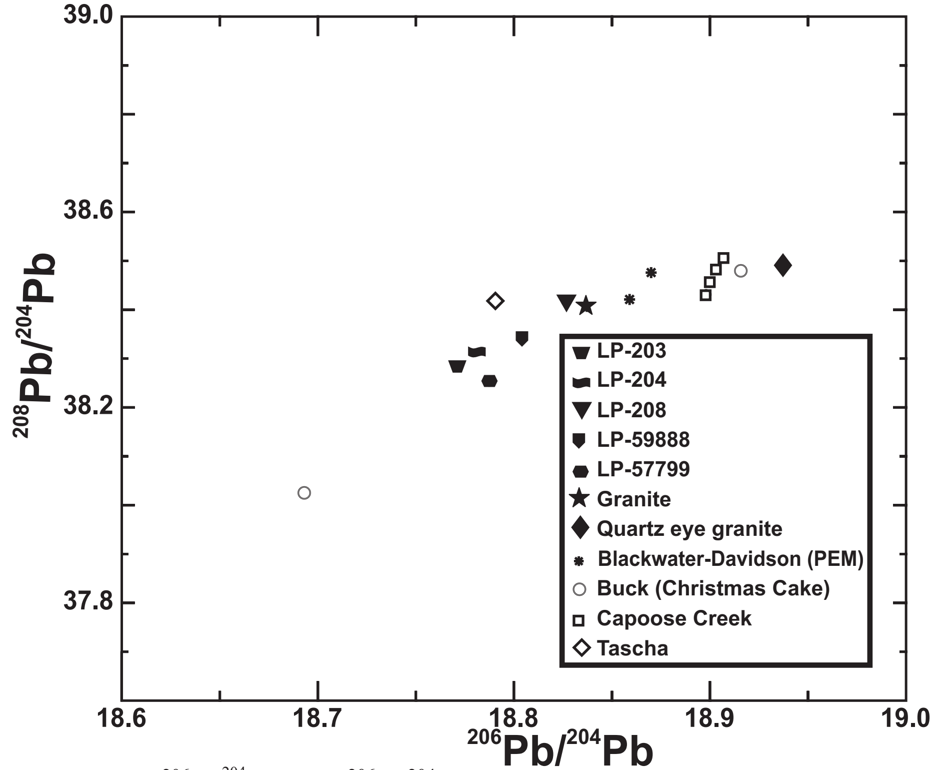

Figure 7. Trace Pb isotope plot of $^{206}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ with Laidman sulphides, feldspars and Pb isotopic data from other deposits.

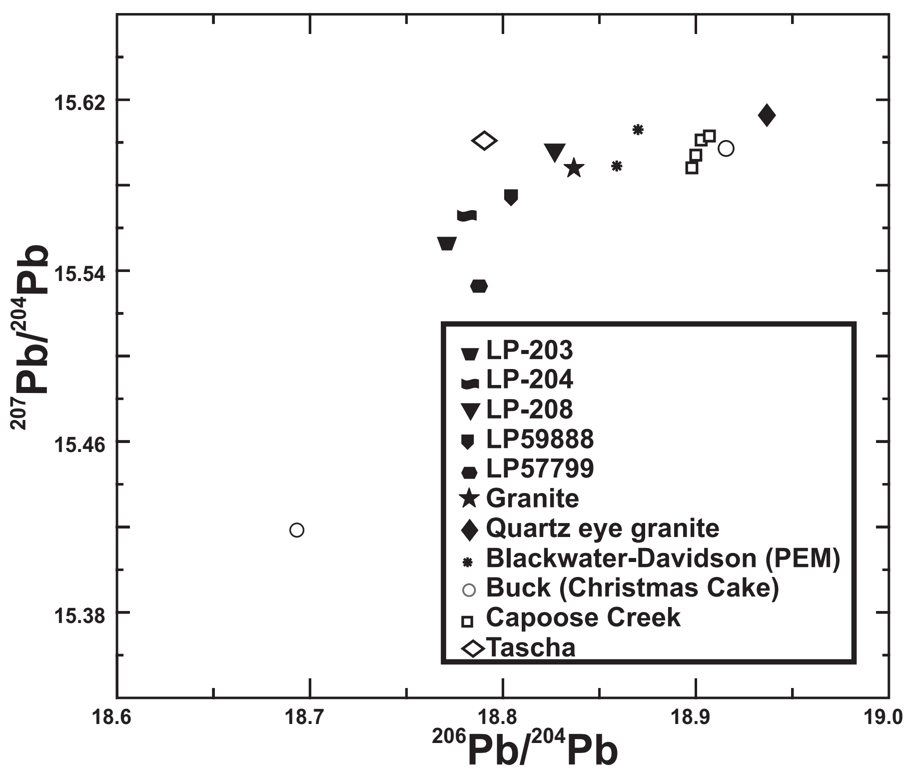

Figure 8. Trace Pb isotope plot of $^{207}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ with Laidman sulphides, feldspars and Pb isotopic data from other deposits.

Plutonic suite the Late Jurassic to Early Cretaceous mineralizing event in the interior plateau. The Late Jurassic-Early Cretaceous mineralizing event in this area has been suggested to be related to emplacement of plutons of this suite (Lane and Schroeter, 1997).

Pb isotopic data is available from relatively few deposits in the Nechako River map area. Currently, data is available only from the Blackwater-Davidson, Buck, Capoose, and Tascha prospects. Previous work has suggested that the Blackwater-Davidson and Capoose prospects are related to a Late Cretaceous mineralizing event (Friedman, pers. comm., 1998). This is evident on the $^{208}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ plots where the Late Cretaceous mineralization has more evolved, radiogenic Pb compared to Laidman Pb isotope data. However, the single Tascha galena Pb sample has a similar radiogenic Pb signature as the Laidman data. This suggests that the Tascha and the Laidman mineralization are a result of the Late Jurassic to Early Cretaceous event.

REFERENCES

Bysouth, G.D. and Wong, G.Y. (1995): The Endako molybdenum mine, central British Columbia: An update, *in* Porphyry deposits of the northwestern cordillera of North America, (ed.) Schroeter; *Canadian institute for Mining, Metallurgy and Petroleum*, Special Volume 46, p. 697-703, Part D – Porphyry Molybdenum (±WO_3) Deposits – Paper 52.

Cook, F. and Erdmer, P. (compilers) (1997):Slave – Northern Cordilleran Lithospheric Evolution (SNORCLE) Transect and Cordilleran Tectonics Workshop Meeting (March 7-9), University of Calgary; *Lithoprobe Report* No. 56, 245 pp.

Cyr, J.B., Pease, R.B., and Schroeter, T.G. (1984): Geology and mineralization at the Equity silver mine; *in Economic Geology*, vol. 79, 1984, p. 947-968.

Diakow, L.J., Webster, C.L., Whittles, and Richards, T.A. (1995): Stratigraphic highlights of bedrock mapping in the southern Nechako Plateau, Northern Interior Plateau Region (NTS 93 F/2 and 7); *in* Geologic Fieldwork 1994; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1995-1, p. 171-6.

Diakow, L.J. and Webster, C.L. (1994): Geology of the Fawnie Creek map area (NTS 93 F/3); *in* Geologic Fieldwork 1993, Grant, B. and Newell, J.M., Editors; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1994-1, p. 15-26.

Fox, P.E. (1998): Diamond drilling report on the Laidman property; *Internal report for Phelps Dodge Corporation of Canada, Limited*. Dated January 23, 1998.

Fox, P.E. (1996): Geological, geochemical and trenching Report on the Laidman property; *Internal Report for Phelps Dodge Corporation of Canada, Limited*. Dated December 25, 1996.

Gabrielse, H., Monger, J.W.H., Wheeler, J.O., and Yorath, C.J. (1991): Part A. Morphogeological belts, tectonic assemblages, and terranes: in Geology of the Cordilleran Orogeny in Canada; Edited by H. Gabrielse and C.J. Yorath. *Geologic Survey of Canada*, Chapter 2, Geology of Canada, No. 4, p. 15-28.

Lane, R.A. and Schroeter, T.G. (1997): Metallogeny of the Interior Plateau, central British Columbia (Parts of 93B, 93C, and 93F), *in* Interior Plateau Geoscience Project: Summary of Geological, Geochemical and Geophysical studies; Diakow, L.J., Metcalf, P. and Newell, J.M. editors; *B.C. Ministry of Employment and Investment*, Paper 1997-2.

Monger, J.W.H., Wheeler, J.O., Tipper, H.W., Gabrielse, H., Harms, T., Struik, L.C., Campbell, R.B., Dodds, C.J., Gehrels, G.E., O'Brien, J. (1991): Part B. Cordilleran terranes; Upper Devonian to Middle Jurassic assemblages, in Geology of the Cordilleran Orogen in Canada; Edited by H. Gabrielse and C.J. Yorath. *Geologic Survey of Canada*, Chapter 8, Geology of Canada, No. 4, p. 281-327.

Mortensen, J.K., Ghosh, D.K., and Ferri, F. (1995):U-Pb geochronology of intrusive rocks associated with copper-gold porphyry deposits in the Canadian Cordillera; edited by T.G. Schroeter; *in Canadian Institute of Mining, Metallurgy and Petroleum*, Special Volume 46.

Whalen, J.B., Struik, L.C., and Hrudey, M.G. (1998): Bedrock geology of the Endako map area, central British Columbia; *in* Current Research 1998-A; *Geologic Survey of Canada,* p. 113-123.

Woodsworth, G.J., Anderson, R.G., and Armstrong, R.L. (1991): Plutonic regimes, Chapter 15 *in Geology of the Cordilleran Orogen in Canada*, H. Gabrielse and C.J. Yorath (ed.); Geologic Survey of Canada, Geology of Canada, no. 4, p. 491-531.