Economic Geology

STRATABOUND BASE METAL DEPOSITS OF THE BARKERVILLE SUBTERRANE, CENTRAL BRITISH COLUMBIA (093A/NW)

By Trygve Höy and Filippo Ferri
B.C. Geological Survey Branch

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INTRODUCTION

The Barkerville subterrane is part of the pericratonic Kootenay terrane, deposited along the western edge of ancestral North America. The Kootenay terrane, and possible correlative rocks of northern British Columbia and Yukon, contain numerous volcanogenic massive sulphide deposits, concentrated largely in EoCambrian to Early Cambrian and Middle Devonian to Early Mississippian times. These periods represent contrasting tectonic regimes along the continental margin, with distinct volcanic assemblages and characteristic massive sulphide deposits.

Tholeiitic and alkalic mafic volcanism in latest Precambrian through early Paleozoic time records episodic extensional tectonics along the rifted, western margin of North America. Mafic volcanics occur locally in the EoCambrian part of the Hamill Group, as Unit EBG in the Eagle Bay Assemblage and in the basal part of the Index Formation in the Goldstream area north of Revelstoke. A number of Cu-Zn Besshi-type deposits of the Goldstream camp are the best examples of volcanogenic massive sulphides in these mafic volcanic/metasedimentary successions.

Bimodal arc volcanism occured along the preserved western margin of the Kootenay terrane in middle to late Paleozoic time, in response to eastward subduction of a paleopacific ocean. Within the Eagle Bay Assemblage, this volcanism is recorded as thick accumulations of mafic and felsic pyroclastic rocks. In the Omineca Mountains in northern British Columbia, the Gilliland tuff records similar volcanism (Ferri, 1997). Rhyolitic and rhyodacitic tuffs of Unit EBA of the Eagle Bay Assemblage contain numerous small, polymetallic massive sulphide deposits.

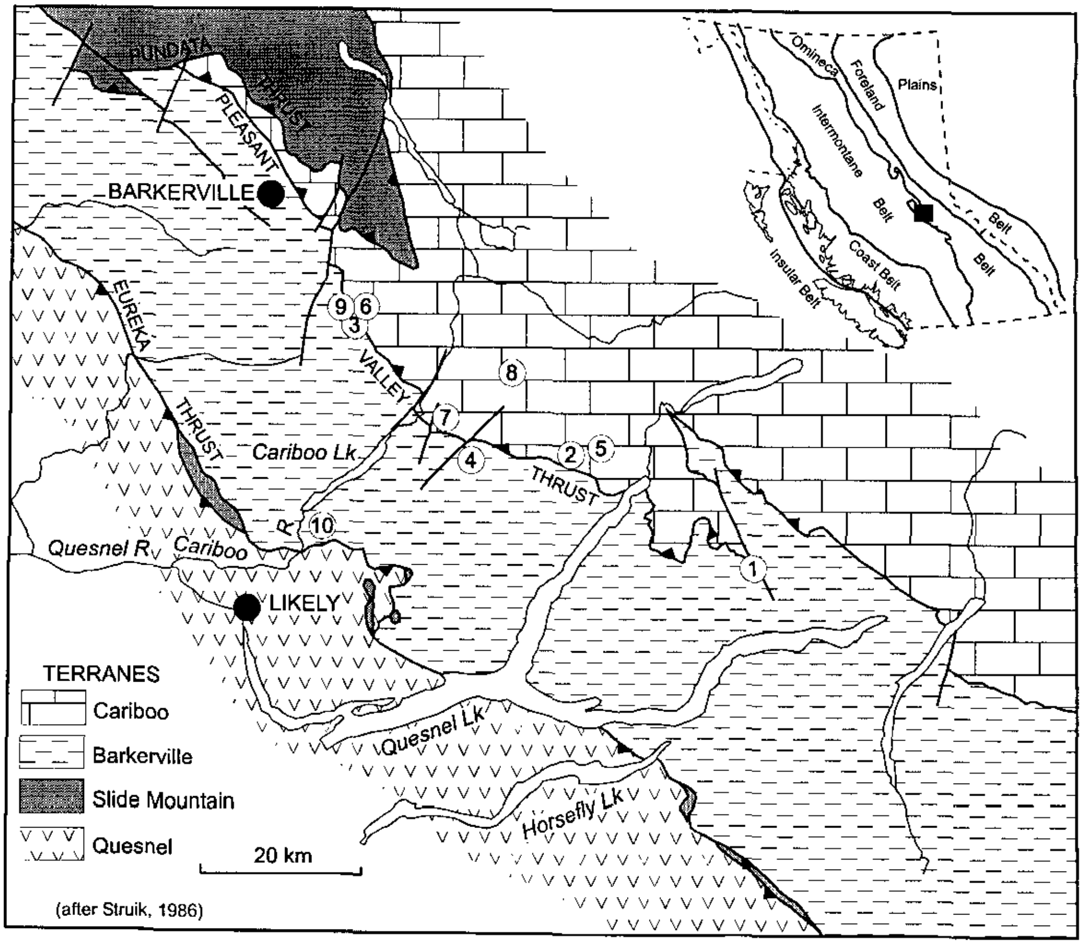
The objective of this study is to evaluate the potential for massive sulphide mineralization in the Barkerville subterrane. This paper describes and classifies a number of known mineral occurrences and attempts to correlate stratigraphic packages in the Barkerville with other parts of the Kootenay terrane.

REGIONAL GEOLOGY

The Barkerville-Likely area is underlain by three fault-bounded geological terranes (Struik, 1988). The Barkerville subterrane is separated from more inboard rocks of the Cariboo subterrane by the west-verging Pleasant Valley thrust fault. The oceanic Slide Mountain terrane has been structurally emplaced along the western margin of the Barkerville subterrane, carried on the east-verging Eureka Thrust fault (Figure 1). It also structurally overlaps the Barkerville and Cariboo terranes along the Pundata thrust (Struik, *op. cit.*). Rocks in these terranes have been polydeformed and metamorphosed, possibly as early as middle Paleozoic time (Sutherland Brown, 1963) but certainly during the Mesozoic (Struik, 1981, 1988).

The stratigraphy of the Barkerville subterrane has been assigned, almost entirely, to the Proterozoic to Paleozoic Snowshoe Group (Struik, 1986; 1988). This package of rocks is dominated by distal, fine grained siliciclastics with lesser carbonate and volcanics. It has been subdivided into several informal units: Ramos succession, Tregillus clastics, Kee Khan marble, Keithley succession, Harveys Ridge succession, Goose Peak quartzite, Agnes conglomerate, Eaglesnest succession, Downey succession, Bralco limestone, Hardscrabble Mountain succession, unnamed carbonate, Island Mountain amphibolite and Tom succession (Figure 2).

Units of assumed Proterozoic age include the Ramos, Tregillus, Kee Khan and Keithley packages. Lithologies are dominated by feldspathic quartzite and phyllite in the Ramos and Tregillus successions and grey quartzite and phyllite of the Keithley succession. These lithologies have similarities with Windermere sequences in the Cordillera.



	Property	Commodities	Host	Deposit type(s)	Terrane
1.	Green Ice (093A 082)	Zn	Snowshoe Gp limestone	disseminated/ vein	Barkerville
2.	Mae (093A 083)	Cu-Zn-Pb	Downie calc silicate	stratabound?	Barkerville
3.	Peter Gulch (093A 093)	Pb-Zn	Snowshoe Gp limestone	vein/ replacement	Barkerville
4.	Ace (new) (093A 142)	Cu-Au-Ag-Zn-(Pb)	Downie "phyllite"	volcanogenic massive sulphide	Barkerville
5.	Al (093A 065)	Pb-Zn-(Cu)	Cunningham limestone	replacement Zn-Pb	Cariboo
6.	Vic (093A 070)	Pb-Zn-barite	Midas Fm limestone	stratiform (sedex?)	Cariboo
7.	Maybe (093A 110)	Pb-Zn-Ag	Black Stuart Gp *black pelite unit*	replacement/ vein	Cariboo
8	Comin Throu Bear (093A 158)	Pb-Zn-barite	Mural Fm limestone	replacement	Cariboo
9.	Cunningham Creek area	Pb-Zn	Hardscrabble Mtn limestone	stratiform (sedex?)	Barkerville
10.	Big Gulp (new) (093A 143)	Cu-Zn-(Ag-Au)	Downie phyllite	volcanogenic massive sulphide	Barkerville

Figure 1: Regional geology of the Barkerville - Likely area showing major terrane boundaries and massive sulphide occerences (*after* Struik *et al.*, 1992).

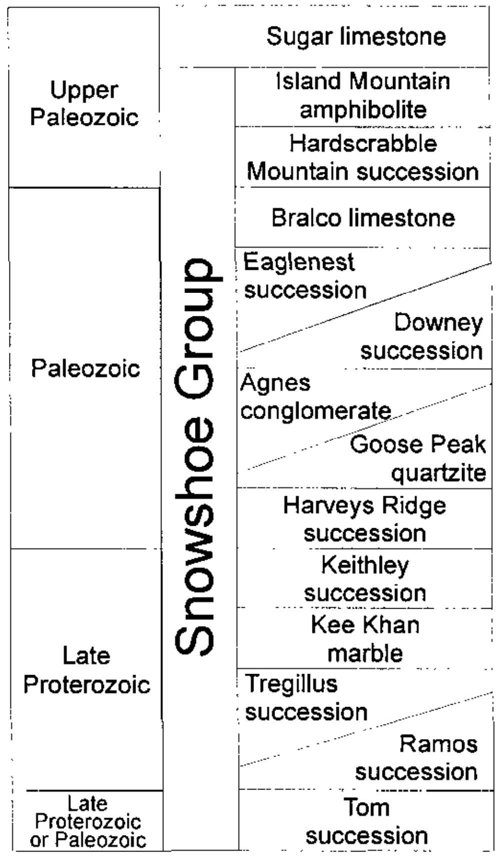


Figure 2: Stratigraphic chart of the Barkerville subterrane (*after* Struik, 1988); see text for suggested revision.

The age of the Paleozoic part of the succession is problematic as it is based primarily on a few fossil localities and correlations of several units with sections of the Eagle Bay Assemblage farther south. The Harveys Ridge succession (Figure 2), a package of black micaceous quartzite, siltite, phyllite, conglomerate, limestone and mafic metavolcanics, is correlated with Unit EBS of the Eagle Bay Assemblage (Struik, 1988; Schiarizza and Preto, 1987). The age of unit EBS is bracketed between Early Cambrian and Middle Devonian. Micaceous feldspathic quartzite, phyllite, marble and mafic metavolcanics of the Downey succession are also correlated, in part, with unit EBS. The Downey contains several microfossil localities of broadly Paleozoic age. The Bralco limestone is interpreted to sit stratigraphically above these successions. It contains Paleozoic echinoderm fragments and has been correlated with the Early Cambrian Tshinakin limestone of the Eagle Bay Assemblage (Struik, 1988; Schiarizza and Preto, 1987).

VOLCANIC ROCKS: SNOWSHOE GROUP

Our work concentrated on examining and sampling the volcanic successions and immediate host rocks within the Snowshoe Group in order to attempt to correlate these with volcanic rocks elsewhere within the Kootenay Terrane. Due to intense deformation and moderate to high grades of regional metamorphism, recognition and interpretation of volcanic rocks can be difficult in the area. However, two distinct successions have been identified (Struik, *op. cit.*), within the Downey and Ramos successions.

Downey Succession

The Downey succession is "characterized from others of the Snowshoe Group by its abundant marble and tuff" (Struik, 1988, page 59). Volcanic rocks include "green chlorite phyllite", "volcanic tuff", and diorites" that may also be tuffs (Struik, *op. cit.*).

Green phyllites of the Downey succession are interlayered with marbles, calcsilicate schists, phyllites and impure quartzites. They are commonly massive, consisting mainly of quartz, muscovite and chlorite with variable but minor garnet, actinolite, carbonate, clinozoite and/or opaques. Locally, green chlorite phyllites contain prominent augens, several centimetres in length, of quartz, feldspar and chlorite. Phyllites may weather a pale brown colour due to alteration of fine iron-rich carbonate.

At higher metamorphic grades, volcanic rocks of the Downey succession are amphibolites. These were recognized at the Mae prospect (Figure 1) and as thick, competent units within phyllite and marble on Barker Mountain (Struik, 1988). Amphibolites on the Mae property are thin, massive to finely laminated layers within coarse-grained garnet-sericite-biotite schist. They are rusty weathering due to finely dispersed pyrrhotite.

Analyses of a few samples of Downey succession metavolcanics are given in Table 1. Major element analyses suggest that they are subalkaline; however, these elements can be relatively mobile during regional metamorphism and, hence, plots with less mobile trace elements are typically more reliable. On a Zr/TiO_2 versus Nb/Y diagram, Downey metavolcanics appear to be alkaline, with compositions ranging from alkali basalts to trachy andesites (Figure 3a), whereas on an SiO_2 versus Zr/TiO_2 diagram (Figure 3b), these same samples plot mainly in the subalkaline fields.

Discussion

Mafic volcanic rocks are recognized in at least three separate stratigraphic levels in ancestral North American and Kootenay terrane rocks of southern and central British Columbia: (1) Late Proterozoic to Early Cambrian Hamill Group, Mohican Formation or correlative(?) EBG of the Eagle Bay Assemblage, (2) Early Paleozoic Index Formation of the Lardeau Group and mafic volcanics of EBS in the Eagle Bay, and (3) the middle (?) Palezoic Jowett Formation of the Lardeau Group and EBM of the Eagle Bay.

TABLE 1: MAJOR AND TRACE ELEMENT ANALYSES OF SAMPLES OF METAVOLCANIC ROCKS OF THE SNOWSHOE GROUP

Sample		H97 BC-59d	H97 BC-60e	H97 BC-6a	H97 BC-6b	H97 BC-11a	H97 BC-11b	H97 BC-32	H97 BC-34a	H97 BC-34b	H97 BC-36	H97 BC-37	H97 BC-43a	H97 BC-43c	H97 BC-43e	H97 BC-44	H97 BC-45
Description		ATMM	ATMM	BGMM	BGMM	GCMM	GCMM	HCMM	HCMM	HCMM	MM	MM	RFV	RFV	RFV	RFV	RFV
SiO2	%	62.5	55.51	50.73	55.97	52.18	47.87	63.01	58.09	58.32	58.34	58.1	78.32	78.18	75.08	80.78	74.55
TiO2	%	0.77	0.96	0.58	0.66	1.01	0.93	1.07	1.15	1.16	0 88	1.16	0.39	0.39	0.57	0.35	0.52
Al2O3	%	17.78	21.15	15.84	18.29	14.95	14.45	18.29	19.82	19.95	19 95	20.02	10.14	10.13	11.7	9.24	11.38
Fe2O3	%	1.4	1.21	1.22	1.77	1.85	2.14	2	2.22	1.84	1.63	1.09	2.18	2.3	2.75	1.79	1.02
FeO	%	5.6	6.17	11.73	3.58	7.85	9.32	4.8	5.96	5.89	5.07	6.4	1.28	1.7	1.29	1.13	3.01
MnO	%	0.03	0.05	0.12	0.06	0.17	0.21	0.04	0.15	0.08	0.13	0.07	0.02	0.04	0.03	0.04	0.04
MgO	%	2.56	2.36	7.26	3.44	7.2	7.44	1.93	2.22	2.31	2.41	2.13	1.01	1	1.16	0.65	1.37
CaO	%	0.24	1.01	2.38	5.26	8.58	13 27	0.13	0 24	0.19	0.93	1.04	0.2	0.12	0.18	0.17	0.6
Na2O	%	0.87	1.37	2.64	2.92	3.43	1.1	0.32	1.53	1.05	1.67	2.03	2.24	1.16	0.73	1.87	2.45
K2O	%	3.6	4.9	0.03	2.8	0.13	0 18	3.85	3.9	4.23	4.3	2.91	1.27	1.79	3.36	1.97	2.23
P2O5	%	0.1	0.12	0.13	0.12	0.07	0.08	0.07	0.12	0.1	0.06	0.14	0.05	0.05	0.07	0.06	0.07
LOI	%	4.17	4.65	7.01	4.37	2.57	2.26	4 19	4.26	4 25	4.16	3.87	2.6	2.82	2.64	1.85	2.24
SUM	%	99.77	99.54	99.68	99.69	100	99.25	99.82	99.85	99.54	99.71	99.25	99.74	99.73	99 66	99.95	99.53
Nb	ppm	18	32	15	15	5	10	31	23	23	23	27	9	11	16	13	15
Sr	ppm	102	194	195	498	77	64	68	173	163	288	690	104	62	52	94	138
Y	ppm	24	36	17	16	33	33	25	26	34	30	29	15	8	13	17	19
Zr	*ppm*	*235*	*206*	*100*	*111*	*58*	*53*	*282*	*149*	*146*	*131*	*171*	*181*	*181*	*261*	*238*	*249*
V	ppm	92	119	118	105	308	282	124	120	136	110	141	57	52	70	42	77
Ba	ppm	530	540	0	3500	0	0	950	1200	1300	1200	2000	310	360	750	460	350
Zn	ppm	120	122	605	141	0	80	168	0	127	153	0	0	115	0	0	0
Co	ppm	18	18	17	14	41	41	8	30	18	16	20	5	6	10	8	10
Cr	ppm	160	190	130	120	500	430	150	180	170	140	140	220	160	180	200	160
Cs	ppm	4	4	0	3	1	0	4	4	4	4	2	2	3	5	2	2
Hf	ppm	9	9	3	5	2	2	10	6	6	5	6	7	7	10	10	9
Na	ppm	0.69	1.09	2.03	2.27	2.64	0.76	0.23	1.14	0.77	1.19	1.59	1.93	0.99	0.69	1.57	2.04
Ni	ppm	130	0	0	0	0	79	0	0	0	0	0	0	0	0	0	0
Rb	ppm	82	170	0	97	0	19	120	160	140	170	110	62	66	110	68	76
Sc	ppm	14	20	12	15	44	40	16	19	20	17	21	6.6	7.2	9.2	6.7	9.2
Ta	ppm	1.4	2	0	0	0	0	0	0	1.3	2.3	2.2	0	0	0	0	0
Th	ppm	15	22	12	13	0	0	14	12	11	15	13	8.4	11	13	15	12
U	ppm	1.7	4.3	0	3.3	0	0	3.6	2.5	2.8	2.7	0	2.5	2.4	2.4	3.3	2.3
La	ppm	51	86	28	51	1.7	1.8	35	50	58	56	49	15	8.3	21	36	33
Ce	ppm	91	150	50	79	8	6	65	92	99	99	84	30	17	57	55	63
Nd	ppm	32	66	18	26	-5	-5	25	39	46	41	38	8	9	13	28	23
Sm	ppm	6.4	10	2.8	4.4	1.7	1.6	4.1	6.2	7.2	6.5	6.2	2	1	2.6	3.9	3.8
Eu	ppm	1.7	2 6	1	1	0	0.9	1.3	1.9	2.3	1.8	1.2	0.6	0.4	0.8	1.1	1
Tb	ppm	0	1.7	0	0	0	0.8	0	1	0.9	0	0	0	0	0	0	0 8
Yb	ppm	3	5.1	1.1	1.7	3.4	3	3.2	3.3	4	3	3	1.4	1.1	1.8	1.6	2.3
Lu	ppm	0.45	0.82	0.18	0.31	0.57	0.45	0.51	0.54	0.69	0.47	0.51	0.19	0.2	0.35	0.31	0.28

ATMM: Ace Trench mafic metavolcanics; BGMM: Big Gulp mafic metavolcanics; GCMM: Grain Ck mafic metavolcanics; HCMM: Hailey Ck. mafic metavolcanics; MM: mafic metavolcanics; 'RFV: Ramos felsic volcanics.
Major Oxides, Nb, Sr, Y, Zr and V analyzed by X-Ray Fluorescence at Cominco Laboratories, Vancouver, British Columbia.
Remaining elements analyzed by Thermal Neutron Activation Analysis at ActLabs, Ancaster, Ontario.

Preliminary geochemical data of Downey mafic volcanic rocks suggests they are comparable to the dominantly alkali basalts of the Late Proterozoic Hamill Group (Logan *et al.*, 1996). However, two undiagnostic fossils, collected from the Downey succession, indicate a Paleozoic (but less likely Cambrian) age (Struik, 1988, p. 60), restricting correlations to the Lardeau Group.

A correlation of Downey metavolcanics with Jowett Formation basalts near the top of the exposed Lardeau Group in both the Goldstream (Logan and Rees, 1997) and Ferguson (Fyles and Eastwood, 1962) areas is also possible. However, the close association of mafic volcanics, limestone, impure quartzite and phyllites is most comparable to the Index Formation at the base of the Paleozoic Lardeau Group. This is supported by a stratigraphic contact with a white marble, the Bralco, which may correlate with the Early Cambrian Tshinakin limestone (Struik, *op. cit*; Schiarizza and Preto, *op. cit.*) or Badshot (Mural) Formation. A correlation of the Bralco - Downey with the Badshot - Index implies that the Snowshoe Group is inverted and may generally young to the west. Considerable more sampling, analyses and interpretation are required to characterize Downey metavolcanics and to make comparisons with the dominantly Mid-Ocean ridge basalt (MORB) compositions of the Index Formation.

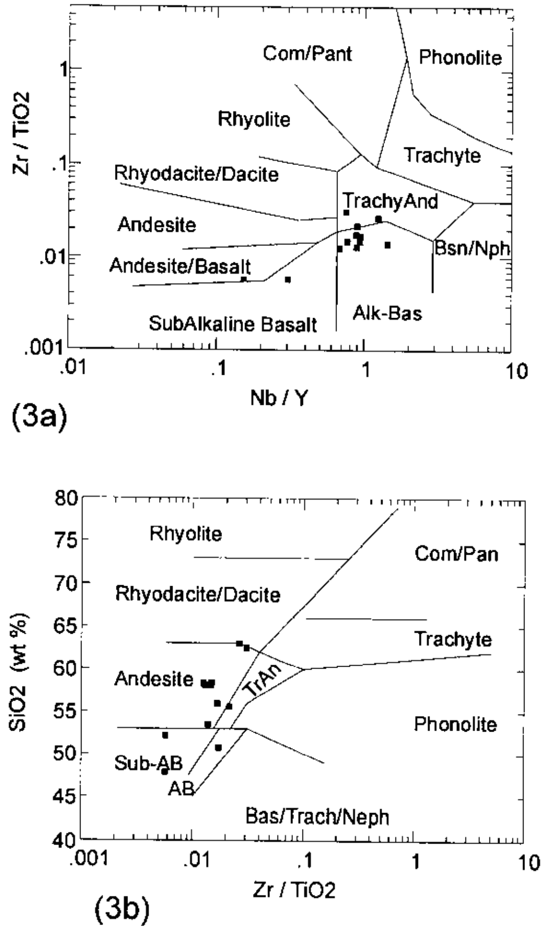


Figure 3: (a): Zr/TiO_2 versus Nb/Y and (b) SiO_2 versus Zr/TiO_2 plots of samples of metavolcanic rocks of the Downey succession; data in Table 1 (plot after Winchester and Floyd, 1977).

Correlating the Downey with the basal Lardeau has considerable implications regarding metallogeny of the Barkerville subterrane. The Index Formation contains numerous volcanogenic massive sulphide deposits, including Goldstream (Höy, 1979; Logan and Colpron, 1995), and therefore the Downey succession must be considered prospective ground for exploration of this deposit type. The restriction of most gold mineralization of the Barkerville camp to the Downey succession (Struik, 1988) may also, by analogy, point to the potential for discovery of lode gold deposits in the Index Formation to the south.

Ramos Succession

The Ramos succession comprises micaceous quartzites, phyllite and siltstone with minor amphibolite, marble and tuffaceous units. Tuff near the top of the Ramos succession in Ramos Creek and Swift River "includes 1 to 2 metre thick beds in black and olive phyllite and fine grained quartzite. Along Keithley Creek tuff is interlayered with dark grey and

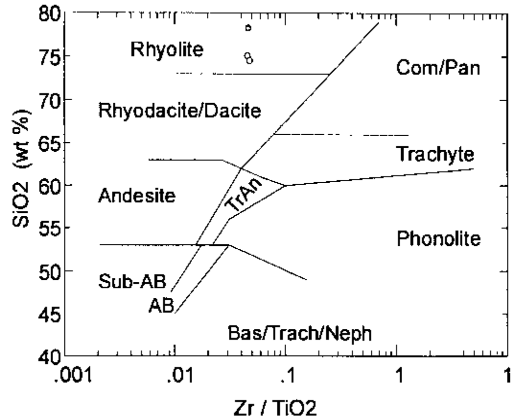


Figure 4: SiO_2 versus Zr/TiO_2 plot of samples of metavolcanic rocks of the Ramos succession; data in Table 1 (plot after Winchester and Floyd, 1977).

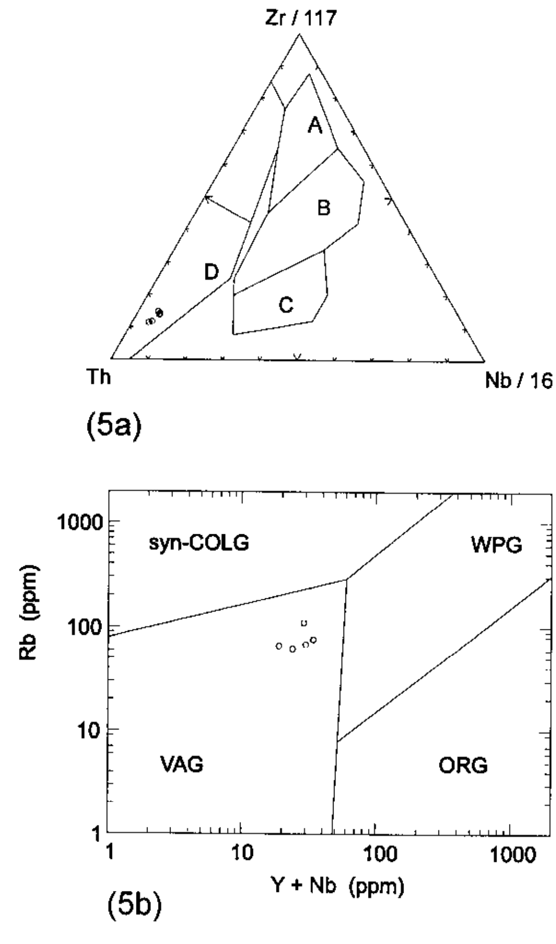


Figure 5 (a): Nb-Th-Zr plot (after Wood, 1980) and (b) Rb versus Y+Nb plot (after Pearce *et al.*, 1984) of samples of metavolcanic rocks of the Ramos succession, showing their volcanic arc affinity. A - N-type MORB; B - E-type MORB, C - alkaline within plate, D - destructive plate margin.

olive phyllite near the upper contact of the Ramos with the Harveys Ridge succession" (Struik, 1988, p. 52).

A poorly exposed section of Ramos tuffs on a logging road along the western slopes of Ramos Creek includes several tens of metres of tan to brown weathering quartz-eye sericite phyllites with minor interbeds of argillite or argillaceous phyllite. In thin section, they comprise crystals of quartz and feldspar in a matrix of sericite, biotite, quartz, feldspar and minor chlorite; other samples contain small clasts, up to a millimetre in length, of intergrown quartz and feldspar. These rocks are interpreted to be intermediate to felsic ash and crystal tuffs. However, separated zircons appear to have a detrital origin, suggesting either considerable reworking of these units or a sedimentary origin (J. Mortenson, personal communication, 1997). An attempt to date these zircons is now in progress.

Analyses of Ramos tuffs (Table 1) support felsic compositions. Analyzed samples are calcalkaline rhyolites (Figure 4). On a trace element tectonic discrimination diagram, Ramos tuffs plot in the volcanic arc field (Figure 5a) and on a Rb versus Y+Nb plot, designed for intrusive rocks, they also plot in the volcanic arc granitoid field (Figure 5b).

Discussion

The Ramos succession has been assigned a Late Proterozoic age, based largely on structural interpretations, regional correlations and superposition of units (Struik, 1988). We suggest, however, that a Devonian age for the Ramos is possible, supporting a model that the Snowshoe Group tends to young to the west.

Arc volcanism in the Kootenay terrane was first documented in Devonian rocks of the Eagle Bay Assemblage. These comprise thick accumulations of felsic and mafic pyroclastic rocks, containing a number of Late Devonian subvolcanic plutons. It is possible that felsic arc volcanics of the Ramos succession are thin, distal correlatives of these Eagle Bay volcanics. Furthermore, the Quesnel Lake orthogneisses may be subvolcanic intrusions related to this volcanism. This is supported by the similar volcanic arc signatures of these gneisses (in preparation) and their restriction to western exposures of the Snowshoe Group.

The suggestion that Ramos tuffs are Devonian in age allows correlation with felsic arc volcanics in the Yukon-Tanana terrane, host to the Kudz Ze Kayah and Wolverine deposits, the Gilliland tuffs in the Big Creek Group, and the massive sulphide host rocks of the Eagle Bay Assemblage.

Summary: Stratigraphic Correlations

Struik (1988), in his definitive work on the Snowshoe Group, correlates certain parts of this succession with similar lithologies in the Eagle Bay Assemblage. This includes equating the Bralco and Tshinakin limestones and the Harveys Ridge and Downey successions with unit EBS. More precise ages on parts of the Eagle Bay Assemblage (Schiarizza and Preto, 1987), and reevaluation of volcanic successions, allow for possible reinterpretation of the stratigraphic succession of the Snowshoe Group. Shiarizza and Preto (*op. cit.*), based on the presence of archeocyathids, assigned an Early Cambrian age to the Tshinakin limestone and placed unit EBS broadly in the Early Cambrian to Middle Devonian due to its stratigraphic position above the Tshinakin and below Middle Devonian felsic volcanics.

Hence, we suggest revisions to the assigned ages of some members of the Snowshoe Group. The Devono-Mississippian age of the Hardscrabble Mountain succession is probably correct, based on similarities of its black siltites and abundance of Pb-Zn-Ba sedex showings with Devono-Mississippian black clastic successions (the Earn Assemblage) elsewhere in the miogeocline. The relative ages of the Ramos to Keithley successions become problematic. We suggest that the felsic tuff intercalated with gritty to phyllitic rocks of the Ramos succession may be Devonian to Mississippian in age and correlative, in part, with unit EBA of the Eagle Bay Assemblage. The Tregillus, Kee Khan and Keithley successions would then be Paleozoic in age. Finally, we suggest that the Downey may correlate with the basal part of the Lardeau Group.

DEPOSITS

Cunningham Creek occurrences

Numerous small, conformable lead-zinc showings occur in the Cunningham Creek valley south of Barkerville (Figure 1). These showings comprise argentiferous galena, sphalerite, pyrite +/- barite in a dark graphitic shale sequence that has been correlated with the Late Proterozoic Midas Formation (Hodgson, 1978; Longe *et al.*, 1978; Longe, 1979). Struik (1988), however, places similar occurrences on the south side of the Cunningham Creek in the Late Paleozic Hardscrabble Mountain succession. We suggest that the nature of these deposits, similar to sediment-hosted massive sulphide deposits, and their close spatial association, argues for a common host and, hence, include all of them in Hardscrabble Mountain.

The Cunningham Creek showings were discovered between 1971 and 1976 by Coast Interior Ventures Ltd. and Riocanex Ltd. in a follow up of both stream and soil geochemical anomalies. Extensive trenching, sampling and limited drilling has recognized both the stratabound nature and the extent of mineralization in the Roundtop Mountain area.

Showings on the northeast side of Cunningham Creek are within a structurally complex succession of phyllites, sandstones, slates, dark shales and minor carbonates (Hodgson, *op. cit.*). Holland (1954) and Sutherland Brown (1963) map this succession as right way up whereas Struik (1988) interprets it to be inverted. The sulphide-barite layers are in either dark limestone or associated black pyritic shales that locally contain minor chert.

The Vic showing (093A 070) comprises massive, fine-grained galena and sphalerite in a siliceous unit in grey banded limestone of a black graphitic shale succession (Longe *et al., op. cit.*). The showing is conformable with layering, of variable width, and exposed strike length of 20 metres.

The Evening showing, located approximately 1200 metres south of Vic, is similar, with fine-grained sulphides, but is in black cherty shales. A geochemical soil anomaly suggests mineralization is more extensive than that exposed in trenching. Samples of the Vic and Evening showings, from Longe *et al.(op. cit.)* assayed:

	% Pb	% Zn	oz/t Ag	sample width
Vic 1	3.3	3.65	0.41	30 cm
Vic 2	13.1	7.6	1.72	20 cm
Evening	0.99	3.25	0.23	40 cm.

A number of other showings in the immediate area also have similar mineralogy as Vic and are hosted in either black siliceous shales or dark limestone. Due to extensive overburden and structural complexity it is not possible to determine if these are structural repetitions or separate stratigraphic horizons. The X anomaly, 3 kilometres southeast of the Evening showing, is hosted in dark limestone and consists of minor disseminated sphalerite and galena, and some massive barite with pyrite. Drilling intersected green chloritic phyllite that may be a mafic volcanic unit, as well as some coarse, probable volcaniclastic units (Hodgson, 1978). The Bralco zinc showing comprises massive to wispy sphalerite with less galena, also in siliceous dark limestone. Grades of two grab samples averaged 5.3 % Pb, 15 % Zn and 0.9 oz /t Ag (Longe, 1977).

Showings south of Cunningham Creek (A-1, A-2 and Ten Dollar) occur in silicified dolostone or limestone that Struik (1988) correlates with the Hardscrabble Mountain succession. Detailed mapping by Hodgson (*in* Longe *et al., op. cit.*), correlates these successions with those north of Cunningham Creek, supporting a model that all conformable sulphide deposits are in Hardscrabble Mountain.

The conformable (stratabound) nature of many of these showings, their simple mineralogy, fine grain size, host stratigraphy and lack of replacement textures suggest that they may be sedimentary exhalite deposits.

Mae (093A 087)

Introduction

The Mae property comprises a number of layers of stratabound Pb-Zn-Cu mineralization in a calcsilicate-amphibolite assemblage of the Downey succession. It is located north of the 8400 logging road, just west of Maeford Lake (Figure 1).

The property was initially staked in 1988, following the discovery of sulphide-bearing float and a follow-up soil geochemical survey (Pride, 1989). Subsequent soil surveys outlined three zones with coincident lead-zinc anomalies. Despite limited outcrop, mineralization was discovered in two of the anomalous zones (Pride, *op. cit.*).

The area is underlain by a northwest dipping succession of garnet schist, black phyllite, calcsilicate gneiss and minor marble and amphibolite of the Downey succession. Although interpreted to be middle Paleozoic in age (Struik, 1988), it is suggested that the Downey may correlate with the Early Paleozoic Index Formation. Immediately to the north, this succession is overlain by a thick limestone-marble unit, the Bralco limestone. Late northwest trending faults, with displacements of a few tens of metres, cut these units. The regional metamorphic grade is high, with garnets and staurolites developed in pelitic units and amphibole in calcsilicates and mafic metavolcanics.

Mineralization in the lower anomalous zone comprises dispersed sulphides in two thin, rusty-weathering, fine-grained quartz-garnet amphibolite layers. High Mn content is reflected in the abundant spessartine (+ almandine/grossular) garnets in the amphibolite (Table 2). The amphibolites are interlayered with coarse-grained garnet-biotite schist, minor calcsilicate gneiss and thin impure marble layers. Petrographic study of a piece of float from this showing contained approximately 10 percent opaques, comprising 60 % pyrite, 20 % pyrrhotite, 12 % magnetite, 5 % chalcopyrite 2 % galena and 1 % sphalerite (Pride, 1989). Pyrite (and marcasite) occurs in late veinlets and replacing pyrrhotite.

The second anomalous zone, on the slopes above the lower zone, is underlain mainly by the Bralco limestone. The only discovered mineralization is minor galena in a sparry dolomite filled fracture within the marble. It is not believed to be the source of the Zn-Pb geochemical anomaly (Pride, 1989).

These showings and host succession have similarities with Mn-rich, stratabound Pb-Zn showings of the Bend prospect (Leask, 1982; Reddy and Godwin, 1987) north of Golden. They also have similarities with volcanogenic sulphide deposits, in particular Besshi-type deposits. These include a mixed mafic volcanic(?)/ metasedimentary host succession and a copper, zinc and lead metal content.

Big Gulp (093A 143)

Big Gulp is a new discovery by Barker Minerals Ltd. It is located approximately 1.5 kilometres south of Cariboo Lake, along "C road", a spur of the 8400 logging road. Work on the property is limited, with only reconaissance mapping, some sampling, and a soil geochemical survey.

TABLE 2: ASSAYS OF HAND SAMPLES OF MASSIVE SULPHIDE PROSPECTS IN THE SNOWSHOE GROUP, BARKERVILL SUBTERRANE

Sample	Description	Source	Mo ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	Ni ppm	Co ppm	Mn ppm	Sr ppm	Cd ppm	Bi ppm	V ppm	La ppm	Cr ppm	Ba ppm
BIG GULP																		
1197BC-6C	py-se schist	1	< 2	674	61	45031	< .5	14	42	62	2343	457	171	19	58	15	98	125
ACE																		
1197BC-10	po-chl schist	1	20	630	17	393	0.5	6	123	70	6055	158	< .4	< 5	431	28	77	26
H97BC-1-E-1	py-qtz schist	1	3	427	39	524	1.6	6	253	22	6537	279	1	< 5	869	27	67	109
H97BC-1-E-2	po-qtz schist	1	2	673	58	131	1.4	< 2	214	< 2	17624	249	0.8	7	1336	41	84	86
RAL 97-9	qtz-bi schist	2	5	361	11	95	<.5	<5	124	62	9182	216	<1	5	797	27	183	74
RAL 97-10	qtz-se schist	2	60	50	65	617	<.5	6	54	9	1204	246	9	<5	144	22	117	812
1133	sulphide schist	3	5	3249	<2	306	1.4	35	23	55	1590	24	<1	<5	159	<10	29	15
1362	gn-qtz-chl schist	3	<1	1281	10	35	3.2	75	474	138	1586	37	2	<5	107	<10	72	50
MAE																		
1197BC-46-2b	po-amph schist	1	< 2	403	57	159	< .5	13	104	13	43955	22	1.5	6	208	27	76	1
1197BC-46-2c	po-amph schist	1	6	772	30	112	< .5	8	130	25	21236	26	< .4	< 5	144	36	76	3
1197BC-46-3a	po-amph schist	1	< 2	328	10	77	< .5	132	45	7	28360	8	< .4	9	100	27	39	< 1

Sample	Fe %	Ca %	P %	Ti %	Na %	K %
BIG GULP						
1197BC-6C	10.57	8.57	0.04	0.03	0.46	0.7
ACE						
1197BC-10	18.11	2.44	0.592	0.2	0.93	0.94
H97BC-1-E-1	23.15	3.46	0.478	0.13	0.78	1.36
H97BC-1-E-2	17.24	6.93	0.246	0.11	0.72	1.84
RAL 97-9	>10	5.92		0.06	0.32	1.09
RAL 97-10	3.03	2.13		0.05	2.05	0.57
1133	9.41	0.39	0.19	<.01	<.04	<.01
1362	26.3	2.04	0.49	<.01	<.01	
MAE						
1197BC-46-2b	18.48	3.04	0.309	0.1		
1197BC-46-2c	17.48	2.8	0.308	0.11		
1197BC-46-3a	12.64	1.49	0.097	0.09		

Notes: Analyses of float samples of Barker Minerals are by Echo-tech labs, Kamloops
Analyses of samples, this report are by MIC, Acme Analytical Laboratories, Vancouver
MIC = HCLO4-HNO3-HCl-HF digestion and ICP
FAC = Fire assay-ICP/graphite furnace finish
data source: 1. this report; 2. R. Lane, personal communication, 1997; 3. Barker Minerals Ltd.
arsenic: Big Gulp = 16 ppm. all other values below 10 ppm

Big Gulp is a stratabound semi-massive sulphide occurrence in the Downey succession. Immediate host rocks are pale grey to green sericite phyllite and darker chlorite phyllite; both contain abundant dispersed ankerite and variable amounts of calcite. These phyllites are interpreted to be altered mafic tuffs (samples H97BC-6a, 6b, Table 1). The phyllites overlie Quesnel Lake orthogneiss immediately to the southwest and are structurally overlain by a "chert to cherty tuff" horizon and then argillite (Roach, 1997).

Mineralization comprises a number of thin layers with dark sphalerite, and minor chalcopyrite and pyrite, dispersed in a siliceous, sericitic matrix. It is streaked parallel to a prominent west-plunging mineral lineation. Sulphides also occur in thin, discontinuous foliation-parallel quartz stringers. A grab sample assayed 4.5 % Zn and 0.06% Cu (H97BC-6a; Table 2), and a sample by Roach (1997) contained 3.17 % Zn and 0.04 % Cu.

The host succession and Zn-Cu tenor suggest similarities with Besshi-type massive sulphide mineralization. Alteration, including sericitic, silicification and "brownish-white carbonate" just northwest of the showing, is also characteristic of this deposit type.

Ace

Introduction

The Ace property is located on the south side of the Little River, approximately 35 km northeast of Likely (Figure 1). It is readily accessible by the Welwood 8400 logging road that cuts through the property. Exposures in the area are minimal, largely restricted to isolated outcrops along the banks of the Little River, on the higher slopes of Mount Barker, in logging roadcuts and in recent trenches. A considerable part of the property has been logged; the remainder is covered by stands of fir, spruce and pine, and by considerable thicknesses of glacial till.

High gold values in sands of the Little River as well as sulphide float boulders, first recognized by Louis Doyle, led to the acquisition of the Ace property and formation of Barker Minerals Ltd. in 1994. Subsequent detailed prospecting, line cutting and soil geochemistry outlined a sulphide boulder float train and coincidental geochemical anomalies that paralleled the regional structural trend. More recent work, during the summer of 1995, including additional prospecting, geochemistry, geophysical surveys and some geological mapping, defined more clearly exploration targets on the property. As a result of successful regional work, the property was expanded significantly in 1996, and now includes prospects such as Big Gulp and the Maybe (*see* Höy and Ferri, 1998). Work in 1997 included considerable trenching, geological mapping and sampling. The following description of the Ace property incorporates results presented in assessment reports as well as unpublished internal reports by Barker Minerals Ltd.

Two main targets are apparant on the Ace claims: massive sulphides and gold-quartz veins. Both of these were recognized in the float train and have since been discovered in trenches. Geochemical soil surveys identified coincident Zn and Pb anomalies, with threshold values of 100 and 25 ppm respectively, along the northern margin of the float train. A moderately anomalous Cu zone was identified to the south, along the lower slopes of Mount Barker; it is locally associated with high As values. The regional extent of these anomalies, their tenor and their orientation parallel to regional structural and stratigraphic trends, suggest that they may be related to massive sulphide targets. Local Bi anomalies, and erratic Au highs, may be related to vein mineralization.

Geology

The Ace property is underlain by phyllitic rocks of the Downey succession. These have been assigned an early to middle Paleozoic age, possibly correlative, in part, with the Broadview Formation of the Lardeau Group (Struik, 1986); however, as described above, they may correlate with the Index Formation at the base of the Lardeau. The succession trends easterly, with moderate dips to the north. It has been cut by at least two prominent northeast trending faults (Struik, 1988), referred to informally as the GSC-1 and GSC-2 faults by Barker Minerals Ltd., that may define a horst in the central part of the Ace claims (Lammle, 1997).

Dominant rock types in trenches include tan to pale grey or green phyllites and dark grey graphitic phyllite, both interpreted to be fine grained metasediments. These are interlayered occasionally with impure sericite quartzites or orthoquartzites and rare dark limestone beds. Green, massive chlorite phyllites are interpreted to be mafic volcanics. At higher metamorphic grades on the northern slopes of Mount Barker, these occur as amphibolites that are referred to as "diorites" or "diorite tuffs" (Struik, 1988).

Mineralization and alteration

The two dominant deposit types on the Ace property, semimassive sulphides and gold-quartz veins, have been found in numerous float samples, in trenches and in a few of the natural exposures.

Pyrite and pyrrhotite are commonly dispersed throughout phyllites on the Ace property. Semimassive sulphides, dominantly pyrite and pyrrhotite, are also concentrated parallel to foliation in coarse, quartzo-feldspathic schists. Sulphide concentrations greater than 50 per cent are common and, therefore, the term "massive sulphide" is locally appropriate. The sulphides are deformed, along with their gangue and host succession, in a ductile manner. A crude banding is often apparent, defined by variable sulphide/silicate concentrations. Chalcopyrite and sphalerite contents are variable, but generally less than a few per cent each.

The sulphide host rock is typically a granular quartz-feldpar schist or phyllite, with grain size up to several millimetres. In the field it has been variously referred to as an exhalite, leucocratic diorite, quartzite or siliceous alteration zone. However, as these various rock types are not all at a single stratigraphic horizon, it is possible that they represent, in part, distinct units. The schist is commonly banded due to either variable sulphide or possibly biotite content. This banding appears to be a tectonic rather than a primary fabric. The schist comprises dominantly plagioclase (andesine and albite) and quartz with varying amounts muscovite, sericite, biotite, ankerite, calcite and opaques (Payne, 1997). Several per cent apatite is common, with local concentrations greater than 20 per cent.

Petrographic work (Payne, *op.cit.*) suggests that the original rock is an intrusive leuocodiorite? that has undergone various degrees of alteration, deformation and mineralization. These include albitization, producing aggregates of fine-grained, equant, non-twinned albite, silicification with introduction of quartz, and potassic (muscovite / sericite and minor K-spar) and magnesian (phlogopite) alteration. Late chlorite commonly replaces biotite. Early sulphides include both pyrrhotite and pyrite, with minor finely dispersed chalcopyrite and sphalerite. Subhedral pyrite grains appear to have formed as a replacement of pyrrhotite; chalcopyrite and pyrite are both commonly remobilized into thin discontinuous veinlets. Marcasite may occur as a late replacement of other iron sulphides.

Analyses of a number of sulphide host rock samples are listed in Table 2. Of note are the high Cu/Pb and Zn/Pb ratios and relatively high Mn values, typical of some Besshi deposits. However, Co/Ni ratios are considerably lower than those typical of Besshi deposits.

Numerous white quartz veins, locally with abundant sulphides, occur on the Ace property. Some are folded along with their host rock while others are clearly post tectonic, cutting across foliation. These may be folded during deformation that crenulates foliation. Veins contain variable amounts of quartz and pyrite, generally minor base metal sulphides and muscovite, biotite, chlorite and tourmaline. "Mineralogical studies indicate the presence of cubanite, various tellurides, cosalite, native bismuth and native gold and prismatic tourmaline. Geochemical analyses indicate presence of Fe, As, Au, Ag, Zn, Cu, Bi and Te and locally at least some Ni, Co and Cr. For the most part, the microscope studies reveal that native gold is sometimes associated with native bismuth, native tellerium and with Bi and Te minerals. In others, gold is enclosed in quartz, in sulphide minerals and along the edges of sulphide minerals" (internal Barker Minerals report, August, 1997).

Analyses of numerous quartz-sulphide float samples, collected and analyzed by Barker Minerals Ltd., indicate variable but locally appreciable gold content; 53 samples had an average gold content of 3106 ppb, with a range from 220 ppb to 28,972 ppb (Lammle, 1997).

Summary and discussion

Semimassive to massive sulphide mineralization on the Ace claims has similarities to Besshi style volcanogenic massive sulphide deposits. Host rocks include a succession of sericite phyllites, impure quartzites, minor calcareous units and chlorite phyllites. These are interpreted to be metasediments and mafic metavolcanic units. They are similar to and may correlate with the basal Index Formation in the Goldstream area, host to a number of massive sulphide deposits.

Sulphides, dominantly pyrrhotite and pyrite with minor chalcopyrite and sphalerite, are in a granular feldspathic schist. The protolith of this unit is unknown; however, it has similarities to the siliceous alteration zone that hosts Goldstream massive sulphides (Höy, 1979) and the albite envelope around other Besshi style deposits (Slack, 1993) and is, therefore, interpreted to be largely an alteration envelope. More regional alteration includes potassic (sericite +/- K-spar), magnesium (chlorite and phlogopite), and widely dispersed pyrite and pyrrhotite.

The metal content, domininantly Cu and Zn with low Pb, is also similar to Besshi deposits. As well, anomalous concentrations of a variety of metals, including Co, Mo, Bi, As and Ni are typical of many Besshi deposits (Slack, 1993). These deposits can also contain high precious metal content, with typical grades of 5 to 20 ppm Ag and variable but locally high gold values.

The gold-quartz veins have some similarities with vein mineralization of the Barkerville-Wells camp. These deposits include both early replacement deposits and younger gold-sulphide veins. They all occur in the Downey succession, in rocks of greenschist facies regional metamorphism, and in fold hinges or along consistent fault or fracture patterns. By analogy, veins on the Ace property may have similar stratigraphic, metamorphic and structural control. Their distribution, coincident with semimassive sulphide mineralization and targets, and somewhat similar base and precious metal content, suggest that they may be, in part, remobilized from these early deposits as has been suggested for deep level veins associated with deposits in the Besshi district, Japan (*see* Slack, 1993).

SUMMARY AND DISCUSSION

The Snowshoe Group of the Barkerville subterrane contains at least two separate and distinct packages of metavolcanic rocks. Correlation of these successions with volcanics elsewhere in the Kootenay terrane allows possible revision of the recognized Snowshoe Group succession.

We suggest that the metavolcanics of the Downey succession may correlate with tholeiitic basalts of the Lower Paleozoic Index Formation and with some of the greenstones of unit EBG of the Eagle Bay assemblage.

Furthermore, we propose that felsic volcanics of the Ramos succession correlate with Devono-Mississippian arc volcanics of the Eagle Bay Assemblage.

Revised correlation of the Snowshoe Group has considerable metallogenic implications. The Downey succession, host to numerous gold veins and replacement deposits in the Barkerville-Wells area, also has potential for Besshi-type volcanogenic massive sulphide deposits similar to those that occur in the Index Formation in the Goldstream camp. Recognition and correlation of Ramos succession tuffs with arc volcanics of the Eagle Bay and possibly Devono-Mississippian volcanics of the Yukon-Tanana terrane enhances its potential for discovery of Kuroko-type (polymetallic) massive sulphide deposits.

Recent discovery by Barker Minerals Ltd. of Cu-Zn+/-Au occurrences in the Downey, including the Ace and Big Gulp prospects, may be examples of stratabound volcanogenic deposits.

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