METALLOGENY OF THE BEATON — CAMBORNE MINING CAMP LARDEAU DISTRICT (082K 12 & 13)

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INTRODUCTION

The Beaton area (NTS 082K12,13) comprises several former mines and dozens of mining prospects scattered across 200 square kilometres in the Lardeau district, West Kootenay region of southeastern British Columbia. The area is centred just north of the settlement of Trout Lake, 60 kilometres southeast of Revelstoke and 140 kilometres north of Nelson in the heart of Selkirk Mountains

Prospecting for metalliferous deposits in the Lardeau district began prior to 1890. A crew led by Peter Walker, following up on a rumor of new mineral discoveries, travelled down the Columbia River from Revelstoke to Upper Arrow Lake and overland to Trout Lake. Mining activity started in the late 1890's after more prospectors overflowed from the Slocan and Kootenay Lakes area. By 1899 mineral claims were located near Beaton on the Northeast Arm of Upper Arrow Lake and along the Incomappleux (Fish) River.

The history of the Lardeau district revolves about three mining camps - the Camborne camp on the Incomappleux River east of Beaton, the Ferguson camp east of Trout Lake and the Poplar Creek camp south of Trout Lake. This paper discusses the mines and mineral occurrences in the Beaton map area including the Camborne camp.

In the early years gold and silver-lead ores from the the Camborne camp attracted the most attention. Claims on Sable Creek, Lexington Mountain and at the head of Mohawk Creek, were responsible for much of the interest. In July 1899, good gold values were obtained from a quartz vein on the Eva claim on Lexington Mountain and a prospecting rush ensued. A wagon road was built to Trout Lake from Thompson's Landing (renamed 'Beaton' in 1903) on the Northeast Arm of Upper Arrow Lake. In the succeeding eight years many gold claims were staked and developed. Four or five stamp mills were erected to process the quartz-rich vein ore and the town of Camborne, founded in 1901, grew rapidly. In 1902 the railway was extended to Gerrard at the south end of Trout Lake and steamer service began on the Arrow Lakes. Activity peaked in 1904 but the operations at Camborne soon proved unprofitable due to a combination of poor management, low ore grades and metallurgical problems. By far the greatest proportion of the ore that was shipped was hand sorted to produce a silver-lead product. Large quantities of ore containing sphalerite, accompanied by appreciable amounts of silver and gold, were left on mine dumps because of a penalty imposed for zinc by the smelters. By 1908 there was a decline in activity and by 1920 Camborne was practically a ghost town. In 1927 the area revived somewhat when the Multiplex Mining, Milling and Power Co. renewed work on their properties along Pool Creek. During the years 1935 to 1941 activity consisted mainly of mill cleanup and salvage projects. Then there was a resurgence of exploration and development in the 1950's. The Spider mine was brought into production in 1952 and continued operations until 1958.

During this period deposits other than just silver and lead were explored in the district. For example in 1942 the Lucky Boy mine on Trout Mountain produced 20 tonnes of scheelite (calcium tungstate) in addition to the previous production of important amounts of silver and lead. Although molybdenite was first reported on the property in 1917, it was not until 1969 and 1975-1982 that further exploration led to the delineation of major molybdenite reserves at what is now known as the Trout Lake deposit.

Figure 1. Location map, Beaton-Camborne mining camp.

Intermittent exploration activity continues in the area driven by changing market conditions for precious and base metals, new geophysical and geochemical methods and new geological interpretations.

GEOLOGICAL SETTING

The geology of the Beaton area (NTS 082K/12,13) comprises diverse lithological elements belonging to several tectonic terranes (Figure 2). On a regional scale, the Beaton-Camborne mining camp is within the Kootenay Arc which lies between the Windermere-Purcell anticlinorium on the east and the Monashee and Shuswap metamorphic complexes to the west and northwest (Reesor and Moore, 1971; Reesor, 1973).

The Kootenay Arc is a 400-kilometre-long curving belt of early Paleozoic to Mesozoic sedimentary, volcanic and metamorphic rocks. It trends northeast across Washington state into British Columbia, then north along Kootenay Lake and northwest into the Arrow Lake and Revelstoke area.

Along Kootenay Lake the arc succession comprises the Hamill, Badshot, Lardeau, Milford, Kaslo, Slocan and Rossland groups. The Hamill, Badshot and Lardeau constitute the early Paleozoic pericratonic Kootenay terrane; the Milford and Kaslo belong to the accreted late Paleozoic (and early Mesozoic) Slide Mountain terrane. The Hamill is mostly quartzite; the Lardeau comprises a lower calcareous section overlain by phyllitic schists, quartzites and lenticular greenstone formations. The Milford and Kaslo groups are metamorphosed oceanic assemblages that include phyllites, thinly bedded calc-silicate metasedimentary rocks, chert beds, basic volcanic rocks and serpentinites (Fyles, 1967).

The Mesozoic formations constitute the Quesnel terrane that lies along the western side and within the curvature of the Kootenay Arc. The Kaslo and Rossland volcanics (Hoy and Dunne, 1997) and the Slocan argillite, slate and limestones are important units in this terrane and contain significant silver-lead-zinc deposits typical of the Lardeau and Slocan mining districts.

Many batholiths and arrays of small stocks interrupt the continuity of the older deformed stratigraphic succession throughout the Kootenay Arc. The Kuskanax and Nelson batholiths are the largest intrusions. They are predominantly granite and granodiorite in composition although diorite, monzonite and syenite are locally important phases. The age of these rocks is generally considered to be middle or late Jurassic age (Armstrong, 1988; Sevigny and Parrish, 1993).

The Nelson batholith and many of the related granitic stocks have local zones of intense deformation around their margins. Regional structures are deflected into near parallelism along the margins of these intrusions. It may be that antecedent structures controlled the emplacement of the granitic masses.

Cretaceous and Tertiary intrusions are common in the northern part of the arc and to the east. These include medium-size plutons and small stocks of fresh granite, monzonite and syenite such as the Battle Range, Fry Creek plutons and the Mount Toby and Glacier Creek stocks east of Kootenay Lake (Smith and Gehrels, 1992).

Lardeau Group

The Lardeau Group, as defined by Fyles and Eastwood (1962) in the Ferguson area, consists of 6 conformable Lower Paleozoic units named the Index, Triune, Ajax, Sharon Creek, Jowett and Broadview formations. This succession was believed to be an upright stratigraphic sequence having the Index Formation at the base and the Broadview

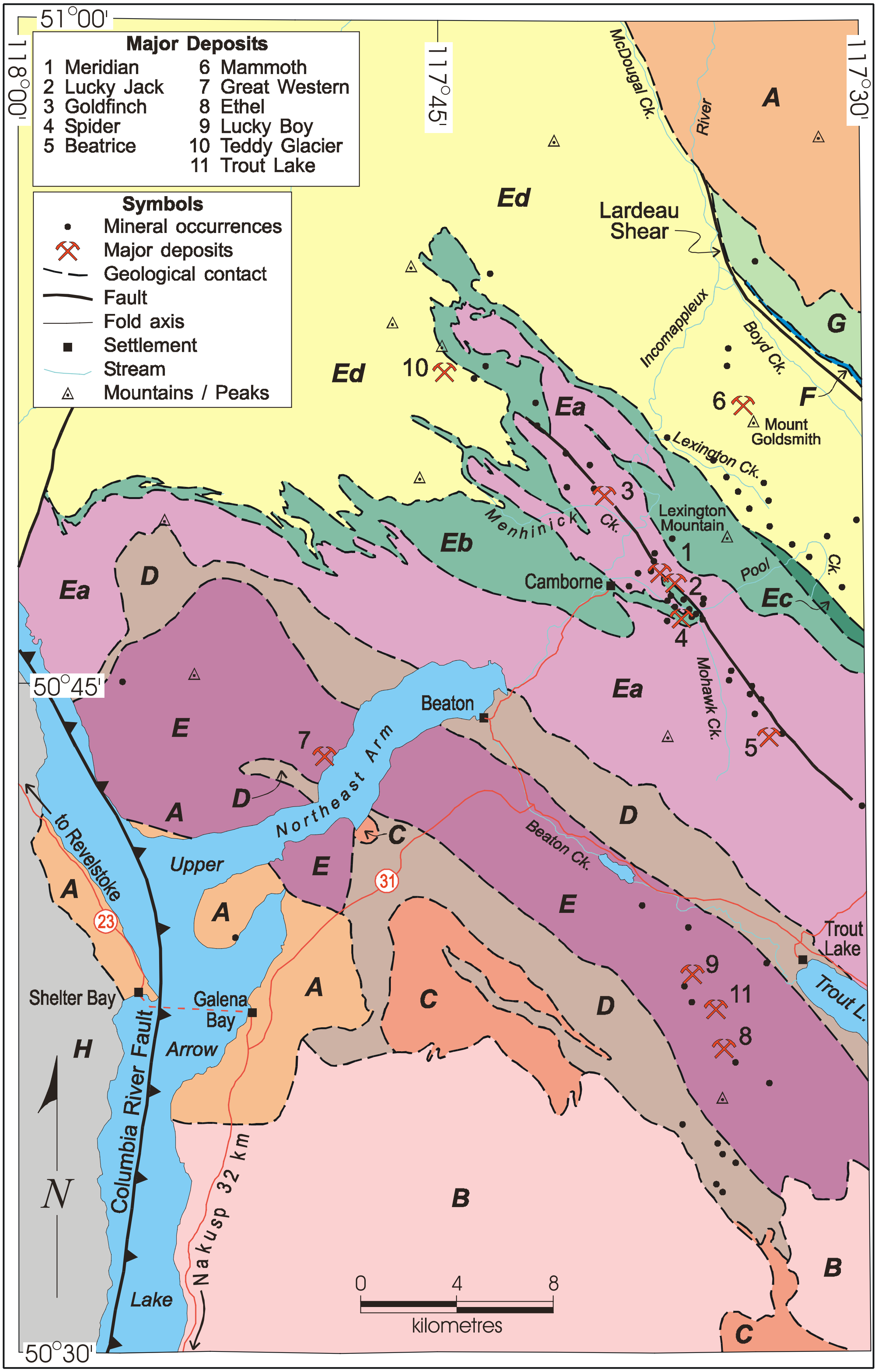

Figure 2. Geology of the Beaton area (modified after Read, 1976, and Read and Brown, 1981). See legend next page.

LEGEND

Cretaceous

- **A** Galena Bay and Battle Range granodiorite, quartz monzonite, alaskite.

Jurassic

- **B** Kuskanax batholith, monzonite, syenite

Permian to Triassic

- **C** Kaslo Group, metavolcanics
- **D** Milford Group, marble, metaconglomerate and sandstone

Lower Paleozoic

- **E** Lardeau Group
  - **Ea** Broadview Formation, phyllite, limestone
  - **Eb** Jowett Formation, metavolcanics
  - **Ec** Sharon Creek Formation, siliceous phyllite
  - **Ed** Index Formation, phyllite, greenstone
- **F** Badshot limestone

Hadrynian (Windermere)

- **G** Hamill Group, quartzite, limestone

Precambrian

- **H** Shuswap - Monashee, crystalline gneiss complex

Figure 2. Legend

Formation at the top. However, the highly folded condition of the beds, the lack of facing indicators and the presence of faulted contacts hindered verification of this interpretation (Smith and Gehrels, 1992).

The Index Formation is the most extensive unit in the Lardeau Group. The Index Formation comprises a thick sequence of grey, green and black phyllite, limestone and thick calcareous phyllite, tuff, tuffaceous greywacke, pillow basalt and rare quartzite and quartzo-feldspathic gritty sandstone. In vicinity of McDougal Creek, along the Incomappleux River, the formation consists of crystalline limestones and interbanded slates and phyllites (Figure 2). Many of the limestone bands are highly carbonaceous - some of them containing a considerable amount of graphite, while other bands contain sufficient chlorite to give a green colour to the rock. Although the formation is highly variable, black and grey phyllite facies predominate near the base at the contact with the Badshot Formation, while green phyllite predominates in the upper part of the unit (Fyles and Eastwood, 1962). The Index Formation is overlain by a conformable assemblage of black siliceous argillite, grey quartzite and black siliceous argillite known respectively as the Triune, Ajax and Sharon Creek formations. The Jowett Formation is a greenstone unit intercalated with the Broadview Formation. The Jowett consists of volcanic breccias and pillow lavas (Photo 1) altered locally to chlorite schist. The predominant lithology of the Broadview Formation is grey green, gritty quartz wacke or subarkosic wacke with grey to black or green slate or phyllite interbeds. Two important bands of quartzite, assigned to the Broadview Formation, cross the valley of the

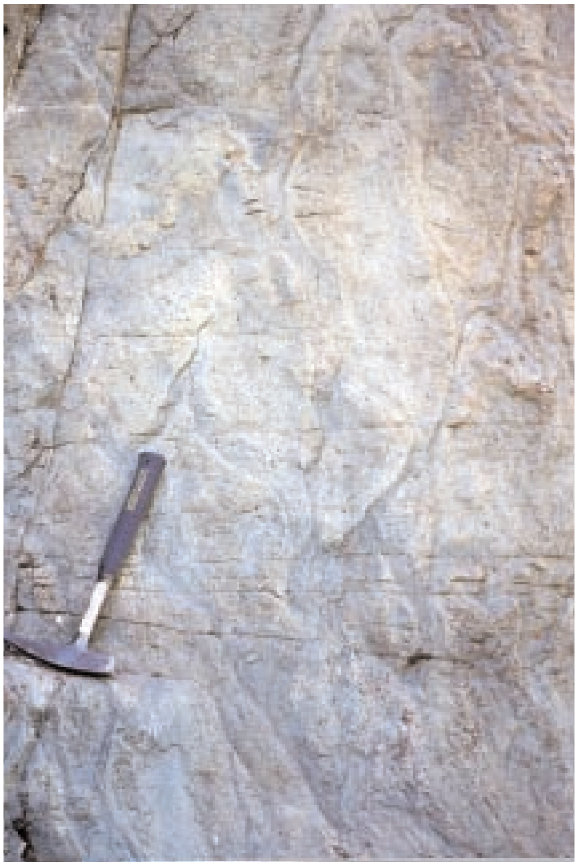

Photo 1. Deformed pillow lava sequence, Jowett Formation, Lardeau Group.

Incomappleux River – one a short distance below the mouth of Menhinick Creek and the other below the mouth of Sable Creek. This quartzite is an exceedingly hard, compact, dark blue rock invaded extensively by numerous quartz stringers. Size grading is occasionally seen, however, a consistent sense of facing could not be ascertained across the stratigraphy because of the intense deformation of these rocks.

Kuskanax and Nelson Intrusions

The Kuskanax batholith, named by Cairnes (1929), borders the southwest side of the Lardeau area from near the north end of the Kootenay Lake to the Northeast arm of Upper Arrow Lake. The rocks of the batholith are typically medium to fine grained, light coloured granite. Dikes and sills from the batholith vary from granite through syenite to granodiorite and diorite composition. Cairnes believed the Kuskanax batholith to be younger than the Nelson batholith, however, more recent studies have established a somewhat older age range for these rocks (Smith and Gehrels, 1992).

The Nelson batholith underlies much of the western part of the Kootenay district where it is a complex of intrusives rocks differing in structure, texture and composition. The Nelson batholith is the principal rock type within the Slocan City camp and in this area it is subdivided into three phases (Cairnes, 1934) - granitic porphyry, crushed porphyry, and massive equigranular granite and granodiorite. The granitic porphyry is the predominant phase and hosts most of the ore deposits. Exposed surfaces of the rock are light grey with a flesh-colour hue due to weathering of the feldspar. It is characteristically coarse-grained and distinguished by rectangular phenocrysts (megacrysts) of potassium feldspar, commonly several centimetres long and comprising up to 50 per cent of the rock. These megacrysts are simple or Carlsbad twins of perthitic orthoclase replaced locally by microcline. The megacrysts are set in a coarse grained groundmass comprising subhedral plagioclase (An30-50), anhedral quartz, irregular clots of amphibole and biotite, interstitial microcline, and minor amounts of apatite, sphene, magnetite and sulphides. Thin sections and chemical analyses indicate that the rock is a silica-poor granite verging to monzonite composition, having roughly equal amounts of alkali feldspar and plagioclase and an alkali/lime index greater than 1.

The various phases of the Kuskanax batholith are leucocratic and as such are readily distinguished from the neighbouring Nelson batholith. The Kuskanax rocks are, in general, medium to fine grained types which in places along the border of the intrusion show a well defined porphyritic texture. Syenite is well developed along the border of the batholith where it forms stock-like apophyses. Elsewhere the batholith is chiefly granite.

The Kuskanax rocks are mostly light coloured, although the syenite generally weathers brown and thus distinguished from the granite. The granite is also generally finer grained than the syenite. In thin section all phases show an abundance of both orthoclase and microcline. Plagioclase occurs chiefly as perthitic intergrowths; the abundance of perthitic intergrowths being a distinctive feature of these rocks. The amount of quartz varies from very little in the syenite to conspicuous proportions in the granites. The quartz exhibits little evidence of strain or fracturing. Ferromagnesian minerals are few and occur as minute blackish specks throughout the rock. The chief mafic mineral is dark green to bluish green amphibole which is usually partly altered. Accessory minerals include sphene, apatite, magnetite, yellow garnet and occasional sulphide grains. Secondary minerals are mainly kaolin, chlorite and calcite.

A peculiar feature of the Kuskanax batholith is the paucity of mineralization associated with this body. This is in direct contrast to the Nelson batholith and, in particular, the Nelson granite whose relations to ore mineralization in the Slocan area have been previously indicated (Church, 1998). Except for occasional grains of pyrite, no significant mineralization was noted in the principal phases of the Kuskanax batholith.

Galena Bay Stock

The Galena Bay stock outcrops at the head of Upper Arrow Lake intruding the north end of the Kuskanax batholith along the eastern margin of the Monashee complex. The stock was originally considered to be Kuskanax (Cairnes, 1929; Walker et al., 1929), however, K/Ar dating on biotite and muscovite yielded 68 and 92 ± 8 Ma dates, respectively, (Leech et al., 1963) which is significantly younger than Kuskanax but similar to the Trout Lake intrusion, dated 76 Ma by K/Ar analysis of biotite (Boyle and Leitch, 1983).

The Galena Bay stock is a light coloured two mica granite similar to the muscovite - biotite bearing phase of the Battle Range pluton in the headwater area of the Incomappleux River. In thin section these rocks are hypidiomorphic granular and contain abundant quartz, plagioclase and significant amounts orthoclase and microcline. Biotite is an accessory mineral and occurs randomly or in clusters with minor ferromagnesian minerals and crosscutting muscovite laths. Determination of the normative mineralogy from major oxide chemical analysis of a typical sample of the granite yields 27% quartz, 69% feldspar and 4% ferromagnesian minerals (Table 1, no.1)

The main phase of the Trout Lake intrusion is a granitic microporphyry. The rock is characterized in thin section by oscillatory zoned, rectangular plagioclase and altered potassium feldspar laths (to 3 mm in diameter) set in a quartz-rich fine grained matrix with peppery biotite, magnetite, and molybdenite. The biotite flakes are partly altered to penninite, a variety of chlorite showing distinctive blue interference colour. Chemical analysis of the Trout Lake intrusion yields 28% normative quartz, 68 % combined feldspar and 4% ferromagnesian minerals (Table 1, no.2), which is essentially the same as the Galena Bay granite.

A notable feature of some of these intrusions, relates to the occurrence of sulphides - i.e.

Table 1. Chemical analyses of Galena Bay granitic rocks.

	1	2
SiO_2	71.90	69.62
TiO_2	0.18	0.27
Al_2O_3	15.00	14.84
Fe_2O_3	1.41	1.77
FeO	-	1.08
MnO	-	0.03
MgO	0.37	0.52
CaO	2.23	2.99
Na_2O	4.28	3.55
K_2O	3.18	3.22
BaO	0.18	0.14
LOI	0.66	0.98
P_2O_5	0.05	0.12
Sum (%)	99.44	99.22
Normative Composition		
Qz	26.9	28.2
Or	19.1	19.6
Ab	39.0	32.8
An	11.2	15.3
Wo	-	-
En	1.0	1.5
Fs	2.0	0.1
Mt	-	1.9
Ll	0.3	0.4
He	-	-
Cr	0.5	0.2

This table is based on fused disc x-ray fluorescence for the major oxides in rock powders and normative mineral calculations (molecular). Sample No. 1 is from the Galena Bay granitic stock located midway between Galena Bay and the junction of Highway 23 and 31. Sample No. 2 is typical of the granitic rocks hosting molybdenite-bearing veins at the Trout Lake Mine.

pyritiferous alaskite at the core of the Battle Range and disseminated molybdenite throughout the Trout Lake intrusion. This is in contrast to the Kuskanax batholith which contains no known mineralization, except for the occasional grains of pyrite, a feature that seems to explain why the host rocks intruded by this batholith have provided meager evidence of ore deposition (Cairnes, 1929).

Structural Geology

The Columbia River fault zone is a 250-kilometre long, linear detachment structure exposed along the Columbia River extending through Revelstoke and southward beyond Nakusp on North Arrow Lake (Figure 2). The Columbia River fault trends subparallel to the Slocan Lake fault and appears to be an offset or an en echelon northwest continuation of this structure. Both faults dip gently to the east and separate major tectonic elements. The footwall plate on both faults comprises the ductilely deformed gneissic rocks of the Monashee - Shuswap complex. The hanging wall plate in the Beaton area, known as the 'Selkirk allochthon', is composed of several tectonic slices comprising parts of the Lardeau, Milford and Hamill groups and associated intrusions (Read and Brown, 1981).

The Columbia River fault is a ductile-brittle break that records a history of movement extending from the Mesozoic to Eocene. According to Read and Brown (1981), early deformation resulted in a mylonitic zone up to one kilometre wide within which the rocks later recrystallized to the greenschist grade of regional metamorphism. The fault truncates the major folds and metamorphic zones that had developed in the middle Jurassic. Orientation of slickensides and strain features in the mylonite shows normal dip slip displacements with slices of hanging wall moving eastward. Late displacement in the Eocene, manifested by intense fracturing, folding of mylonite and the development of gouge zones, again shows dip-slip motion with the hanging wall moving eastward. As a result, the tectonic slices east of the Columbia River fault were transported tens of kilometres eastward over the gneissic complexes.

Between the head of Upper Arrow Lake at Beaton and Camborne, the largest tectonic slice, the 'Selkirk allochthon', is comprised of dark carbonaceous phyllites, grey siliceous schists, greenschists assigned to the Lardeau Group and a green rusty-weathering schistose altered eruptive rocks (Jowett Formation?). These rocks generally have a southeasterly strike, dip northeasterly 50° to 80° and are cut by a series of joints dipping from 40° to 80° northwesterly (Figure 3).

North of Camborne the formations are mainly metasedimentary rocks represented by phyllites, talcose schists, calc-schists and quartzites interbanded with green chloritic schist and rusty weathering schistose eruptives. These rocks are folded forming a series of tight but gently southeast plunging, asymmetrical anticlinal and synclinal structures (Figure 4). The folds are inclined to varying degree, to the southwest and northeast, along the mid section of the Incomappleux River. According to Colpron et al. (1998) the diverse fold inclinations are part of the Selkirk fan structure that was developed regionally outboard of a pre-Cambrian basement ramp during the Columbian orogeny, from mid-Jurassic to Cretaceous.

At Boyd Creek, the Lardeau shear zone marks the boundary between the of the Lardeau Group and the older Badshot and Hamill miogeoclinal strata in the east part of the map-area. The Lardeau Group was deformed prior to mid-Mississippian time as shown by the basal conglomerate in the Milford Formation which contains foliated clasts of the underlying Broadview unit of the Lardeau. Regional constraints indicate probable Devonian - Mississippian timing of the orogeny (Antler-age tectonism) and juxtaposition of the Lardeau Group against the Badshot and Hamill strata along the Lardeau fault at this time. Further deformation (Columbian) produced large isoclinal folds with subhorizontal axes (Photo 2), and southeast (orogen-parallel) stretching lineations. This deformation was not synchronous everywhere and may have continued through late Jurassic time northeast of Trout Lake. This was followed by Cretaceous dextral strike-slip and normal movement on the Lardeau shear zone and other parallel faults. While apparently the locus of several episodes of faulting, the Lardeau shear zone does not record the accretion of far-travelled tectonic fragments. Clearly, the sedimentological evidence ties the Lardeau Group to the

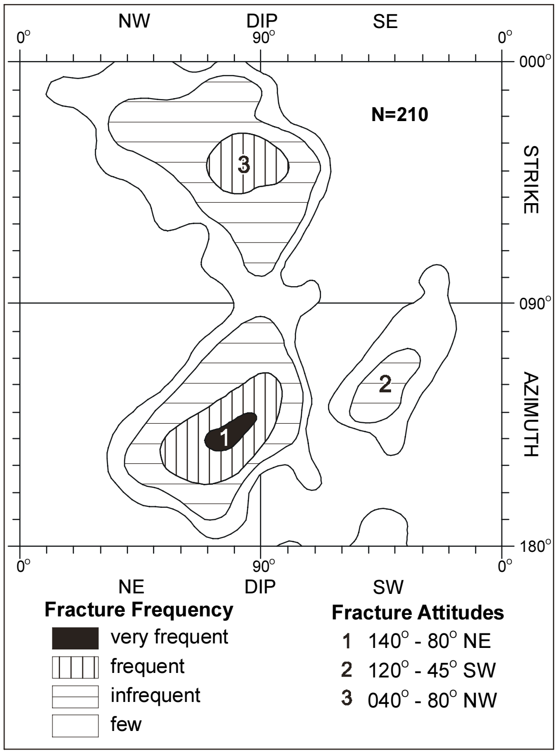

Figure 3. Fracture frequency plot, main belt, Lardeau Group.

Photo 2. Isoclinally folded limestone, Index Formation, Lardeau Group.

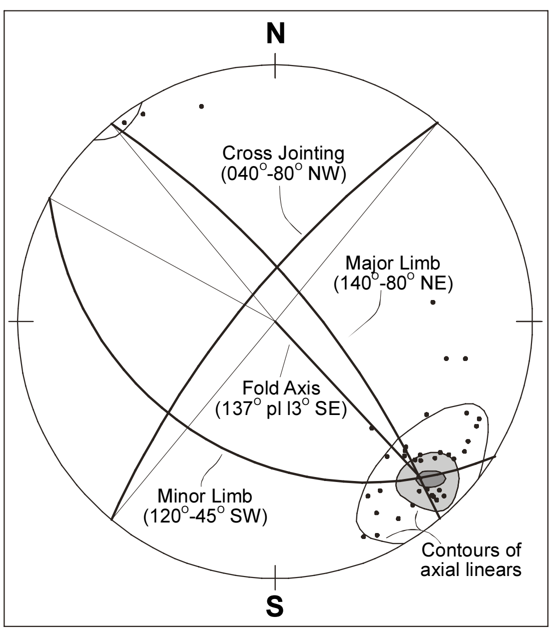

Figure 4. Stereographic projection of (lower hemisphere) of fracture and fold elements, main belt, Lardeau Group.

North American craton (Smith and Gehrels, 1987).

The lack of penetrative fabric distinguishes plutonic rocks of the Kuskanax batholith from the gneisses and schists of the surrounding areas. Fabrics in the shear zone associated with the Columbia River fault indicate easterly down dip displacement of the upper plate. Geochronological data suggest that some ductile strain exhibited in the gneisses and faulting is early Tertiary age and superimposed on considerably older deformation structures possibly related to the original emplacement of the Kuskanax and Nelson batholiths.

Carr et al. (1987) believe that uplift in the early Tertiary resulted in detachment along the Slocan and Columbia River faults and Monashee decollement causing downward movement of the overlying slab to the east. This listric process was accompanied by the development of a system of steeply dipping cross fractures (normal faults) in the hanging wall due to extension. The combined fracturing at this time provided convenient channelways and repositories for mineralizing solutions (Beaudoin et al., 1991; Church, 1998).

MINERAL DEPOSITS

The Lardeau and Slocan sections of the Kootenay Arc are among the regions in British Columbia where small scale mining has remained viable for many years because of the richness of the ores. The Beaton - Camborne camp, near the northern extremity of the Kootenay Arc, includes 86 mineral deposits of which 18 are past mineral producers having a combined production of more than 60 million grams of silver and significant amounts of gold, lead and zinc (Table 2).

Comprehensive descriptions of the mineral deposits are provided by Brock (1904), Emmens (1915) and Walker et al. (1929), and Linnen et al (1995). The history of many of the various properties is also recorded in numerous assessment reports and the British Columbia Minister of Mines Annual Reports covering the area.

The following property descriptions are based on MINFILE reports and visits to the principal mines by the author during the summer of 1998.

Meridian (MINFILE 082KNW064, 066, 065, 063, 143)

The Meridian property consists of a consolidation of the Eva, Criterion-Oyster, Cholla, Lucky Jack and Red Horse claim groups. The property is situated on the southwest slopes of Lexington Mountain, northeast of Camborne near the confluence of Pool Creek and the Incomappleux River. The original access to the property was via a horse trail following the cable tram line beginning at a log bridge crossing the canyon of Pool Creek at Camborne. Later a switchback road was constructed to the Eva workings from flats of the Incomappleux River directly below the mine. The road, trail and mine working are presently overgrown and in total disrepair.

The first discovery of gold in the district was on the **Eva** claim (MINFILE 082KNW066). In 1900 an inexperienced prospector searching for silver-lead ores found what is now known as the Eva lode (Lat. 50°47.8’, Long. 117°37.8’). Assays returned high gold values and a staking rush followed. By 1902 a group of 21 claims was assembled forming the nucleus of the property and much surface work together with more than 490 metres of lineal underground development was completed by Imperial Development Syndicate Ltd. At the end of mine operations in 1908 development comprised 945 metres of drifting on seven levels, 610 metres of crosscuts, 115 metres of raises and 23 metres of shaft sinking.

The Eva mine explores and develops two veins (‘A’ and ‘B’) lying in and along two fault planes connected by numerous cross veins and stringers. The direction of the veins is about 135°, cutting the steeply dipping host rocks at a low angle. On the No. 6 level the confining faults are 53 metres apart and dip away from each other. Since the veins follow these faults and converge upward, they are only 27 metres apart on the No. 2 level (150 metres above).

The country rocks are spotted phyllite cut by yellow-weathering schistose diabase. The veins are quartz accompanied by siderite and a small amount of pyrite, galena and sphalerite and some free gold (Photo 3). The veins vary in width from a few centimetres to several metres. Gouge along the faults has evidently confined the ore-bearing solution within these planes and the crushed country rock between them.

The **Criterion-Oyster** claim group (MINFILE 082KNW065) adjoins the Eva on the southeast (Lat 50°47.6’, Long 117°37.6’). In addition to a number of surface cuts on these claims, a total of 780 metres of underground development work has been done mostly on two levels following the Criterion vein. This vein is sub-parallel and appears to converge with the ‘A’ vein of the Eva mine. The ore was transported from the mine to the mill by a 1,066-metre-long aerial tram - the mill at Camborne was operated by water power taken from Pool Creek below the intake of the Eva flume.

The Criterion vein is a well defined and persistent structure that strikes 120° and dips 70° northeast. No. 1 level develops the vein 30 metres below its surface outcrop following a continuous ore-shoot 300 metres long, averaging 1.5 metres wide, from which about 12,700 tonnes of ore was extracted. The vein is the result of fissure filling with quartz and replacement of the brecciated country rock consisting of carbonaceous phyllite. In places the vein is solid

MINFILE Number	Name	Mined (tonnes)	Silver (grams)	Gold	Lead (kilograms)	Zinc	Copper	Other	First Year	Last Year
082KNW003	**Lucky Boy (L.5423)**	473	3097421	31	114703	1887	1997	Tungsten: 203	1902	1976
082KNW004	**Copper Chief (L.4584)**	26	135019		2728				1901	1917
082KNW040	**Beatrice (L.4586)**	618	1832369	558	182930	10894			1899	1984
082KNW041	**Mohawk (L.4571)**	8	13499		1358	1699			1963	1963
082KNW045	**Spider (L.15752)**	128063	53480800	370531	10844750	11519402	85348	Cadmium: 60371 Antimony: 4261	1911	1958
082KNW059	**Ethel**	74	377839		8045				1899	1918
082KNW062	**St. Elmo (L.4581)**	5	19408	31	1098				1899	1899
082KNW064	**Meridian**	88763	165499	543899					1903	1941
082KNW069	**Teddy Glacier**	5	2302	124	855	1351			1929	1929
082KNW071	**Lead Star**	12	19315	31	3104	1263			1930	1930
082KNW076	**Goldfinch (L.5654)**	4347	124215	50830	31	31			1903	1989
082KNW077	**Mammoth (L.6473)**	76	483652	249	23167	1952			1905	1907
082KNW097	**Mike**	2	778		195	657			1973	1973
082KNW101	**Silver Dollar**	6	9860		1378	1009			1947	1947
082KNW127	**Gillman**	1	62	62	22	23			1933	1933
082KNW150	**Silver Queen**	24	40434		9435				1917	1917
082KNW187	**Lucky Jack**	462	373	2333					1904	1908
Totals		**222965**	**59802845**	**968679**	**11193799**	**11540168**	**87345**	**Tungsten: 203 Cadmium: 60371 Antimony: 4261**	**1899**	**1989**

Table 2. Mineral production in the Beaton-Camborne Camp

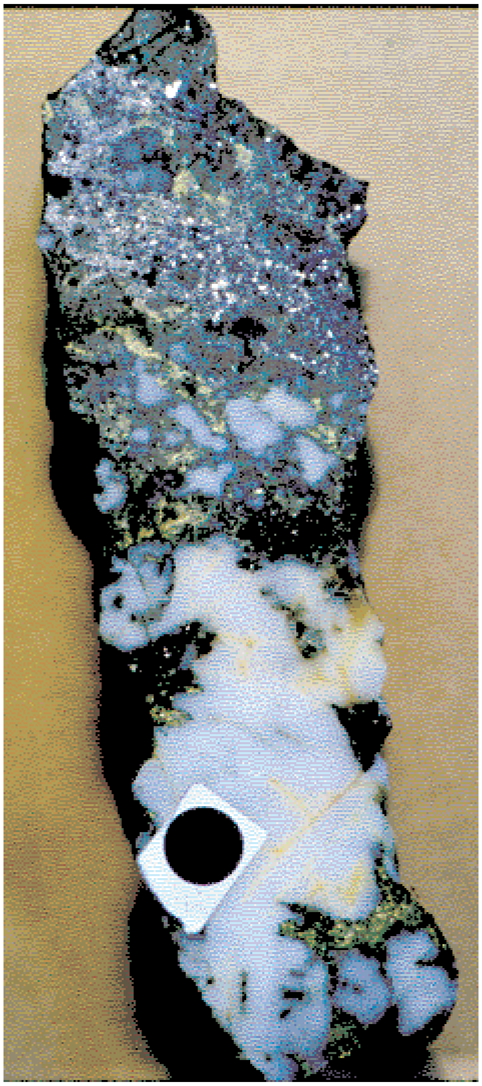

Photo 3. Pyrite, sphalerite, galena and chalcopyrite in vein quartz, ore feed, Meridian mill, Camborne (solid circle = 1 cm.)

quartz but elsewhere it is comprised of a mass of reticulating quartz veinlets with phyllite between. It has been suggested that the carbon in the phyllite has acted as a precipitating agent for the gold contained in the mineral-bearing solutions - the highest grade of gold occurring around the carbonaceous inclusions.

The Criterion vein is cut by a mineralized fault striking 043° known as the 'galena vein'. Where it cuts the Criterion it narrows from more than 1 to 0.3 metre wide, retaining well defined gouge seams along slickensided walls. This younger vein has been explored for 106 metres by drifting on the No. 1 level to a point where it is finally cut off by a shallow south-dipping east-west fault. At 160 metres into the tunnel a 2.4-metre wide quartz vein similar to the 'A' vein at Eva was encountered. The No. 2 adit, 53 metres below the upper level, was driven 137 metres to intersect the Criterion vein, however, the continuation of the ore-shoot, mined out on the No. 1 level, was not encountered.

The Oyster vein outcrops 90 metres north of the Criterion. It strikes 145°, dips 65° northeast and extends onto the Lucky Jack property to the southeast. The only development on the vein is a series of trenches.

The **Cholla** claim group (MINFILE 082KNW143) on Lexington Mountain adjoins the west margin of the Eva and Criterion-Oyster groups (Lat. 50°47.6', Long. 117°38.0') and extends beyond Pool Creek to Camborne. The quartz veins on these claims are all gold bearing, however, there is little development other than two short adits, 38 metres apart, driven on the Cholla vein. The Cholla is a well defined vertical, north-trending quartz vein cutting phyllites that strike 110° and dip 85° northerly. A sample of a 1.5-metre wide section of the vein from the face of the upper adit assayed 18.5 grams per tonne gold and 13.7 grams per tonne silver. A manganese enriched, pyritic sample from the same general area assayed 41 grams per tonne gold and trace silver. A metre-wide channel sample across the vein in the lower adit, which contained many fragments of phyllite in the quartz, assayed 14 grams per tonne gold. (Emmens, 1915, page K256).

The **Red Horse** claim (MINFILE 082KNW063) is situated on Pool Creek 2.4 kilometres upstream from Camborne (Lat. 50°47.0', Long. 117°36.9'). The principal vein consists mostly of quartz and has been traced for a distance of 60 metres up the mountain side by a series of open cuts, trenches and an adit. The host rock is phyllite striking 135°, dipping vertically. The most prominent joint set strikes 045° and dips 80° northwesterly; a weaker set dips 15° northwesterly. At the adit, the vein strikes 155°, dips 70° northeast and is divided by a median seam of phyllite into a 2.4 metre wide footwall section and a 1.8 metre wide hangingwall section. Mineralization consists of discontinuous seams of massive and disseminated pyrite in the quartz. Sampling across the hanging wall section assayed trace gold and 20.5 grams per tonne silver. Sampling of the foot wall section assayed 0.7 gram per tonne gold, and 82 grams per tonne silver (Emmens, 1915, page K258).

Lucky Jack (L. 8715); (MINFILE 082KNW187)

The Lucky Jack property is situated on Lexington Mountain and adjoins the Criterion-Oyster and Cholla claim groups on the southeast (Lat. 50°47.5', Long. 117°37.1'). There are several veins on this property that have been prospected but the only significant development is confined to surface cuts and shallow underground workings which test the continuation of the 200 metre long Oyster vein. The vein ranges from 1 to 4.6 metres wide and consists mostly of quartz with bands of carbonaceous phyllite mineralized with pyrite. The vein has an average strike of 145° and a dip of 54° northeast. Close to the line of the Sleve Namon and Mascotte claims the vein has been opened by a large cut from which ore was mined and processed in a small two-stamp mill from 1904 to 1908. A crosscut driven through ore on the floor of the cut exposed a wide section of the vein. It dips 35° northeast and is divided into three bands by narrow seams of graphitic schist. Sampling and assay results across 1.5 metres on the hanging wall section yielded 6.9 grams per tonne gold, and 33 grams per tonne silver. Results from 1.8 metres of the central section assayed 10.3 grams per tonne gold and 17.1 grams per tonne silver; while 0.9 metre across the footwall section assayed 28 grams per tonne gold and 33 grams per tonne silver. About 38 metres southeast of this old cut, and 30 metres below it, a crosscut was driven into the hill to the vein and a drift extended for 12 metres to the northwest. Near this point, a sample of the 0.8 metre hanging wall section of the vein assayed 16.1 grams per tonne gold; the middle section across 0.85 metre returned 0.3 gram per tonne gold; and the footwall section across 1.7 metres returned 6.5 grams per tonne gold (Emmens, 1915, pages K257).

Goldfinch (L. 5654); (MINFILE 082KNW076)

The Goldfinch property, comprising the Goldfinch (L.5654), Walrus (L.5653), Dorothy (L.12481), Independence (L.12460) and 11 additional Crown granted claims and fractions, is centered on the west side of the Incomappleux River, 3.7 kilometres north-northwest of Camborne (Lat. 50°49.4', Long. 117°39.5'). Elevations on the property range from 488 metres at river level to 1,040 metres at the main showings. Access to the property is from Camborne via a switchback logging road that ascends the ridge between Scott Creek and Menhinick Creek.

The property extends 1.5 kilometres following a series of gold-bearing quartz veins that strike southeast coincident with the regional structural trend. The claims were staked at the turn of the century and operated for several years by Northwestern Development Syndicate. The chief work was on the Goldfinch and adjoining Dorothy and Independence claims. Early reports mention numerous trenches and adits and a tramline connecting the Goldfinch mine with the mill at the mouth of Menhinick Creek.

The Goldfinch claim was the focus of the initial development work. In 1903 production of 726 tonnes of ore yielded 16.2 kilograms of gold and 4.98 kilograms of silver and, in 1904, an additional 590 tonnes returned 4.67 kilograms of gold and 633 grams of silver. Much of this production was from an open cut. The vein system is explored by two principal adits and a shaft. A short upper adit (Photo 4) was driven northeast to intercept a splayed vein striking 135° and dipping variably 20°-40° southwest and 75° northeast. The vein is 10 to 30 centimetres wide, and contains quartz, accessory pyrite, galena and visible free gold. Assays on selected samples range up to 62 grams per tonne gold and 21 grams per tonne silver (Emmens, 1915, page 251). The lower adit, located 20 metres below the upper adit, explores the area mostly west and south of the upper workings. A strong quartz vein at the shaft, dipping 80° southwest, is aligned with a similar vein striking 155° at the lower portal, located 130 metres to the southeast of the shaft. Assay results for several one metre sections taken across the shaft vein range up to 0.68 grams per tonne gold and 5.83 grams per tonne silver (Read, 1981).

There are two principal quartz veins on the Independence claim. These are hosted in phyllite and occur in, and adjacent to, a rusty-weathered diabase dike. The No. 1 vein was originally exposed by trenching which follow the bedding planes for 120 metres striking 135°, dipping 60° to 70° northeast. An assay sample taken across 0.9 metre of the vein returned 2.1 grams per tonne gold and 3.4 grams per tonne silver. The No. 2 vein has been opened and drifted on from a short adit. This vein strikes 155° and dips 70°

southwest. A splay of this vein, sampled across 4.9 metres, assayed 17.1 grams per tonne gold and 10.2 grams per tonne silver (Emmens, 1915, page 250).

After a long period of dormancy Eaton Mining and Exploration Co. Ltd. renewed exploration in 1971 and shipped ore in 1979. The property was then acquired by Windflower Mining Ltd. in 1985. Granges Exploration Ltd., in an option agreement with Windflower, completed additional work on the Dorothy zone which led to further production in 1989.

The Dorothy zone consists of a number of quartz lenses and pods on what appears to be an axial plane shear. This mineralized structure trends southeast for a several hundred metres from the Dorothy claim, across the western extremity of Goldfinch to the boundary of the Walrus claim. The main Dorthy structure has been tested by drilling to a depth of 99 metres and traced on strike for 546 metres. Width of the structure ranges between 1.8 and 9.1 metres. The East Zone, located 20 metres east and parallel to the Dorothy zone, is comprised of en echelon quartz veining containing visible gold and a minor amount of galena, sphalerite and a trace of chalcopyrite. The zone has a strike length of 150 metres, depth of 80 metres and width of 1.98 metres. The West zone, traced by drilling for 60 metres along strike, is a sulphide-rich lens containing coarse pyrite with native gold in quartz within graphitic phyllite, similar to the Dorothy zone. The Dorothy North is 80 metres in length and separate from the main zone. Best assay results returned 11.65 grams per tonne gold over 3.61 metres (George Cross Newsletter, # 224, 1987).

A soil sampling program in 1988 by Granges revealed a number of geochemical anomalies. Follow up prospecting resulted in the discovery of a new gold bearing quartz-carbonate vein near Scott Creek. The Scott Creek zone is located 500 metres north of the Dorothy zone and comprises quartz stockwork and quartz-carbonate veining averaging three to four metres and occasionally 10 metres in width. Assay results on grab and chip samples reportedly range from 3 to 27 grams per tonne gold (Northern Miner, Aug. 10, 1987).

Estimated ore reserves for the combined largest zones on the property reported by Granges Exploration Ltd., based on 60 diamond drill holes, is 180,000 tonnes grading 10 grams per tonne gold (Northern Miner, March 1987).

Photo 4. Main portal, Goldfinch mine, Menhinick Creek area.

Spider (L. 15752); (MINFILE 082KNW045, 044, 048, 049)

The Spider mine (also known as the Sunshine Lardeau mine) is on the south side of Pool Creek, 2.7 kilometres by steep road southeast of Camborne (Lat. 50°46.8’, Long. 117°36.5’). The Spider (L.15752), Spider No.1 (L.15753), Eclipse (L.5170) and Sandy (L.8719) are the nucleus of a group of Crown granted claims and fractions that extends from the valley of Pool Creek southeasterly towards Mohawk Creek.

The first discovery of ore in this area was made in 1910 on the Spider claim. Development work continued until 1949 during which there were small intermittent shipments of hand-sorted ore (Photo 5). Sunshine Lardeau Mines Ltd. acquired the property and initiated a diamond drilling program which discovered Nos. 4 and 5 veins in 1950. A crosscut was driven to the veins on No. 5 level and No. 6 adit was extended to intersect No.4 vein. A mill was installed in the old Meridian building on Pool Creek in May 1952. Concentrates were transported by truck to Beaton and thence by the Arrow Lakes barge to the rail-head at Nakusp and from there to smelters in the United States. Berens River Mines Ltd. provided additional funding to gain control of operations. In 1953 the No. 10 adit was driven. In 1956 the company was liquidated and operations passed to Newmont Mining Corp. Mining and milling operations were suspended on May 14, 1958.

The mine is underlain by southeasterly striking, steeply dipping volcanic and sedimentary rocks of the Lardeau Group. Sedimentary rocks of the Broadview Formation include medium grey to greenish quartzites, greywackes, carbonaceous phyllites and quartz sericite schist. The volcanic rocks of the Jowett Formation comprise massive fragmental lenses and lava flows, some chlorite schist and a few thin beds of banded iron formation. In the fragmental units, extreme elongation of the clasts, caused by synkinematic metamorphism, has imparted a crude secondary layering subparallel to the primary stratification.

The volcanic rocks are host to most of the ore. At the Spider mine the volcanic rocks underlie a lens-shaped area roughly 2,300 metres long by a maximum of 600 metres wide. As a unit, the volcanics are considerably more competent than the sedimentary rocks. The few schist zones that are found are generally only a few feet wide and are believed to represent strike or bedding parallel faults.

The major structures have been inferred from cleavage parasitic relationships in the volcanic and sedimentary rocks and the attitude of the minor folds. Large folds with many drag folds appear to be confined to the central part of the volcanic belt. In general the folds are tight isoclinal. The axes of all the folds strike northwesterly, and the axial planes are inclined steeply to the northeast. The folds plunge to the southeast at angles averaging from 25° to 30°.

A northwesterly trending fault, known locally as the Camborne fault, cuts the north limb of a southeasterly plunging anticlinal structure along the north side of Pool Creek.

The orebodies occupy four main veins on a system of steeply dipping, northerly trending

Photo 5. Ore bin, No. 8 Adit, Spider mine, Pool Creek area.

faults. The faults, spaced at ~ 275-metre intervals, cut across the bedding at about 50°, showing some dextral strike slip displacement. From northwest to southeast the veins are named the **Sandy** (MINFILE 082KNW048), **Barclay** (MINFILE 082KNW049), **No. 4** (MINFILE 082KNW045) and **Eclipse** (MINFILE 082KNW044).

Past development at the Spider mine consists of at least seven levels. Production by the end of 1957 was mainly from one ore shoot on the No. 4 vein. This vein, striking 170°, dipping 75° east, was developed from surface to a depth of 200 metres. Ore grade material was intersected in drilling an additional depth of 70 metres below this level.

The Eclipse vein (Lat. 50°46.6', Long. 117°36.3'), accessible via the No. 10 adit level of the Spider mine, produced 31,748 tonnes of ore in the period 1956-58. This development exposed the top of the ore body (005°/75° east) through a vertical range of 46 metres.

The principal showing on the Sandy claim (Lat. 50°46.9', Long. 117°37.1') is a quartz vein which strikes 160°. It is crosscut by four subparallel faults. The ore minerals occur as irregular veinlets and small pockets along these faults. A small ore shoot discovered in this setting was explored but the limited tonnage indicated did not warrant production.

The Barclay vein is hosted by altered greenstone and exposed at the east end of a road cut. The vein consists of galena sparingly disseminated in quartz. Diamond drill programs in 1954 and 1956 failed to locate any extension of this mineralization. There is no record of ore production from this zone.

The orebodies range from 30 metres to 120 metres in length and from 0.45 to 4.5 metres in width. They are essentially tabular with some pinching and swelling. Tensional branch veins are fairly common. Some of these are more than 30 metres long and 100 metres deep - most of these pinch out within a metre of the main vein.

The main constituents of the ore bodies are quartz, pyrite, sphalerite and galena and minor amounts of ankerite, chalcopyrite, and rarely arsenopyrite and tetrahedrite. Sections composed essentially of pyrite, sphalerite and galena are common. The order of deposition of the vein minerals is ankerite, quartz, pyrite, sphalerite, chalcopyrite, galena. Fine and coarse grained varieties of galena are present.

Zones of carbonate alteration and oxidation, as much as several metres wide, occur along the faults principally on the eastern or hangingwall side with or without accompanying vein mineralization. These zones comprise altered remnants of the volcanic country rock, ankerite, disconnected quartz stringers and a small amount of chrome mica. In the oxidized zone, most of the pyrite, sphalerite and gangue has been leached, leaving a mixture of clay, limonite and galena. The No. 4 orebody shows vertical oxidation for 40 metres below the surface.

In summary, the main ore controls are a series of northerly trending fissures (splays or tension fractures?) that appear to be related to the through-going southeasterly trending Camborne fault along the valley of Pool Creek. Hydrothermal solutions were controlled by the intersection of the principal fissures with fold crests. Mineralization appears to have favoured the Jowett Formation because of the volcanic composition and the competent, fissure-sustaining characteristics of these rocks.

Total production to the end of 1958 was 370 kilograms of gold, 53,480 kilograms of silver, 85 tonnes of copper, 10,845 tonnes of lead and 11,519 tonnes of zinc from 128,063 tonnes of ore (MINFILE, also see Keys, 1956).

Measured geological reserves at the Spider mine are 25,398 tonnes grading 4.4 grams per tonne gold, 255 grams per tonne silver, 6.19 per cent lead and 6.34 per cent zinc (George Cross News Letter, April 26, 1987).

Beatrice (L. 4586); (MINFILE 082KNW040)

The Beatrice mine (Photo 6) is situated, at 2,103 metres elevation, near timber line, at the head of the southeast fork of Mohawk Creek (Lat 50°44.3’, Long 117°33.5’). The property consists of six contiguous claims including the Beatrice (L.4586) and Folsom (L.4587). Access to the property is via the badly eroded and overgrown Spider mine road, 11 kilometres southeast of Camborne. Construction of a new logging road to Mohawk Creek has begun from a point just southwest of the canyon section on the Incomappleux River road, about five kilometres northeast of Beaton.

The Beatrice and Folsom claims were staked in 1897 and Crown granted about 1902. They were originally part of the Beatrice Group located on the southwest spur of Mount Pool.. The original discovery by two prospectors consisted of a small chimney of clean galena at the contact of schist and crushed slate. A 10-metre shaft was sunk on the ore, which was further developed by a 60-metre adit, known as the No. 1 level. The No. 2 level was driven from the opposite side of a shoulder (jutting north from the main ridge) to a vertical depth of 46 metres below the No. 1 level. In 1898 approximately 200 tonnes of silver-rich ore was hand mined.

The property was worked continuously from 1898 to 1906. In 1902 the Beatrice Mines Ltd. was organized. The company resumed operations in 1910, but ceased work in 1911. In 1918 the property was bonded to New Era Mines Ltd. and operations continued through 1920. At this point the workings consisted of a several hundred metres of drifts, crosscuts and raises on three levels. In 1921, a two-bucket tramway was installed to connect the No. 2 adit with ore bins on the main trail. However, the high zinc content of the ore prevented satisfactory market arrangements at the time and this discouraged further work. In 1954 a private company, Beatrice

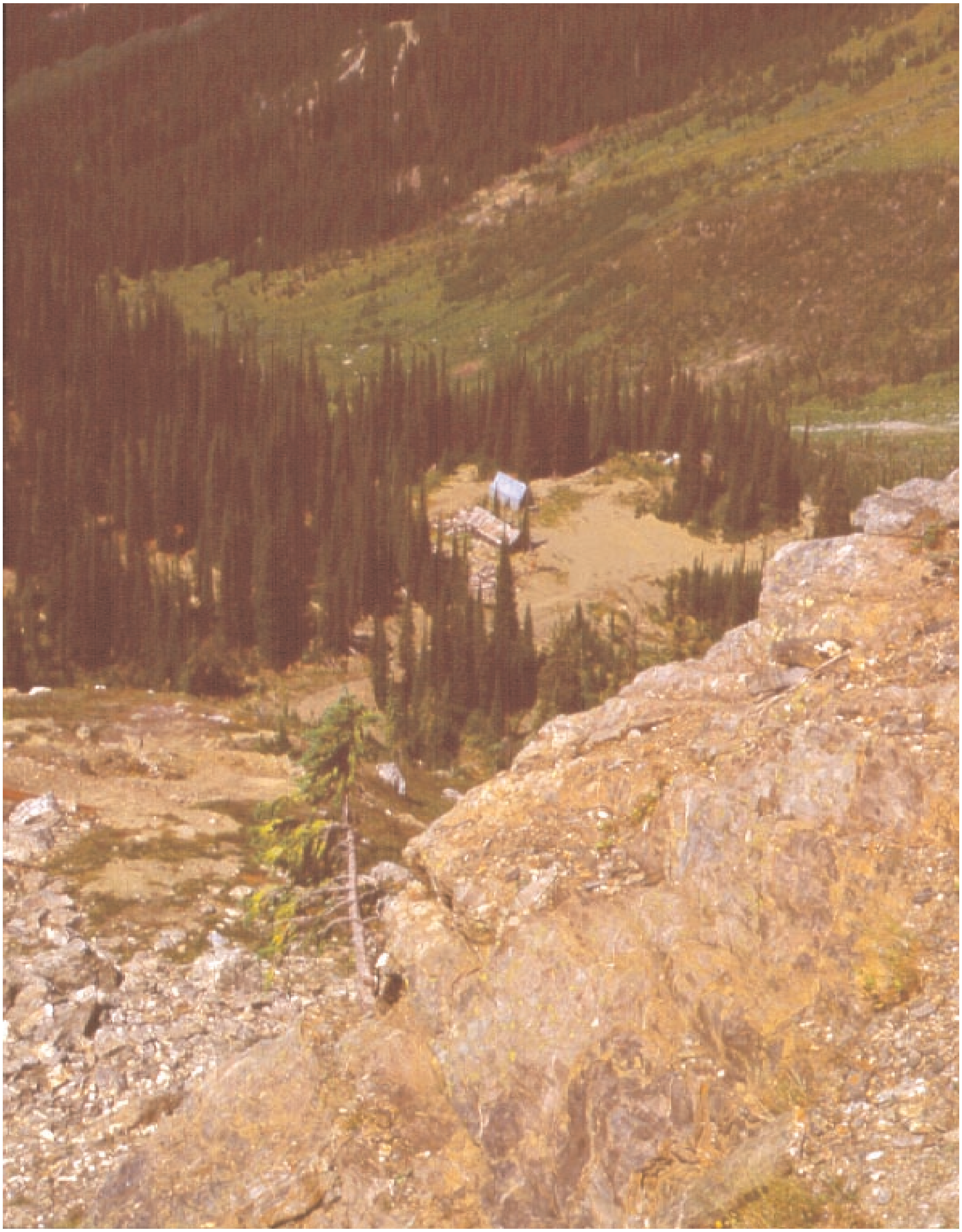

Photo 6. Panoramic view of the Beatrice camp site looking northeast from portal.

Mines Ltd., rehabilitated the mine and during the next few years rebuilt the road. In 1964 the property was optioned to Dakota Silver Mines Ltd. During this and the following years, limited work was carried out but the property and equipment was eventually abandoned.

The Beatrice is on the same belt of Lardeau metasedimentary rocks as the Silver Cup (MINFILE 082KNW027), Nettie L (MINFILE 082KNW100) and True Fissure (MINFILE 082KNW030) mines of the Ferguson camp to the southeast.

Black slates, carbonaceous schists, grey and reddish-brown weathering grits and quartzites and greenish grey talcose schists underlie the property. On average the rocks strike 140° and dip 65° northeast.

Ore occurs as irregular veins in shear zones, on bedding plane slips and crosscutting faults. The veins range from a few centimetres to a few metres wide and consist of sphalerite, galena, tetrahedrite and pyrite in quartz gangue with minor calcite. Replacement is considered to be an important factor in the formation of the ore.

The mine workings develop two principal vein-lodes - the Beatrice and the Main veins. The Beatrice vein, which was the original discovery at surface, strikes 050° and dips 65° southeast across the axis of the controlling synclinal structure. The Main vein, found only on the lower levels of the mine, strikes 140° and dips 65° northeast.

The No. 1 adit was crosscut to the Beatrice vein where considerable stoping was done. Above the level the vein was mined for a vertical distance of about 18 metres and horizontally for 20 metres. The ore appears to have been hand cobbed in the stope and backfilled with rejected subgrade debris. The mineralization consists of a solid band of pinching and swelling massive sulphides, ranging up to 50 centimetres wide. The hanging wall is a two metre wide siliceous zone carrying disseminated sulphides. Sampling at the face of No. 1 level across 0.6 metre yielded an assay result of 0.3 grams per tonne gold, 450 grams per tonne silver, 5.2 per cent lead and 7.8 per cent zinc (Ashton, 1977).

The Main vein on the No. 2 level consists of solid bands of sulphides and disseminations up to three metres wide, in a graphitic shear zone. In the most easterly workings of the intermediate level, the ore zone follows a parallel partly mineralized structure trending 138°, dipping 60° northeast.

A third vein, known as the 'Gold Lode' has been traced for a few hundred metres in open cuts below the main road. This vein, contains pyrite and a sprinkling of galena. It is 1.2 to 1.8 metres wide and strikes 155° and dips steeply to the northeast. Assay results returned 5.1 grams per tonne gold and 32.5 grams per tonne silver (Emmens, 1915, page K267).

Altogether, 618 tonnes of hand sorted ore was shipped from the property, mostly between 1899 and 1917, yielding 558 grams of gold, 1,832 kilograms of silver, 182,930 kilograms of lead and 10,894 kilograms of zinc (MINFILE).

Mammoth (L.6473); (MINFILE 082FNW077)

The Mammoth property comprises four Crown granted claims situated between 2,070 and 2,530 metres elevation, straddling the narrow northwest ridge extending from the summit of Mount Goldsmith (Lat. 50°51.4', Long. 117°34.5'). The original route to this remote mountain top property was by steep mountain trail from the Incomappleux River valley, however, the only practical access nowadays is by helicopter, 9.7 kilometres northeast of Camborne.

The property was worked from 1904 to 1907 by the Edward Baillie Syndicate of Nelson B.C. Production amounted to 76 tonnes of hand sorted ore that yielded 249 grams of gold, 484 kilograms of silver, 23 tonnes of lead and 1.95 tonnes of zinc (MINFILE).

The mine consists of an adit driven 180 metres southeast and several side tunnels crosscutting the main ridge. Some tunnels broke through to surface which now give views of the valleys of Boyd Creek to the east and the Incomappleux River to the northwest (Photo 7). These workings develop a seam of galena, pyrite and argentiferous tetrahedrite, up to 25 centimetres thick, on an essentially horizontal rolling fissure, dipping locally 5° to 10° northeast, in a fine grained, dark grey limestone bed that strikes 150°, and dips 80° northeast. These beds are succeeded to the southwest by other units of the Index Formation (Lardeau Group), including a bed of pure white crystalline limestone and west of that a thick band of green chlorite schist. The host rocks at the mine site are cut by a set of northeast striking vertical joints. Southeast from the adit, along the ridge, there are several small quartz veins and a band of limestone that has been heavily replaced by pyrite (with minor gold) and iron carbonates.

Lucky Boy (L. 5423); (MINFILE 082KNW003, 004)

The Lucky Boy property consists of a small group of Crown granted claims of which the **Lucky Boy** (L.5423), **Horseshoe** (L.5342) and **Copper Chief** (L.4584) (MINFILE 082KNW004) are the most important. The prop-

Photo 7. Main portal area, Mammoth mine, Mount Goldsmith.

erty is located on the northern shoulder of Trout Mountain overlooking Wilkie Creek (Lat. 50°38.5', Long. 117°36.2'). Access to the property is by dirt road, five kilometres from the north end of Trout Lake.

The first claims in the area, the Lucky Boy and Copper Chief, were staked in 1897 and 1901, respectively. The property was worked originally for high-grade silver-lead ore. From 1901 to 1906 a total of 395 tonnes of this type of sorted ore was shipped and from 1911 to 1917 an additional 25 tonnes of similar ore was mined and shipped to smelters. In 1942 a further 20 tonnes of tungsten (scheelite) ore was hand sorted and shipped. In 1972 an additional 24 tonnes silver-lead-zinc ore was shipped. Total recovery from the claims was 3,232 kilograms of silver, 117,431 kilograms of lead and minor copper, zinc and gold.

The ore was developed by a number of surface cuts, adits and inclined shafts - most of the work was on the Lucky Boy claim and some of the remainder on the adjacent Horseshoe claim. The principal workings are accessible from an inclined shaft that extends downward southeasterly for 58 metres on the Lucky Boy claim. Drifts were developed east and west from this shaft on three levels. The underground workings on the Horseshoe claim are accessible by two shafts collared 46 and 59 metres due west, respectively, from the Luck Boy shaft. Both of these shafts were driven as declines down dip about 50 metres on the extension of the Lucky Boy vein. The Copper Chief workings lie approximately 1.2 kilometres southwest from the main Lucky Boy and Horseshoe shafts (Lat. 50°38.0', Long. 117°36.5'). The main showing, at the elevation of 1,575 metres, is exposed in an adit driven at 027° on a steeply dipping fault.

The geology of the area has been described by Read and Brown (1981). The area in the vicinity of Wilke Creek on Trout Mountain is underlain by schists, pelitic quartzites, calcareous phyllites and limestone beds of the Lardeau Group that underwent regional metamorphism and multiple episodes of deformation. The strike of beds across the claims is rather uniform at 150°. Bedding within the quartzite is obscured, but it and most limestone or skarn contacts dip from 65° to very steeply northeast. In several places small dragfolds plunge 20° to 30° northwest. This kind of folding, combined with gentle northwesterly plunging fold axes, seems typical of the area.

There are two types of mineral deposits on the property. One is typical of the main Lucky Boy and Copper Chief ore deposits and consists of nearly flat, drusy quartz veins which cut steeply dipping quartzites and limestones of the Lardeau group at nearly right angles. These veins carry galena, sphalerite, pyrite, tetrahedrite, minor native silver and scheelite in a quartz gangue. The second type is skarn mineralization in silicified limestone. The skarns contain garnet, pyroxene, pyrrhotite and considerable scheelite but little or no galena, tetrahedrite and only small amounts of sphalerite. They are rarely more than several metres in length and vary from 1 to 12 metres in width. The skarns usually crop out over exceedingly rugged and steep mountain sides.

The Lucky Boy vein has an easterly strike, with an average dip of 50° south that becomes almost horizontal in places. The vein apparently follows the major jointing of the enclosing silicified schist and quartzite. The sulphides reticulate through the vein quartz, sometimes occurring as almond-shaped masses. The following order of formation of the metallic minerals is suggested - galena, tetrahedrite, chalcopyrite and pyrite, galena, sphalerite. Galena is found both in and surrounding tetrahedrite; sphalerite encloses both. Chalcopyrite encloses and forms veins in the foregoing assemblage, and pyrite and galena form the matrix for the other sulphides. From the way chalcopyrite embays the tetrahedrite, it looks as if it was formed at the expense of the latter - perhaps the result of a reaction of tetrahedrite with pyrite.

From the shaft on the No. 1 level (100-foot level) drifts have been driven to connect with the Horseshoe workings and stopes opened at intervals along the strike of the vein. Near the face of the west drift, a ribbon of ore 15 centimetres wide, containing abundant tetrahedrite, assayed 5 grams per tonne gold, 6,500 grams per tonne silver and 3.3% copper. Also, a sample across a 25 centimetre width of the vein, at the head of the stope, assayed 13.7 grams per tonne gold, 2,600 grams per tonne silver and 47.2% lead (Emmens, 1915, page K 317).

The No. 2 level is driven eastward and westward from the shaft. To the east, the drifting was carried 75 metres without encountering significant ore. To the west, the vein was followed 37 metres and stoped throughout to the No. 1 level. At 17 metres from the shaft, scheelite mineralization is present in the remaining pillars and exposed along the drift westward. In the vein, in the stoping face at 30 metres from the shaft, there is an attractive display of scheelite across 0.7 metre that contains an estimated 1.84% tungsten oxide (J.S. Stevenson, 1942, unpublished notes).

There is no development below the No. 3 level of the Lucky Boy mine. At that depth the vein fissure appears to cut a limestone bed but without significant accompanying mineralization. On the lowest level, the vein as exposed is narrow and contains little sulphides. However, scheelite mineralization extends nine metres up from the base of the shaft, and seven metres east on both walls of the drift - the drift having been driven 40 metres east and west from the shaft accessing raises that go through to the No. 2 level.

The distribution of scheelite mineralization indicates the existence of a shoot of several hundred tonnes of ore that rakes southeastward from the Horseshoe workings at surface, beginning by the east shaft, traversing through to the raise at the west end of No. 2 level and to the base of the shaft on No. 3 level, coinciding with the main shoot of sulphide mineralization which was previously mined. A grab sample of this scheelite ore assayed 1.41% tungsten oxide and 0.63% phosphorous (Stevenson, 1943, page 133).

There appears to have been a considerable tonnage of scheelite ore in place before the silver-lead quartz-sulphide vein was mined. Unfortunately, the sulphides and scheelite were in the same sections of the vein and, as a result of the original focus on precious metals, only the high grade silver-lead ore was mined and much of the scheelite was discarded. The bulk of this rejected material was used as fill in empty stopes or in surface waste dumps.

Other less mineralized veins can be found on parallel fissures. Locally, there is evidence of replacement of inclusions of country rock where the veins widen.

Skarn occurrences are principally southeast of Wilkie Creek. A total of 16 skarns have been found between elevation 1,090 metres (150 metres above the creek) and the crest of the northeast spur of Trout Mountain, at 1,630 metres elevation. The skarn mineralization consists of varying amounts of pyrrhotite and fine grained scheelite. The skarn occurrences appear to coincide with three limestone beds or perhaps a single limestone bed that was intricately folded.

Several skarns lie on the southwest side of a steep gully extending from the Copper Chief adit at 1,475 metres elevation down to creek level. The lowest showing is about 150 metres below the old low trail that leads southwest from the Lucky Boy camp along the side of Wilkie Creek. The skarn is light coloured and composed mainly of calcite with small amounts of garnet and diopside. It occurs on the northeast side and close to the top of a band of grey limestone that extends uphill from the creek. The skarn is about 2.4 metres wide and is moderately well mineralized with scheelite. The skarn is below an anticlinal fold in quartzite that plunges 20° northwest.

Additional skarn exposures are located in the gully at 1,408 metres elevation on the high trail from the Lucky Boy camp to the Copper Chief adit. One exposure of dark coloured skarn in this area is 3.3 metres wide and contains some scheelite and abundant pyrrhotite. Another dark coloured skarn band, exposed on the southwest side of the gully, is 16 metres wide and contains a high proportion of diopside and epidote. Scheelite is disseminated through this skarn across four metres adjacent to a narrow enclosure of grey limestone. At the portal of the Copper Chief adit, the skarn is 0.6 to 1.2 metres wide and encloses several lenses of limestone. A sample across 1.2 metres of the skarn and limestone assayed 1.06% tungsten oxide (Holland, 1952, page A186).

Ethel (MINFILE 082KNW059)

The Ethel mine is situated northeast of the summit of Trout Mountain, between 1,800 and 1,900 metres elevation, overlooking Humphries Creek (Lat. 50°37.2', Long. 117°34.9'). It is reached by a switchback logging road that connects the property to the settlement of Trout Lake, four kilometres to the northeast.

The Ethel group, comprising the Ethel, Esther, May-Day, Frances and Noel claims, was located in 1898 on a silver-lead rich vein lode. In 1902 the property was purchased by a Philadelphia based company and, after lying idle for four years, the mine was worked on a small scale resulting in a shipment of 480 sacks of high grade ore to the Trail smelter. Mining continued intermittently until 1918 resulting in a total production of 74 tonnes of ore yielding 378 kilograms of silver and 8,045 kilograms of lead. Underground development of the vein system extends over a vertical range of 50 metres and consists of one crosscut adit and seven drift adits - the longest of which is 90 metres. Since that time there has been no mining activity and the Crown granted claims have revered. In the summer of 1965, the ground was restaked by Rexony Mining Co. Ltd., and a road was built connecting the property to an existing logging road. The workings were mapped and sampled and in June 1966 three holes were drilled that totalled 236 metres. In 1978 Cominco Ltd. staked the surrounding area and conducted detailed geochemical surveys, from 1979 to 1981, across the surrounding terrain. Subsequently there has been no additional development.

The showings at the Ethel mine are a series of closely spaced quartz veins hosted in dark grey phyllites and limestones of the Lardeau Group. A layer of fine grained limestone 15 to 23 metres thick contains the principal vein-lodes, however, some veins extend beyond the limestone into the phyllite. The veins strike 130° to 155° and dip 60° northeast essentially parallel to the schistosity of the phyllites. The quartz, containing scattered grains of galena, sphalerite, pyrite and tetrahedrite form lenses up to 46 centimetres thick following the schistosity. They have mostly been mined out, but judging from surface exposures and small underground stopes, they formed en echelon bodies with an average dip of 40° to the northeast. The old workings passed from one lens to the next, giving the appearance of a single continuous vein (Photo 8). Selected samples from the surface, containing sulphides or showing copper stain, assay as much as 2,800 grams per tonne silver (Fyles, 1966, page 230).

Teddy Glacier (MINFILE 082KNW069)

The Teddy Glacier property is located at 2200 metres elevation on Mount McKinnon, at the head of a tributary of Stephany Creek, 16 kilometres north of Beaton (Lat. 50°52.1', Long. 117°44.8'). Access is 30 kilometres by road from Beaton via the main Incomappleux River and Sable Creek roads.

The property was staked in 1924 by G. Ritchie and G. Edge. High grade float strewn for 300 metres downslope led these prospectors to the mineral occurrences at the foot of the receding 'Teddy' glacier.

Teddy Glacier Mines, Ltd. was incorporated in 1924 by Blockberger and Associates to acquire the important Rambler-Cariboo, Blackhead, Margaret and Mary Jane claims. A trail was opened to the property in 1925, and in late 1926 a crosscut adit was begun just below the main showing. The adit was advanced to the vein during 1927 and then work stopped. In 1929 the Bush and McCulloch interests provided funds for extending the crosscut to a second vein. A shipment of five tonnes of ore was made at this time yielding 2,302 grams of silver, 124 grams of gold, 855 kilograms of lead and 1,351 kilograms of zinc.

No further activity was reported until a syndicate, financed by Mines Selection Trust of London, began extensive development work in 1934. A considerable amount of money was spend on equipment, trails and camp buildings. Also, at this time, about 500 metres of drifting and crosscutting was done in the upper adit. In 1935, a lower adit, begun 55 metres below the upper adit, was driven 18 metres then abandoned because the upper level results were not encouraging.

Photo 8. Adit development, Ethel mine, Humphries Creek area.

The claims were allowed to lapse in 1942. The central claims of the group, covering the main showings, were then restaked in 1942 by A.D. Oakley who subsequently sold controlling interest to A.M. Richmond representing American Lead-Silver Mines Ltd. Richmond did a detailed re-evaluation of the property. The property was optioned to Columbia Metals Corporation Ltd. in 1952. However, no activity other than road building was report and the option was abandoned.

In 1959 the property was acquired under joint ownership by Sunshine Lardeau Mines Ltd., Maralgo Mines Ltd. and Magnum Consolidated Mining Co. Ltd. - an indirect interest was secured by Transcontinental Resources Ltd. Work by this consortium during 1963 included geological mapping, sampling of the underground workings and 150 metres of diamond drilling in six holes. Road construction in 1964 disclosed new showings on the Bell No. 14 claim, located 900 metres southeast of the main workings. However, a drill program (which totalled 660 metres of diamond drilling) was somewhat discouraging and did not establish the continuity of the ore zones.

The Teddy Glacier property is underlain by tightly folded and sheared limestones, carbonaceous phyllites and grits of the Index Formation, Lardeau Group. These rocks trend southeast (115°-135°), dip 50°-60° northeast and are cut by steeply dipping cross-joints.

The ore zones are confined to quartz veins that vary from a few centimetres to 1.2 metres in width, are up to 40 metres long and occupy two adjacent fractures, striking 163° and 170°, and dipping steep easterly. On surface and in the upper adit level, these fractures join to form the 'Big Showing'. This showing comprises a large body of quartz roughly nine metres long carrying bodies of coarse sulphides up to 1.5 metres wide. Assay results across 4.9 metres at the widest point on the vein yielded 8.9 grams per tonne gold, 280 grams per tonne silver, 12.9% lead and 7.1% zinc (Richmond, 1949). Other showings occur 90 metres to the northwest ('Dunbar vein') and again at 180 and 300 metres on the same structure. Assay results on the Dunbar vein across 0.7 metres returned 6.9 grams per tonne gold, 840 grams per tonne silver, 34.0% lead and 2.8% zinc (Richmond, 1949).

The sulphides occur as masses and bunches of almost clean (70-80%) galena, pyrite, sphalerite and minor chalcopyrite in quartz gangue and, less frequently, as intimately intermixed fine grained sulphides in narrow lenses in quartz. Tetrahedrite occurs as small inclusions in the galena. In most of the ore, silver is closely associated with galena and gold with pyrite (~29 grams of gold per tonne of pyrite). The wall rocks on both the foot and hanging wall sides of the orebodies are hard, competent limy-quartzitic sedimentary rocks that have been silicified, fractured and faulted during folding, and to a minor extent after sulphide mineralization.

The probable and inferred ore reserves at the Teddy Glacier mine are 44,212 tonnes of ore grading 161.1 grams per tonne silver, 4.4 grams per tonne gold, 7.9 per cent lead and 6.8 per cent zinc (Sunshine Lardeau Mines, Ltd., 1964 Annual Report).

Great Western (L.4503); (MINFILE 082FNW213)

The Great Western property, comprising the Great Western, June, Silver Tip and All Blue claims, is located two kilometres north of Whiskey Point on the shore of the Northeast Arm of Upper Arrow Lake (Lat. 50°43.4', Long. 117°49.3'). The claims extend from lake level, at 425 metres elevation, to 900 metres elevation on the southeast slopes of Mount Sproat. The property is reached from the shoreline of Arrow Lake and short access roads.

The rocks underlying the claim group are undivided units of the Lardeau Group consisting of grey to white crystalline limestone, green chloritic schist and a granodiorite body. The Lardeau rocks strike southeast at 120° on average. The large granodiorite body is generally concordant with these beds. The lowest showing located at 60 metres above the lake consists of a width of 3.5 metres of quartz in granodiorite. Galena and pyrite occur sparingly along the fractures and as disseminations in both the quartz vein and the dike. At 210 metres above the lake, at the face of a short adit, mineralization occurs across a width of 2.4 metres. Higher above the lake, at 440 metres, white and grey marble on the east side of the dike contains small irregular masses of serpentinite and barite plus irregular galena replacements.

Trout Lake (MINFILE 082KNW087)

The Trout Lake deposit is located 60 kilometres southeast of Revelstoke on the northern spur of Trout Mountain between 1450 to 1520 metres elevation (Lat. 50°38.2', Long. 117°36.2'). Access to the property is by logging road, five kilometres west of the north end of Trout Lake.

The first claims in the area, the Lucky Boy and Copper Chief, were staked in 1897 and 1901, respectively. A total of 414 tonnes of hand-sorted ore was shipped from several small veins from the Lucky Boy between 1901 and 1917 - from which 2,898 kg of silver and 121 tonnes of lead were recovered; a further 18 tonnes of tungsten (scheelite) ore was shipped in 1942.

Molybdenite was first reported in 1917, but it was not until 1969 that a subsidiary of Scurry Rainbow Oil Ltd. carried out trenching and a diamond drill program. The property was optioned by Newmont Exploration of Canada in 1975. From 1976 to 1982, a joint venture project by Newmont and Esso Minerals Canada Ltd. delineated the deposit by surface drilling and subsequently by diamond drilling and bulk sampling from an exploration adit (Photo 9). Underground development on the property consists of about two kilometres of crosscuts and drifts. The pipe-like stockwork deposit extends from the surface to a depth greater than 1000 metres and contains estimated reserves of 49 million tonnes grading 0.19% MoS_2 (Linnen et al., 1995). The property has been inactive since 1982 and is now wholly owned by Newmont Mines Ltd.

The geology of the area has been described by Holland (1952, 1953), Boyle and Leitch (1983) and Linnen et al. (1995). The property is centred on the Trout Lake stock, a small granitic intrusion, in a belt of highly deformed metasedimentary rocks of the Lardeau Group (Lower Paleozoic).

The Lardeau Group is bowed around the eastern margin of the Kuskanax batholith. The group consists of argillite, quartzites, carbonate beds and schists that underwent middle Jurassic regional metamorphism and deformation. Light grey to black argillite beds are interlayered with very fine grained grey to tan phyllites and brown biotite-chlorite-sericite schists with prominent segregated quartz layers and lenses. The carbonate beds are composed of massive and banded grey to white limestone and dolomite with variable skarn development. The skarnified rocks contain quartz, calcite, epidote, diopside, garnet, prehnite, phlogopite and minor amounts of idocrase, wollastonite, sphene and actinolite.

The Trout Lake stock is late Cretaceous age (76 Ma) and consists of four intrusive phases, the earliest of which is porphyritic granodiorite, comprising the bulk of the stock. This is followed by aplite dikes and a succession of somewhat younger dikes including porphyritic quartz diorite, granodiorite, and quartz diorite. These dikes cut off and are cut by mineralized quartz veins.

The porphyritic granodiorite is a grey, medium grey rock characterized by euhedral quartz eyes (10%) set in a seriate-textured groundmass of euhedral plagioclase (35%), anhedral quartz (35%), potassium feldspar (10%), and altered biotite relics.

The young porphyritic quartz diorite is medium to dark grey with a peppery appearance caused by fine biotite flakes in the groundmass. These rocks are composed of quartz (35%), plagioclase phenocrysts (45%), potassium feldspar (< 5%) and accessory biotite. The quartz diorite is also distinguished by hornblende phenocrysts and late magmatic potassium feldspar porphyroblasts.

The aplite dikes, commonly less than a metre thick, are gradational to pegmatitic quartz-potassium feldspar veins.

The regional metamorphic grade increases towards the southwest on the property, with chlorite, biotite and finally garnet and oligoclase appearing in the phyllite and schist facies of the Lardeau Group, as the Kuskanax batholith is approached. Superimposed on this regional metamorphic gradient is a thermal biotite hornfels surrounding the Trout Lake stock. This contact metamorphic aureole, measuring 1.2 x 2 kilometres, was developed during emplacement of the stock. The aureole is easily recognized in the calcareous lithologies where the appearance of clinozoisite defines the outermost isograd. At surface, the highest grade of contact metamorphic assemblage in the phyllites and schists, consisting of muscovite- chlorite- tremolite-clinozoisite- plagioclase- potassium feldspar- and quartz, suggests a temperature of roughly 400°C.

Photo 9. View of main portal, Trout Lake prospect.

Hydrothermal alteration at the Trout Lake deposit comprises; a central quartz- orthoclase-albite- (biotite)- ‘potassic zone’, coincident with molybdenum mineralization and overlapped by a slightly later antipathetic quartz-sericite-pyrite ‘phyllic zone’. The youngest alteration is quartz-muscovite- ankerite- pyrite- (microcline). This alteration is developed pervasively along faults or as halos around late subhorizontal quartz veins. Late chlorite and pyrite filled fractures are widespread but never pervasive. In detail many local variations and some retrograde effects are observed. The relationships of biotite, sericite and chlorite are complex due to the presence of regional metamorphic sericite, chlorite and biotite; the later development of hornfels biotite around the contacts of the stock; and the superimposed hydrothermal sericite and biotite related to vein margins.

Molybdenite mineralization is best developed in a quartz vein stockwork around the margin of the Trout Lake intrusion and dike offshoots of the same body. Molybdenite occurs as fine to medium grained flakes and rosettes accompanied by pyrite and pyrrhotite, mainly along the margins of the veins (Photo 10). In the highest grade zones, molybdenite is strongly disseminated on microfractures in areas of intense quartz vein flooding, some areas measuring as much as 200 metres long and 20 metres wide. Molybdenite grades drop off markedly towards the centre of the large granodiorite mass and wherever the younger quartz diorite dikes are encountered.

Veins in the Trout Lake stockwork comprise several sets. The older veins trend southeast parallel to the major fold axes and most of the faults (135°, subvertical). Secondary vein sets occur on cross-joints striking 045° and dipping subvertical; and there are late subhorizontal veins. In addition, conjugate subvertical, shear-related veins, striking 005° and 095°, are prominent. The close spatial and temporal relationship between these veins and the Trout Lake stock suggests that hydraulic fracturing followed emplacement of magma. Furthermore, this suggests that the fracturing was caused either by the release of orthomagmatic fluids, or by hot overpressured metamorphic or meteoric fluids.

Post mineral faults observed in drill core cut off good grade molybdenite, but displacements, seen underground are clearly only minor readjustments between fault blocks. Only the ‘Z’ fault, which bounds the deposit on the east, appears to have significant dip-slip movement.

Tungsten mineralization is restricted to lenses of garnet-clinopyroxene skarn occurring as replacements in limestone along faults adjacent to the Trout Lake stock. The tungsten occurs as scheelite, with pyrrhotite and minor chalcopyrite on the Copper Chief (MINFILE 082KNW004) and as scheelite in quartz veins with galena, sphalerite and tetrahedrite on the Lucky Boy (MINFILE 082KNW003).

Skarns, manifested mainly by clinopyroxene and garnet, and hosting minor scheelite, occur as replacements of marble along faults adjacent to the Trout Lake stock. Tremolite ± clinozoisite (calc-silicate alteration) locally replaces clinopyroxene and in turn is replaced by biotite and/or calcite, indicating that skarn predated potassic (biotite) alteration.

DISCUSSION

The most striking feature about the ore deposits in the Beaton-Camborne camp is that they occur in well defined linear mineral belts trending southeast parallel to the regional strike of the formations (Brock, 1904). These are referred to as the ‘central’, ‘northeast’ and ‘southwest’ belts. The central belt consists of an alignment of properties that extends southeaster-

Photo 10. Molybdenite-bearing quartz stringer in granite porphyry, Trout Lake prospect (solid circle = 1 cm).

ly from Scott and Menhinick Creek across the valley of the Incomappleux River near Camborne to the southwest slopes of Lexington Mountain and to Pool and Mohawk creeks. If extended further to the southeast, the trend aligns with the main mineral belt in the Ferguson area containing the Nettie, Triune and Silver Cup mines. The northeast mineral belt is less well defined and extends more or less along the divide between Lexington and Boyd Creeks and across the head of Pool Creek into the Ferguson area. The southwest belt consists of a few aligned deposits on the slopes of Trout Mountain, southwest of Trout Lake.

Control and Style of Mineralization

The belts are clearly controlled by regional structures and the physical characteristics of the deformed rocks. For example the central belt follows the axis of the Silvercup anticline and the trend of the Cup Creek fault from the Ferguson camp (Fyles and Eastwood, 1962). It appears that the favourable zones of mineralization along this belts developed at sites of intense fracturing where the fault approaches the crest of an anticline - local structures having formed subsequent to the folding. To the northeast the mineral deposits are scattered and the beds in which the deposits are found comprise relatively incompetent limestone units which were isoclinally folded, sheared and deformed again.

Silver-lead-zinc ores are typical of the central belt and occurrences to the northeast. The ore minerals are mainly pyrite, galena, sphalerite and smaller amounts of chalcopyrite and pyrrhotite. Silver is the most important commodity and it occurs in argentiferous tetrahedrite, galena and less commonly as native silver and sometimes in argentite, polybasite, ruby silver, stephanite and electrum. Gold is present in small quantities and is rarely seen as native gold or electrum. Quartz is the dominant gangue mineral, but carbonates such as ankerite, calcite and/or dolomite are significant gangue components in some veins. The deposits are characterized by open-space fillings with limited wall rock replacement. In a few places where replacement is important, carbonate gangue is relatively abundant.

The fracture frequency pattern in the central belt, underlain by the Lardeau Group, shows three principal attitudes based on 210 measurements (Figure 3). These are (1) 140°/80°NE and (2) 120°/45°SW and (3) 040°/80°NW. Fracture set (1) is the principal layering, foliation and fissility of the sedimentary and volcanic rocks of the area; (2) is like (1) but a subsidiary fabric (short limb) in assymetrical folds; (3) is the main cross joint direction. These fractures are mostly steeply inclined relative to the Columbia River fault and underlying Monashee gneiss complex that form the footwall of the Selkirk allochthon. Sets (1) and (2) are also the main fracture and vein direction (dipping mostly to the northeast) at the Meridian, Goldfinch, Ethel and Beatrice mines (Table 3). Cross joints (3) trend northeasterly subparallel to some of the veins at the Trout Lake and Meridian mines.

The southwest mineral belt is dominated by the Trout Lake molybdenum porphyry - tungsten skarn system. The deposit is temporally and spatially related to the emplacement of a small, late Cretaceous granodiorite intrusion. Molybdenite occurs in a quartz vein stockwork and as disseminations in the granodiorite and, to some extent, in the metasedimentary host rocks. In general molybdenite appears to accompany alkali feldspars, but in detail it is intimately associated with incipient muscovite replacing albite and potassium feldspar. Fluorite and barite are uncommon in this system.

Tungsten mineralization is found in skarn lenses in limestone bands peripheral to the main molybdenum zone. Scheelite occurs with pyrrhotite and minor chalcopyrite at the Copper Chief prospect and scheelite in quartz veins with galena, sphalerite and tetrahedrite at the Lucky Boy mine.

Veins associated with the Trout Lake deposit are diverse and complicated (Linnen et al., 1995). At least five orientations are recognized. The oldest veins are subvertical and strike southeasterly parallel to the regional foliation (135°), similar to (1) and (2) above. Orthogonal to this are steeply dipping veins striking 045°, similar to (3) and late subhorizontal veins. A conjugate set of subvertical shear related veins at 005° and 095° is also found. Although there is a close spatial and temporal relationships between the veins and the Trout Lake stock, no radial or concentric pattern occurs such as usually associated with hypabyssal intrusions. This suggests a moderately deep intrusion regime where hydraulic frac-

Table 3. Principal vein attitudes at mines and mineral prospects.

Occurrences (MINFILE No.)	Location Lat.	Long.	Vein Attitudes	
Lucky Boy (003)	50º 38.5'	117º 36.2'	100º/25ºSW	
Copper Chief (004)	50º 38.0'	117º 36.5'	150º/80ºNE	
Beatrice (040)	50º 44.3'	117º 33.5'	138º/60ºNE	155º/80ºNE
			050º/65ºSE	140º/65ºNE
Mohawk (041)	50º 46.7'	117º 35.8'	155º/72ºNE	120º/80ºNE
			160º/80ºNE	090º/60ºNE
Excise (043)	50º 46.5'	117º 36.1'	155º/80ºNE	
Eclipse (044)	50º 46.6'	117º 36.3'	005º/75ºE	
Spider (045)	50º 46.8'	117º 36.5'	170º/75ºE	
St. Joe (046)	50º 47.3'	117º 36.9'	135º/90º	
Sandy (048)	50º 46.9'	117º 37.1'	165º/90º	
Ethel (059)	50º 37.2'	117º 34.9'	130º/60ºNE	
Red Horse (063)	50º 47.0'	117º 36.9'	155º/70ºNE	
Meridian (064)	50º 47.4'	117º 37.2'	120º/70ºNE	043º/90º
Oyster (065)	50º 47.6'	117º 37.6'	146º/65ºNE	
Eva (066)	50º 47.8'	117º 37.8'	135º/80ºNE	135º/80ºSW
Teddy Glacier (069)	50º 52.1'	117º 44.8'	163º/80ºNE	170º/80ºNE
Lead Star (071)	50º 51.8'	117º 41.1'	145º/50ºNE	
Burniere (072)	50º 51.2'	117º 41.7'	125º/80ºSW	
Goldfinch (076)	50º 49.4'	117º 39.5'	152º/80ºSW	135º/20ºSW
Mammoth (077)	50º 51.4'	117º 34.5'	135º/10ºNE	
Big Showing (078)	50º 52.7'	117º 34.9'	035º/50ºSE	
Trout Lake (087)	50º 38.2'	117º 36.2'	135º/90º	045º/90º
Silver Dollar (101)	50º 44.7'	117º 33.9'	155º/60ºNE	
Gillman (127)	50º 44.9'	117º 34.1'	165º/35ºNE	
Agnes (132)	50º 51.8'	117º 42.5'	035º/45ºSE	
Nelson (138)	50º 49.6'	117º 41.0'	120º/50ºSW	
Cholla (143)	50º 47.6'	117º 38.0'	180º/90º	
Lucky Jack (187)	50º 47.5'	117º 37.1'	145º/54ºNE	

turing within the existing structural framework, caused by the release of orthomagmatic fluids (perhaps combined with metamorphic and meteoric solutions), coincided with the emplacement of the magma. Linnen and William-Jones (1987) have interpreted the magmatization and the development of the orthogonal fracture system to be the result of release of elastic stresses during the late Cretaceous / early Tertiary uplift of the Kootenay arc.

Age of Mineralization

The age of mineralization in the Beaton-Camborne camp coincides with a major late Cretaceous through early Tertiary tectonic transition (to 59 Ma) that is marked by uplift, decollement and intrusion in the Kootenay Arc. This was followed by extensional exhumation of the Monashee gneissic core complexes along the Columbia River and Slocan Lake faults. The Trout Lake intrusion dated 76 Ma (Boyle and Leitch, 1983) and associated Mo and W deposits represent the beginning, and the Ag, Pb, Zn veins, such as found at the Enterprise mine in the Slocan City area, dated 58.2 ± 0.7 Ma (Beaudoin et al., 1992), represent the culmination of the mineralizing cycle.

Source of Mineralization

The solutions that formed ore deposits ascended along whatever channels that were available in the host rocks such as bedding planes, shear zones and cross fractures (Walker et al., 1929). In the Beaton-Camborne camp predominant fissures are approximately parallel to the strike of the formations, and because the schistocity with few excep-

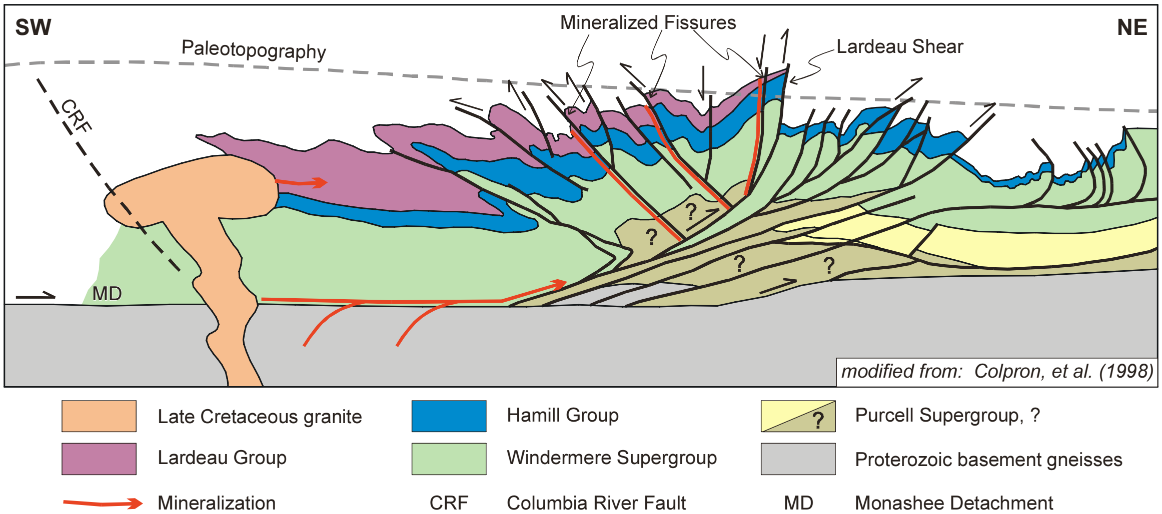

Figure 5. Schematic cross-section of the Selkirk fan structure, during late Cretaceous to early Tertiary time, showing mineralizing systems controlled by doubly verging assymetrical and isoclinal folds and trusts above Dogtooth crustal ramp.

tions also parallels the strike, it is clear that the solutions were forced to ascend along definite zones subparallel to bedding. Consequently, the ore deposits for the most part are aligned more or less along the strike of the beds.

A cross-section through the Selkirk allochthon shows a fan-like arrangement of southwesterly and northeasterly-verging tight folds with steeply dipping axial planes (Figure 5). These structures formed as a result of thrust-ramping of the covering beds along the Monashee decollement from mid-Jurassic to early Tertiary (Colpron et al., 1998). It is these structures that are also believed to have provided the main plumbing system and the regional control of mineralization.

The source of mineralizing solutions was believed by early workers to be the Kuskanax batholith. However, the deposits in the area are much younger and mostly remote from the nearest Kuskanax body. In the case of the southwest belt, which is closest to the Kuskanax, there is clear evidence that the late Cretaceous Trout Lake intrusion is the source of the Mo-porphyry, W-vein and skarn deposits.

The origin of the numerous Ag-Pb-Zn-Au deposits of the central and northeast belts is more complicated. Holk and Taylor (1997) support the general proposal of Beaudoin et al. (1992) that ascending metal-bearing aqueous fluids, derived from crystallizing granitic magma, mixed with deeply circulation meteoric ground waters. This produced numerous Ag-Pb-Zn vein deposits in the Slocan area during Eocene extension related to the Slocan fault. This is similar to the model proposed (this study) for the Camborne area. Figure 5 shows the ore fluids tapped from magmatic and metamorphic sources, including the high grade gneisses of the underlying Monashee Complex.

CONCLUSIONS

The veins of the Beaton-Camborne camp are hosted by the Lardeau Group and consist mostly of galena, sphalerite and pyrite in quartz and carbonate gangue. Molybdenite and scheelite are associated with the Trout Lake intrusion.

Early workers regarded the granitic rocks as the singular magmatic - hydrothermal source of the mineralization, however, recent studies suggest a more complicated genesis. The veins are fracture fillings and replacements that appear to be related to the Columbia River fault and Monashee decollement that forms the footwall of the Selkirk allochthon. Prolonged movement on this fault system during the late Createaceous and early Tertiary is believed to have sustained channelways for mineralizing solutions, which are the result of commingling of metamorphic and magmatic fluids and meteoric water.

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