British Columbia Geological Survey
Geological Fieldwork 1999

Bull River Copper-Silver-Gold Prospect, Purcell Supergroup, Southeastern British Columbia

Trygve Höy, W.R. Smyth and Ray E. Lett
British Columbia Geological Survey, Ministry of Energy and Mines, Victoria, B.C.

INTRODUCTION

The Bull River deposit (also called the Dalton Mine or the Gallowai Bul Mine) is a past producer of copper, silver and gold. It is located approximately 30 kilometres due east of Cranbrook on the eastern side of the Rocky Mountain trench (Figure 1). It was operated by Placid Oil Co. from 1971 to 1974, producing 7256 tonnes of copper, 126 kilograms of gold and 6354 kilograms of silver from 471 899 tonnes of milled ore (B.C. MINFILE).

The property and surrounding area, collectively referred to as the Gallowai Bul River claims, was acquired by R.H. Stanfield in 1976. The Bull River mine is jointly owned by Gallowai Metal Mining Corporation and Bul River Mineral Corporation Ltd. It has undergone extensive exploration by these companies since that time. This exploration includes underground work, considerable sampling, geological mapping, geophysical surveys and more than 59 000 metres of percussion and diamond drilling. Exploration in 1998 included advancement of a decline 1100 metres and level advancement of 725 metres, 6508 metres of underground diamond drilling, 1144 metres of surface diamond drilling and 367 metres of percussion drilling. Ongoing work in 1999 mainly involved extending the decline by 554 metres, 1424 of level development and 11 169 metres underground drilling, as well as considerable sampling and anayltical work (Photo 1).

In 1998, the Stanfield Mining Group's Consultant and Project Engineer released to the Ministry estimates of the measured and indicated, mineral resource of the Gallowai Bul River as 5.3 million tonnes containing 2.25 percent copper, 1.06 oz/tonne (36 grams/tonne) silver and 0.35 oz/tonne (12 grams/tonne) gold (de Souza, 1998). This resource was quoted in Ministry publications (Schroeter, 1999, Wilton, 1999).

This study, based on a brief visit to the property in June, 1999, was undertaken to better understand the geology of the deposit and to attempt to verify reported resource grades.

REGIONAL GEOLOGY

The Bull River deposit is located in the Rocky Mountain trench just east of the inferred trace of the Rocky Mountain trench fault, a west-side-down Tertiary normal fault with at least 5 kilometres of vertical displacement. The area is within the Hosmer thrust sheet, the structurally highest thrust package in the Western Ranges of the Rocky Mountains (Benvenuto and Price, 1979). Broad, open east-plunging folds dominate the structures in the immediate area.

The deposit is within the Aldridge Formation, a thick succession of mainly sandy turbidites and interbedded laminated siltites and argillites that forms the basal part of the Middle Proterozoic Purcell Supergroup (Höy, 1993). A number of extensive gabbroic sills and less commonly dikes, collectively referred to as the Moyie sills, intrude this turbidite package. These rocks are overlain to the east by mainly argillites and siltites of the upper Aldridge. Several percent of finely disseminated pyrite and pyrrhotite in the Aldridge result in typically rusty-weathering outcrops.

The Creston Formation, a shallow water platformal succession of mainly quartzites and siltites, is exposed east and upslope of Aldridge exposures. To the southeast, on the south side of the Bull River, the Creston Formation is overlain by tan-weathering carbonate rocks of the Kitchener Formation.

A number of small Cretaceous monzonite stocks intrude rocks of the Purcell Supergroup as well as younger Paleozoic platformal rocks. One of these is exposed just west of the Bull River deposit, intruding mainly carbonate rocks of the Devonian Fairholme Group.

BULL RIVER DEPOSIT (082GNW002)

The Bull River deposit is the largest and probably most important known mineralized zone on property of the Stanfield Holdings. It is described as a massive chalcopyrite vein and replacement deposit in a quartz-siderite gangue (B.C. MINFILE). Placid Oil Co. estimated total underground ore reserves, based on a cut-off grade of 1.0 percent copper and minimum thickness of 1.2 metres, as 664 000 tonnes containing 1.94% copper (Chiang, 1973). These reserves were concentrated in two main zones, the A zone with a strike length of 275 metres and a down dip extent of 90 to 175 metres, and the E zone, 150 metres in strike length and up to 275 metres dip extent. Neither gold nor silver content were reported in these reserve estimates.

The deposit includes a number of quartz-carbonate-sulphide veins in shear or breccia zones that generally trend easterly and dip steeply to the south (Photo 2).

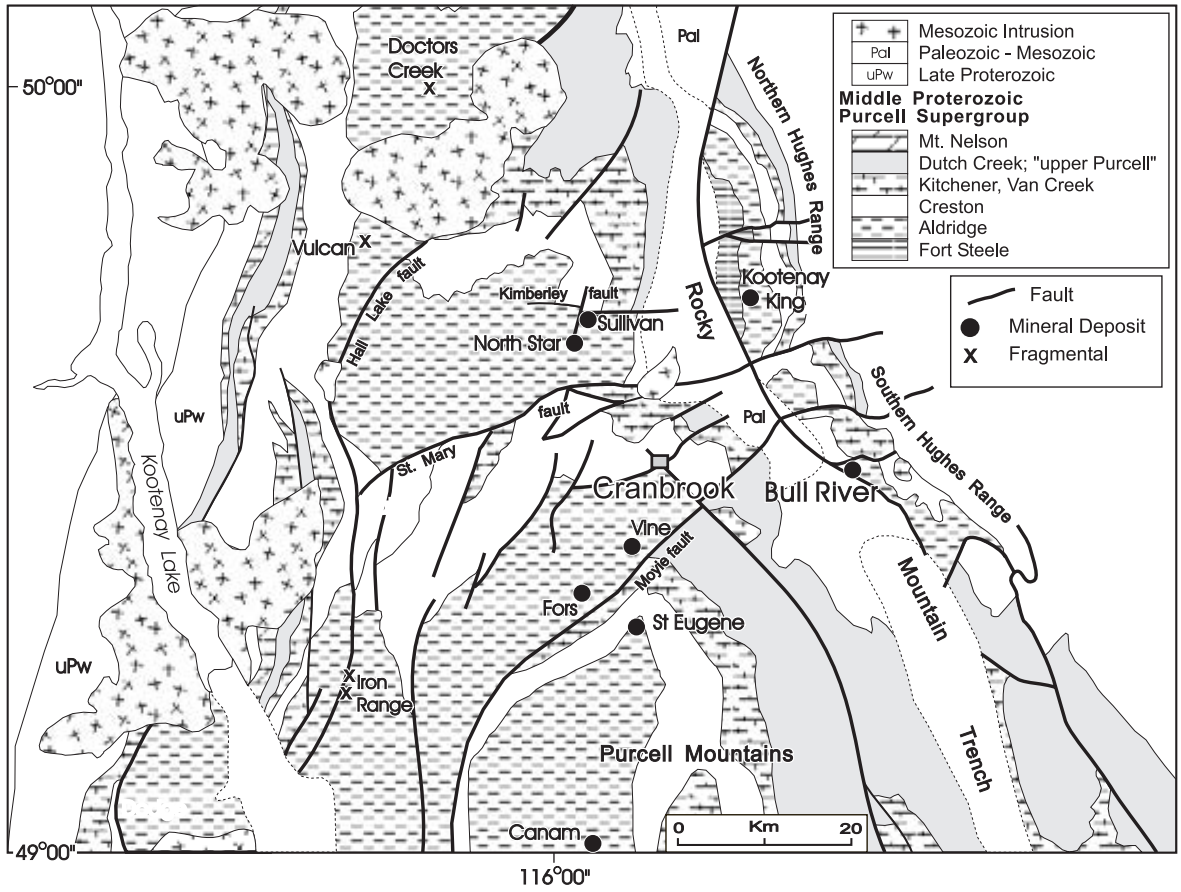

Figure 1. Regional geological map showing the location of the Bull River deposit, and other mineral deposits in the Middle Proterozoic Purcell Supergroup, southeastern British Columbia (base map after Höy *et al.*, 1995, in press)

TABLE 1
DESCRIPTION OF SELECTED SAMPLES, BULL RIVER DEPOSIT

Drill core	Lab no.	Location (depth)	Sample type	Description
BRU-99-11	54661	51.2 - 51.8 m	0.6 m split core	massive argillite, cut by thin qtz-cc veinlets
BRU-99-11	54662	51.8 - 52.6 m	0.8 m split core	vein breccia, with cp, po in qtz-sid gangue
BRU-99-11	54663	52.6 - 53.4 m	0.8 m split core	semi-massive po + cp in qtz-sid gangue; brecciated
BRU-99-11	54664	53.4 - 54.0 m	0.6 m split core	massive siltstone, with thin qtz-sid + po, cp veinlets
BRU-99-11	54665	81.5 - 82.0 m	0.5 m split core	massive cp-po with qtz-carb gangue
BRU-99-11	54666	82.0 - 82.5 m	0.5 m split core	massive cp-po with qtz-carb gangue; late sid veinlets
BRU-99-11	54667	83.1 - 83.7 m	0.6 m split core	semi-massive po + cp in qtz-sid gangue
BRU-99-11	54668	84.7 - 85.2 m	0.5 m split core	sericite-altered siltstone, cut by thin cp veinlets
BRU99-16	54669	37.3 - 37.8 m	0.5 m split core	altered quartzite?, cut by qtz-carb veinlets
BRU99-16	54670	37.8 - 38.5 m	0.7 m split core	massive qtz-sid vein, with po and cp
BRU99-16	54672	38.9 - 39.4 m	0.5 m split core	brecciated vein with cp, cut by carb veinlets
BRU99-16	54673	39.4 - 39.8 m	0.4 m split core	argillaceous quartzite, with minor blebs of po
BRU99-16	54674	122.8 - 123.1 m	0.3 m split core	qtz vein cut by po-cp veinlets
98L3-2	54650	91.1 - 91.7 m	0.6 m split core	massive qtz vein, with patchy cp-po
98L3-2	54651	100 - 100.4 m	0.4 m split core	massive cp, minor po in brecciated qtz vein
98L3-2	54653	98.6 - 99 m	0.4 m split core	argillaceous siltstone, with minor qtz-carb-cp veinlets
98L3-2	54654	100.9 - 102.0 m	1.1 m split core	massive cp, minor po; barite and qtz gangue
Underground samples				
BR-UG-1	54655	Level 3, west wall	grab	semi-massive, brecciated po-cp-carb vein
BR-UG-2	54656	Level 3, Stn 189, -3m	grab	semi-massive, brecciated po-cp-carb vein
BR-UG-3	54657	Level 3, Stn 189, -5m	grab	semi-massive, brecciated po-cp-carb vein
BR-UG-4	54658	Level 3, Crosscut	grab	semi-massive, brecciated po-cp-carb vein
BR-UG-5	54659	Level 5, Crosscut	grab	semi-massive, brecciated po-cp-carb vein

Abbreviations: qtz - quartz; cc - calcite; cp - chalcopyrite; po - pyrrhotite; sid - siderite; do - dolomite; carb - carbonate

Photo 1. A) Photo showing one of the open pits developed during mining of the Bull River deposit by Placid Oil Co. from 1971 to 1974.
B) Portal for underground development, Bull River deposit.

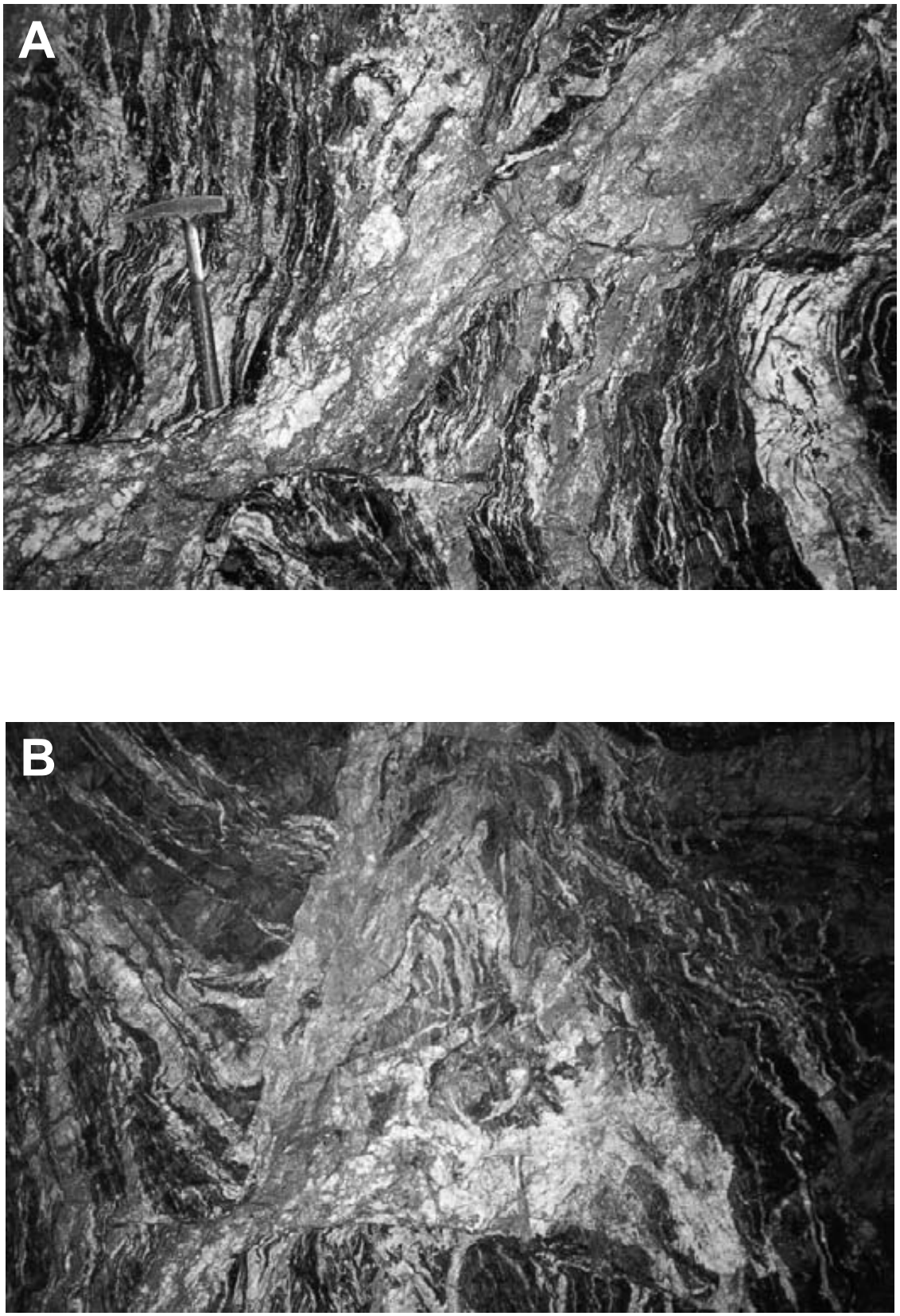

Photo 2. A) Semi-massive chalcopyrite-pyrrhotite vein, Bull River deposit; note multiple vein episodes, with quartz-carbonate gangue, and early ductile folding of veins followed by brittle deformation. Host is dark siliceous argillite of the Middle Proterozoic Aldridge Formation. B) Similar intense brittle deformation of chalcopyrite-pyrrhotite vein; note rock hammer scale.

Widths of these brecciated vein zones vary from a few centimetres to greater than ten metres, and are continuous for several hundred metres in strike length. Common sulphides include chalcopyrite, pyrite and pyrrhotite, with variable but generally minor galena and arsenopyrite, and trace tetrahedrite and interstitial native gold. The sulphides range from massive, irregular bodies within the vein system, to thin discontinuous veins and veinlets, and disseminations in host rocks. Secondary malachite and azurite occur locally. The main gangue minerals are quartz, siderite and dolomite. Sericite, quartz and chlorite alteration occurs within and adjacent to many of the sulphide veins.

SAMPLING AND ANALYTICAL PROCEDURES

Samples from four drill holes, shown by the Company logs to have intersected mineralized vein structures, and from mineralized zones underground were collected. Visible inspection of all samples, summarized in Table 1, confirmed that they are typical of the vein mineralization of the Bull River deposit.

Samples were crushed, split and pulverized in the Ministry of Mines' laboratory in Victoria, and sent to Chemex Laboratories, Vancouver, for gold assay by fire assay-atomic absorption spectrometry finish, and for copper and silver assay by aqua regia digestion-atomic absorption spectrometry. Several randomly selected samples, including a duplicate and a CANMET standard, were also sent to Loring Laboratories, Calgary, for gold by fire assay-atomic absorption spectrometry finish and to Activation Laboratories Ltd. Ancaster, Ontario for thermal neutron activation analysis. The Loring analyses are comparable to those reported by Chemex Laboratories. Thermal neutron activation gold values are similar to those obtained by five assay-atomic absorption spectrometry finish.

TABLE 2
ASSAYS OF MINERALIZED AND HOST ROCK SAMPLES FROM DRILL CORE AND UNDERGROUND, BULL RIVER DEPOSIT

		Chemex Lab			Loring Lab	Act Labs
	GSB Lab No	Au-FAA (g/t)*	Ag-ARAA (g/t)**	Cu-ARAA (%)**	Au-FAA (g/t)***	Au-INA (g/t)****
Drill hole	54662	0.030	4.8	0.45		0.048
samples	54663	0.145	7.5	0.72		0.171
	54665	0.440	102.5	16.95		0.551
	54666	0.180	55.8	8.75		0.305
	54667	0.960	97.2	13.85	0.650	0.650
	54670	0.070	9.3	0.55		
	54672	0.070	12.6	1.33		
	54650	0.390	18.0	2.41		0.445
	54651	0.550	65.4	8.01		0.630
	54654	4.770	161.5	13.00		4.690
	range	0.030-4.77g/t	4.8-161.5 g/t	0.45-16.95 %		
	median value	0.285 g/t	36.9	5.21		
Underground	54655	1.045	34.5	4.53	1.250	
samples	54656	0.160	18.0	2.61		
	54657	1.135	95.4	9.24		
	54658	0.290	26.7	2.92	0.291	
	54659	0.710	13.2	1.17		
	range	0.16-1.135 g/t	13.2-95.4 g/t	1.17-9.24 %		
	median value	0.71 g/t	26.7 g/t	2.92		
Table 2b: Assays of immediate host rock samples						
	54653	0.060	13.2	1.47		
	54661	<0.005	<0.3	0.01		
	54664	0.010	0.6	0.11		
	54668	0.010	2.4	0.37		
	54669	<0.005	0.3	<0.01	0.005	
	54673	<0.005	<0.3	0.01		
	54674	0.055	2.4	0.30	0.055	

Notes:
Preparation: Samples jaw-crushed, split and ring-mill pulverized at the Geological Survey Laboratory, Victoria.
*Au-FAA=Fire Assay-AAS Finish at Chemex Ltd. , Vancouver.
** Ag and Cu assay by aqua regia digestion-atomic absorption spectrometry at Chemex Ltd., Vancouver.
*** Au FAA Fire Assay finished at Loring Laboratory, Calgary.
****Au-INA Thermal Neutron Activation Laboratories Ltd., Ancaster, Ontario.

Results

Assay results from Chemex Laboratories are given in Table 2. Gold content in the 10 mineralized samples from drill core ranged from 0.030 to 4.77 grams/tonne, with a median value of 0.285 grams/tonne. The best intersection, a 1.1 metre interval of massive to semi-massive chalcopyrite and pyrrhotite, with barite and quartz gangue, contained 4.77 grams/tonne gold, 161.5 grams/tonne silver and 13 percent copper. Gold content in the five samples collected underground ranged from 0.16 to 1.135 grams/tonne, with a median of 0.71 grams/tonne. Silver content in these samples ranged from 13.2 to 95.4 grams/tonne and copper, from 1.17 to 9.24 percent.

A number of samples of host rocks immediately adjacent to the sheared and brecciated veins were also analyzed, in an attempt to determine if these contained finely dispersed gold. Although thin quartz-siderite-sulphide veins, minor disseminated sulphides and some vein alteration were apparent in these samples, gold content was low (Table 2). Sample 54653 contained 0.06 grams/tonne gold, probably concentrated mainly in a thin quartz-carbonate vein that contained visible chalcopyrite.

The correlation between gold and copper content, and the essential restriction of gold values to vein structures that contained visible chalcopyrite, suggest that gold is largely restricted to these veins.

CONCLUSIONS

The Bull River deposit is a brecciated and sheared copper-gold-silver prospect in the Middle Proterozoic Aldridge Formation in southeastern British Columbia. Mineralization appears to be restricted to a series of essentially east-trending, steep south-dipping veins just east of the Rocky Mountain trench. The veins vary from mainly massive chalcopyrite and pyrrhotite, to brecciated or sheared quartz-dolomite-siderite veins with variable sulphide content.

In 1998, a measured and indicated, mineral resource for the Bull River deposit of 5.3 million tonnes containing 2.25 percent copper, 36 grams/tonne silver and 12 grams/tonne gold was reported to the Ministry (de Souza, 1999). This resource calculation was based mainly on a volume of the exploration block, which contains both mineralized veins and host rock.

Assays of selected hand samples from underground and drill core, collected during this study, returned variable copper and silver content and trace to minor gold. Copper in these samples are comparable to those in original reserve calculations of Placid Oil Co. Gold values in the mineralized veins ranged from 0.03 grams/tonne to a maximum of 4.77 grams/tonne for a sample collected across 1.1 metres of core. These gold values are in the same order of magnitude as those recovered during the mining life of the deposit in the early 1970s. This brief study, using standard fire assay techniques with atomic absorption spectrometry finish, does not confirm the gold grades reported by the company for the Bull River deposit. Further and more detailed study, using standard techniques, would be necessary to confirm what grades are in fact present.

In summary, the Bull River deposit is fairly typical of the Cu±Ag quartz vein deposit class (I06; Lefebure, 1996). These veins are typically fault-controlled, commonly continuous for several hundred metres, and contain variable copper and silver content, with trace to minor gold.

ACKNOWLEDGEMENTS

We would like to acknowledge the cooperation of personnel of Gallowai Metal Mining Corp. and Bul River Minerals Corp. Ltd. while on a visit to the property in June, 1999.

REFERENCES

Chiang, M.C. (1973): A report on underground ore reserve estimation, Bull River Mine; internal report, *Placid Oil Company*, 16 pages.

Benvenuto, G.L. and Price, R.A. (1979): Structural evolution of the Hosmer thrust sheet, southeastern British Columbia; *Bulletin of Canadian Petroleum Geologists*, volume 27, pages 360-394.

de Souza, P. (1998): Stanfield Group-British Columbia Mineral Exploration Review 1998, *in a letter from Precious and General Metals, Calgary, December 1998.*

Grieve, D.A. (1980): Base metal deposits in the Libby Pondage Reserve area*; B.C. Ministry of Energy, Mines and Petroleum Resources*; Geological Fieldwork 1979, Paper 1980-1, pages 115-117.

Höy, T. (1993): Geology of the Purcell Supergroup in the Fernie west-half map area, southeastern British Columbia; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Bulletin 84,157 pages.

Höy, T., Price, R.A., Legun, A., Grant, B., and Brown, D.E. (1995): Purcell Supergroup, southeastern British Columbia, compilation map, scale 1:100 000; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Geoscience Map 1.

Höy, T., Anderson, D., Turner, R.J.W. and Leitch, C.H.B. (in press): Tectonic, magmatic and metallogenic history of the early synrift phase of the Purcell basin, southeastern British Columbia; *in* The Sullivan Deposit and Its Geological Environment, J.W. Lydon, T. Höy, M. Knapp, and J.F. Slack, Editors, Sullivan Volume; *Geological Association of Canada / Mineral Deposit Division,* Special Publication No. 1..

Lefebure, D.V. (1996): Cu ± Ag quartz veins (I06); *in* Selected British Columbia Mineral Deposit Profiles, Lefebure, D.V. and Höy, T., Editors, *B.C. Ministry of Energy and Mines*, Open File 1996-13, pages 71-73.

Schroeter, T.G. (1999): British Columbia 1998 Mineral Exploration Review; *in* Exploration and Mining in British Columbia 1998; *B.C. Ministry of Energy, Mines and Petroleum Resources,* pages 1-17.

Schroeter, T.G., Cathro, M., Lane, B., Pinsent, R., Ryan, B., Simandl, G., Wilton, P. and Wojdak, P. (2000): British Columbia Mineral Exploration Review 1999; *B.C. Ministry of Energy, Mines and Petroleum Resources,* Information Circular 2000-1.

Wilton, H.P. (1999): Kootenay Region; *in* Exploration and Mining in British Columbia 1998; *B.C. Ministry of Energy, Mines and Petroleum Resources,* pages 65-75.