Several New Plutonic-related Gold, Bismuth and Tungsten Occurrences in Southern British Columbia

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INTRODUCTION

Exploration interest in plutonic-related gold deposits in the Cordillera was initially sparked in the 1990s by the discovery and development of the Fort Knox bulk tonnage gold mine located near Fairbanks, Alaska. It has been rejuvenated by the discovery of the high-grade Liese Zone gold deposit (Smith *et al.*, 1999) on the Pogo property in east-central Alaska, with a published resource of 8.89 million tonnes grading 17.83 g/t Au (Teck Corporation Annual Report, 1999). These deposits are part of the "Tintina Gold Belt" and are associated with mid-Cretaceous granitoid rocks of the Tombstone Plutonic Suite. They have a metal assemblage of gold-bismuth-tungsten-arsenic-tellurium-(molybdenum-antimony) and are considered to be plutonic- or intrusion-related deposits, as described in recent review papers by McCoy *et al.* (1997), Poulson *et al.* (1997), Thompson *et al.* (1999), and Baker *et al.* (submitted).

Recent prospecting in the Omineca Belt in southern British Columbia has identified several new plutonic-related gold, bismuth and tungsten occurrences which exhibit similarities to the well studied deposits in Alaska and the Yukon. The potential for plutonic-related gold-quartz veins in B.C. has been discussed by Lefebure and Cathro (1999) and Logan *et al.* (2000) and a compilation map of exploration indicators for these types of deposits was prepared by Lefebure *et al.* (1999).

The showings described here are at an early stage of exploration, with only limited surface mapping, trenching or drilling completed. This paper provides short descriptions, based on brief field visits, of the local geology and exploration history of the showings, along with multi-element geochemical data from grab or chip samples collected by the authors or compiled from other sources. More detailed studies of specific occurrences have been started and the initial results are reported by Logan (this volume), Logan and Mann (2000a) and Logan and Mann (2000b). The results of orientation geochemical surveys conducted near several of the showings are reported by Lett and Jackaman (this volume).

REGIONAL GEOLOGY

The Omineca Belt is a belt of metamorphic, plutonic and sedimentary rocks which separates Proterozoic and Paleozoic sedimentary rocks of the North American miogeocline from Paleozoic and Mesozoic accreted terranes to the west (Monger *et al*., 1982). The belt includes portions of allochthonous terranes and the North American Terrane but is mainly comprised of para-autochthonous terranes such as the Kootenay, Barkerville, Nisling, and Yukon-Tanana Terranes (Monger and Berg, 1984). It has a complex metamorphic, structural and intrusive history which records pre-Paleozoic rifting and deformation, Paleozoic rifting, Devono-Mississippian island arc magmatism, Early-Middle Jurassic to Eocene compression and obduction related to accretion of the Intermontane Superterrane, and Eocene uplift and extension (Monger *et al*., 1982, Parrish *et al*., 1988, Parrish, 1995).

The Omineca Belt in southern British Columbia is comprised of Proterozoic metasedimentary rocks of the Windermere and Purcell Supergroups and Proterozoic and Paleozoic metasedimentary rocks of the Kootenay Terrane. The Omineca Belt here also includes several metamorphic core complexes, such as the Shuswap, Monashee, Okanagan and Valhalla complexes.

Eocene extension in southern British Columbia resulted in exhumation of high-grade metamorphic rocks in domal culminations, such as the Shuswap metamorphic complex, which are bounded by low- to moderate-angle, outward-dipping faults including the Okanagan, Adams-North Thompson and Columbia River-Slocan fault systems (Figure 1, Parrish *et al*., 1988; Johnson, 1994). The Shuswap metamorphic complex has been traditionally understood to include those rocks in the sillimanite zone of regional metamorphism (upper amphibolite facies) as shown on Figure 1 (Okulitch, 1984). Brown and Carr (1990), however, proposed that the term Shuswap complex be used to refer to rocks that lie in the footwall of Eocene extensional faults, which include the Okanagan Valley and Adams-North Thompson faults shown on Figure 1. Johnson (1994) proposed that mylonitized leucogranites of the Pukeashun suite represent the left-stepping "Shuswap Lake transfer zone" which connect the Okanagan- and Adams-North Thompson fault systems.

Granitoid intrusive rocks in the southern Omineca Belt are very common and are mainly Devono-Mississippian, Early Jurassic, Middle Jurassic, middle Cretaceous and Eocene in age. The Middle Jurassic granitoids range in composition from quartz diorite to tonalite to granite, and are thought to have formed as part of a magmatic arc complex formed during accretion and subduction of

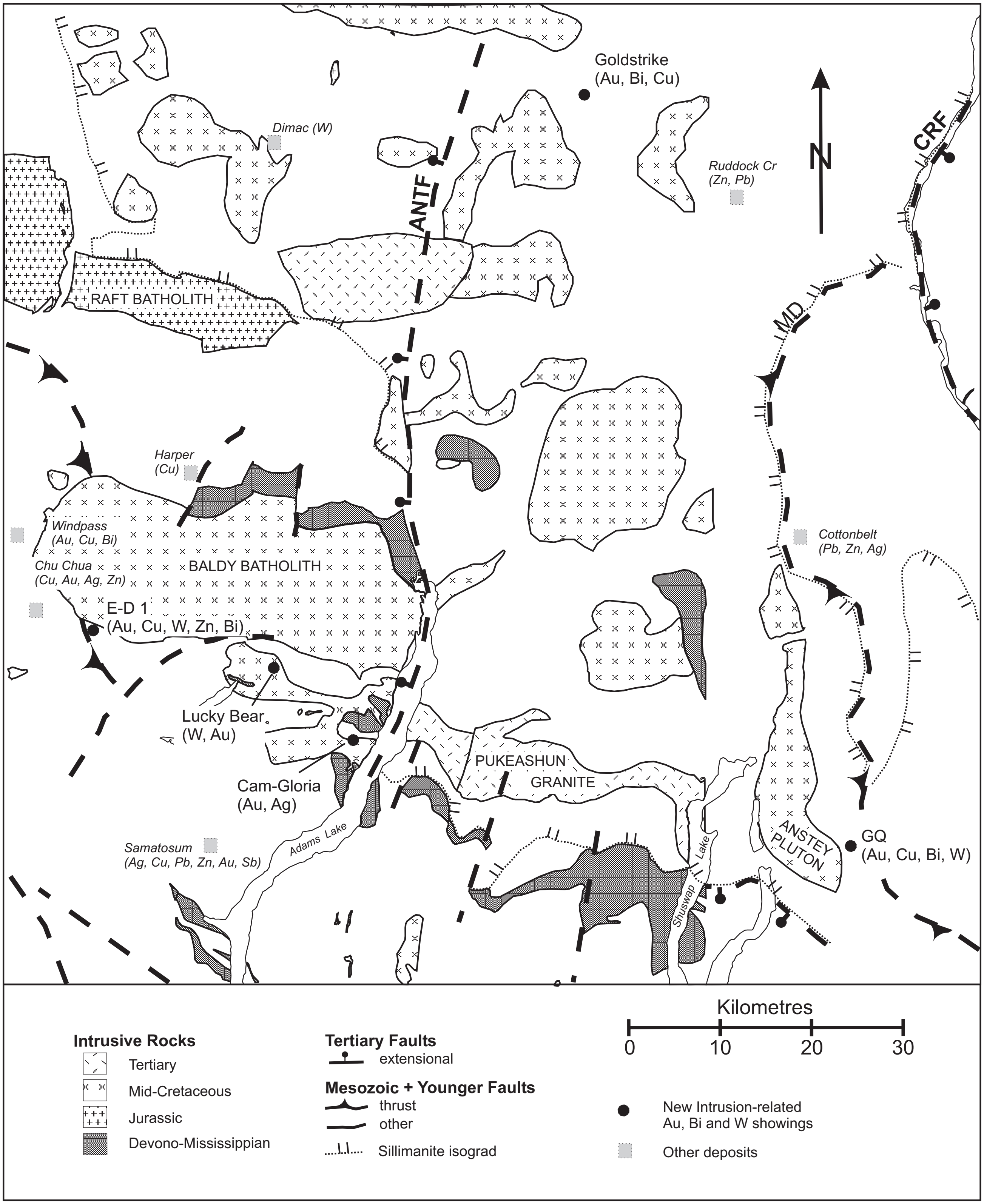

Figure 1. Generalized geology of the Shuswap metamorphic complex and adjacent areas (modified after Wheeler and McFeely, 1991) showing locations of new intrusion-related gold prospects and granitoid intrusions. Adams-North Thompson fault (ANTF), Monashee decollement and Columbia River fault are after Parrish *et al*. (1988) and Johnson (1994). Sillimanite isograd is after Read *et al*. (1991).

allochthonous oceanic terranes (Brandon and Smith, 1994). Mid-Cretaceous intrusions (ca. 100 Ma) are mainly metaluminous to weakly peraluminous hornblende-biotite granites and strongly peraluminous two-mica granites which probably formed by melting of basement gneisses and metapelites in response to crustal thickening (Brandon and Smith, 1994). Trace element plots are indicative of within-plate tectonic settings for inboard intrusions, and volcanic-arc settings for some of the others, such as the Baldy batholith (Logan, this volume).

BALDY BATHOLITH AREA OCCURRENCES

Numerous mid-Cretaceous granitic plutons of the Bayonne suite intrude the Omineca Belt in southern B.C. One of the larger of these is the east-trending Baldy batholith (Figure 1), a multiphase, mid- to Late Cretaceous granitic batholith which intrudes oceanic rocks of the Fennell Formation (Slide Mountain Terrane) and Neoproterozoic to Paleozoic metasedimentary and metavolcanic rocks of the Eagle Bay Assemblage (Schiarizza and Preto, 1987), part of the Kootenay Terrane. Radiometric age dating of the batholith has given a range of 99 +/- 5 Ma to 106 +/- 5 Ma by K-Ar methods, and 115.9 +/- 4.6 Ma by U-Pb methods (summarized by Logan, this volume). Mapping by Logan and Mann (2000a) identified two compositionally similar, but texturally distinct granite phases in the western 2/3 of the batholith, a potassium-feldspar megacrystic hornblende-biotite granite to granodiorite and an equigranular biotite monzogranite. The eastern third of the batholith is predominantly a leucocratic biotite-muscovite granite. Biotite-muscovite pegmatite and aplite dikes cut all the phases (Logan this volume).

South of the main Baldy batholith, between East Barriere and Adams Lake, is an irregular body comprised of hornblende porphyry monzodiorite, biotite-hornblende-epidote quartz monzonite, biotite granite and quartz monzodiorite. It has irregular contacts and intrudes Devono-Mississippian orthogneiss, micaceous quartzite, grit, mica schist, gneissic units containing sillimanite, staurolite, biotite and hornblende assemblages, calc-silicate gneisses and rusty-weathering migmatites (Schiarizza and Preto, 1987; Logan and Mann, 2000a). The southeastern-most apophysis, named the Honeymoon Bay stock (Logan and Mann, 2000a), is comprised mainly of biotite quartz monzodiorite with sparse potassium feldspar megacrysts. Petrographic work by Logan (this volume) suggests that the Honeymoon stock formed at high pressure (>8 kbars) under fairly oxidizing conditions, based on the mineral assemblage epidote, quartz, plagioclase, potassium feldspar, hornblende, biotite, sphene and magnetite.

Cam-Gloria (Honeymoon)

The Cam-Gloria gold prospect (MINFILE 82M 266) is located three kilometres west of Adams Lake (Figure 1). The property was staked by prospector Camille Berubé in spring, 1997 following his discovery of a large auriferous quartz vein on a logging road (Cathro, 1998; Lett *et. al*, 1998). He was following up a British Columbia government till geochemical release by Bobrowsky *et. al* (1997) which showed two sample sites with 215 and 43 ppb gold values, located approximately 300 metres northeast and 1200 metres east of Cam-Gloria, respectively. Berubé optioned the property to Teck Corporation in early 1999. During the summer, Teck staff completed surface mapping, geophysics and excavator trenching. They also drilled 7 holes totaling 835.9 metres in the fall.

The main quartz vein is up to 7.3 metres in width, but locally pinches out or is missing. It occurs within a 35 to 40 metre wide zone of alteration, quartz veining, quartz breccia and minor fault gouge. This zone strikes for 700 metres northeasterly (025 to 045 degrees) and dips steeply northwest (45 to 70 degrees). Drilling has shown that two to three additional large quartz veins (>1 metre wide) also occur within the zone. Subparallel (possibly sheeted) quartz veinlets up to 10 centimetres wide have been encountered over a width of 20 metres in the footwall of the main vein in one drillhole. A second, parallel alteration zone with a narrow quartz vein has been discovered by trenching in one location about 100 metres northwest of the main zone (Randy Farmer, personal communication, 1999). Weak to moderate, pervasive sericite and clay alteration has affected feldspar and mafic minerals in the host quartz monzodiorite. In addition, some veins have narrow (2-5 cm) biotite and k-spar selvages.

The veins typically contain 1 to 5 percent, coarse-grained sulphides, comprising mainly pyrite and pyrrhotite with traces of galena, chalcopyrite, sphalerite and arsenopyrite (Photo 1). Pegmatitic quartz and

Photo 1 Drill core from Hole CG 99-01, Main vein, Cam-Gloria prospect. The grey and white banded material at 44.8 metres is brecciated quartz and fine grained sulphides at the upper (hangingwall) contact. Coarse-grained white quartz is below and sericitized quartz monzodiorite is above.

TABLE 1
SELECTED GEOCHEMICAL ANALYSES OF GOLD, BISMUTH AND TUNGSTEN PROSPECTS IN SOUTH CENTRAL BRITISH COLUMBIA

Property	Showing	Sample #	Au	Ag	As	Bi	Co	Cu	Mo	Ni	Pb	Sb	Se	Te	W	Zn	Comments
Cam-Gloria	Main vein	97RL33	1112	8.6	27.4	55	3	113	11.6	5	420	3.7	<0.3	3.5	n/a	27.1	Grab by R. Lett, GSB; Au by INA; qtz with po, py
	Main vein	CAM-1	3746	61.4	87	56	<2	17	<2	<2	191	<5	n/a	n/a	8	18	Grab by T. Höy, GSB; Au by INA; qtz with po, py
	Main vein	C98-093	10	1.2	31	123	76	794	33	36	60	1.8	0.6	4.1	86	20	Grab; qtz with po, py
Lucky Bear	Water Tank	C99-052	<5	0.2	<5	205	14	30	24	23	18	10	n/a	1.2	4368	1515	Grab; float; garnet-bt-trem-qtz skarn with 1% scheelite
	Little Creek	C99-059	20	<0.2	<5	5	7	18	2	7	6	<5	n/a	0.8	<1	237	Chip; 0-2 m; sheeted qtz vns in gd; trace po and scheelite
	Little Creek	C99-060	20	<0.2	<5	<5	6	22	3	6	6	<5	n/a	1.3	8	95	Chip; 2-4 m; sheeted qtz vns in gd; trace po and scheelite
	Little Creek	C99-061	15	<0.2	10	15	8	23	3	9	6	10	n/a	1.8	<1	95	Chip; 4-6 m; sheeted qtz vns in gd; trace po and scheelite
	Little Creek	C99-062	370	<0.2	<5	35	8	22	3	7	8	<5	n/a	2.5	8	87	Chip; 6-8 m; sheeted qtz vns in gd; trace po and scheelite
	Little Creek	C99-063	5	<0.2	5	10	9	25	3	9	8	<5	n/a	1.2	<1	129	Chip; 8-10.25 m; sheeted qtz vns in gd; trace po and scheelite
	Flat Rock	C99-064	10	<0.2	<5	25	1	46	4	3	<2	<5	n/a	0.3	1480	46	Grab; dump; qtz vn with 1-3% po and trace scheelite
E-D 1	Gossan 1	C98-092	3300	6	4	262	63	1146	26	24	<2	1.8	15	3.1	1487	1320	Grab of limonitic po-cpy manto
	Gossan 1	ED-1	3697	8.7	<5	377	74	1348	2	42	14	5	n/a	n/a	54	55	Grab of limonitic po-cpy manto by T. Höy; Au by INA
	Gossan 1	M1F	2340	7	<5	260	48	1105	19	17	<2	<5	n/a	n/a	280*	1537	Grab of limonitic po-cpy manto by R. C. Wells
Goldstrike	#1 (Bizar)	99607	6000	2.2	<2	300	79	4660	5	60	2	<2	n/a	n/a	<10*	24	DDH 99-02, 59.2-59.4 m; 20 cm qtz vn with 2-3% po, 1% cpy, 2% plag, 1% green sericite and trace pink
	#1 (Bizar)	C98-096	11690	2.2	36	769	318	1939	30	292	<2	2	4.8	1.5	62	24	Grab; 5 cm qtz-po-py-cpy vn
	#1 (Bizar)	C98-097	56800	5.4	6	5271	151	3423	13	140	<2	0.6	11.6	11.8	18	16	Grab; 20 cm wide qtz-po-py-cpy vn; concordant with foliation
	#1 (Bizar)	C99-098	570	<0.2	6	70	6	169	2	8	4	0.4	0.4	0.3	<2	8	Grab; micaceous quartzite with trace FeOx on sheeted fractures
	#2	LBR-99-06	110	<0.2	>10000	<2	44	23	10	20	22	24	n/a	n/a	<10*	<2	Grab by L. Lindinger; 25 cm qtz-aspy vn
	#3 (Road)	LBR-99-32	1710	0.6	466	79	28	361	8	54	<2	2	n/a	n/a	<10*	37	Grab by L. Lindinger; float; bt schist with trace-2% qtz, po and cpy
GQ	SW	WP 023R	1580	1.3	3	225	61.1	305	2.4	38.8	n/a	0.1	n/a	11.2	33.6	72	Grab by W. Gruenwald; 10 cm quartz-po-py-cpy vein
	SW	C99-047	5	<0.2	<5	20	18	44	<1	25	16	<5	n/a	1.7	<20	42	Grab; po-bearing qtz-bt schist
	SW	C99-048	1730	1.8	<5	235	50	389	7	24	40	<5	n/a	5.7	<20	45	Grab; 10 cm qtz-po-py-cpy vn
	SE	WP 025R	115	1.85	<1	11.2	126	992	2.8	43.4	n/a	0.1	n/a	1.35	288	106	Grab by W. Gruenwald; qtz-calc-silicate-po vn/lens adjacent to
	SE	WP 029R	6	<0.2	<1	<2	36	390	3	26	n/a	n/a	n/a	<0.5	1210	90	Grab by W. Gruenwald; calc-silicate-po vn/lens adjacent to pegmatite
	SE	C99-045	15	8.4	5	10	13	47	2	22	34	30	n/a	0.3	<20	35	Grab; po-bearing qtz-bt schist
	SE	C99-058	15	<0.2	<5	<5	16	57	17	33	<2	<5	n/a	1.2	37	340	Grab; 10 cm qtz-po layer at contact between pegmatite and gneiss
	NE	WP 032R	1250	2.1	1	91.2	47.4	510	3.4	33.8	n/a	0.2	n/a	7.25	251	126	Grab by W. Gruenwald; 30 cm po-py-qtz vein/lens
	NE	C99-046	1150	4.2	<5	45	73	734	14	45	12	<5	n/a	6.2	70	40	Grab; 30 cm po-py-qtz vein/lens

plagioclase crystals were noted in the main vein in one of the deeper drill hole intersections. Pale green fluorite is present locally in veins in the footwall of the main vein, as well as in some narrow quartz-sulphide veins in road cuts located some 100 to 200 metres east of the Cam-Gloria discovery outcrop. Limited sampling suggests that the latter are apparently gold-poor, although they do contain locally anomalous Bi (to 1380 ppm), Cu (1198 ppm) and W (48 ppm). In addition, float boulders of garnet-pyroxene skarn with traces of pyrrhotite and weakly anomalous Cu and W values have been found on the road about 750 metres northeast of the Main vein.

Surface grab samples of the main vein have returned gold values varying between trace amounts up to 26.66 g/t (Table 1, Camille Berubé, personal communication, 1997). The vein is also moderately anomalous in Ag, Bi, Cu, and Pb and weakly anomalous in As, Mo, Sb, Te, and W. The gold content is highly erratic, but higher values appear to be associated with galena, fine-grained, bluish-grey sulphides, and local, discordant gouge or brecciated zones. The assay results of the drilling program have not been released by Teck Corporation.

Lucky Bear

Prospecting by Camille Berubé and Dave and Len Piggin has located several new small W-Bi-Zn, W and W-Au showings on the Lucky Bear claim group (Figure 1) near East and North Barriere Lakes. The showings occur about seven kilometres northwest of Teck's Cam-Gloria showing, and are within, or adjacent, to the mid-Cretaceous Baldy batholith.

The "Little Creek" W-Au showing (Figure 1, UTM 11 0314393E 5688542N) is hosted by sericite- and biotite-altered granodiorite. Steeply dipping, north-trending, sheeted quartz veinlets range up to 10 centimetres in width in a 10 metre-wide blasted roadcut exposure (Photo 2). The veinlets contain minor sericite and pyrrhotite. Ultraviolet lamping has identified scheelite grains up to 1.5 centimetres long which occur in scattered patches in the veins, and selected samples collected by the owners have returned up to 6.15 % W (D. and L. Piggin, written communication, 1999). One chip sample by the senior author contained 370 ppb Au over 2 metres; otherwise the results were not significant for Au, Bi or W (Table 1).

Photo 2. Sheeted quartz-sericite-pyrrhotite-scheelite veinlets in mid-Cretaceous granodiorite, "Little Creek" showing, Lucky Bear claims.

Approximately 500 metres to the east at the "Flat Rock" W showing is an irregular, half-metre-wide quartz vein with 1-3% pyrrhotite and traces of chalcopyrite and scheelite. The vein is hosted by quartz-feldspar-biotite gneiss, part of the Devonian Orthogneiss (Schiarizza and Preto, 1987). A grab sample of the vein taken by the author ran 1480 ppm W and selected samples taken by the owners ran up to 0.39% W, 80 ppb Au, and 135 ppm Bi (L. and D. Piggin, written communication, 1999).

Scheelite-bearing pegmatite and garnet-tremolite-biotite-quartz skarn boulders ranging from 30 centimetres to 1 metre in diameter are found 2 kilometres to the northeast of the Little Creek showing in the "Water Tank' area (UTM 11 0314806E 5690793N). A grab sample of one of the skarn float boulders returned 0.437 % W, 205 ppm Bi and 1515 ppm Zn (Table 1). Although this mineralization has not yet been found in outcrop, the boulders suggest that skarn and pegmatite-hosted tungsten mineralization is associated with the margin of the Baldy batholith.

E-D 1

The E-D 1 claims, owned by Manto Mining Corporation, are located approximately 500 metres south of the southern contact of the Baldy batholith in the headwaters of Birk Creek (Figure 1). The showings were discovered in 1995 by Wayne Tyner, and have received limited mapping, hand trenching, sampling, and geophysical surveys (Wells, 1998). Three holes were drilled in 1997, but no logs or assays are available.

The mineralization occurs at the contact between a grey limestone unit and an underlying green and pink-banded rock, interpreted to be calc-silicate-altered sediments. Regionally, these rocks are mapped as Mississippian-aged Unit EBPl of the Eagle Bay Assemblage (Schiarizza and Preto, 1987) and the faulted contact with basalt of the Fennell Formation (Slide Mountain Terrane) occurs a few hundred metres to the west. The Gossan 1 and 2 showings consist of stratabound pods of partially oxidized, massive pyrrhotite with lesser pyrite, chalcopyrite and sphalerite (Photo 3). They are up to 2 metres thick and several metres in length and dip moderately to the southwest (Wells, 1998). Three surface grab samples indicates that the sulphides contain significant Au (up to 3300 ppb), Bi (up to 377 ppm), Cu (up to 1348 ppm), Zn (up to 1537 ppm), and W (up to 1487 ppm) values and are also weakly anomalous in Ag, Cd, Mo, Se, and Te (Table 1).

The stratabound sulphide mineralization has the appearance and characteristics of a manto-style deposit. The metal assemblage of Au-Cu-Zn-W-Bi with anomalous Te and Mo, combined with proximity to the Baldy batholith and the presence of weakly calc-silicate altered

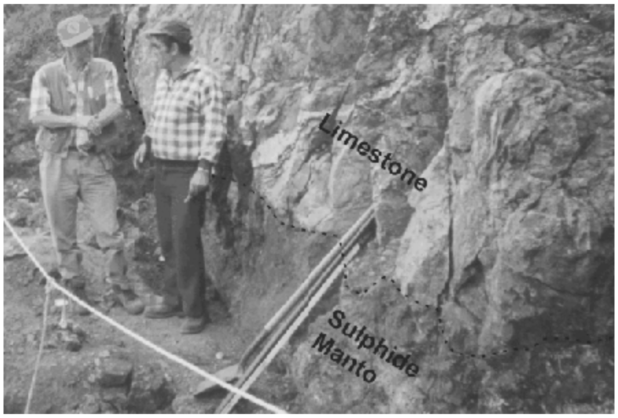

Photo 3. Shallowly west-dipping massive sulphide mineralization containing Au-Cu-Zn-W-Bi at the Gossan 1 showing, E-D 1 claims, Upper Birk Creek area. The mineralization is hosted by Mississippian-aged limestone of the Eagle Bay Assemblage, near the southern contact of the mid-Cretaceous Baldy batholth.

rocks in the footwall suggest that mineralization formed by replacement of limestone adjacent to the batholith.

SHUSWAP AREA OCCURRENCES

Goldstrike (Bizar)

The Goldstrike property is located 16 kilometres northeast of the village of Avola and 2.5 kilometres west of Tumtum Lake in the upper Adams River drainage (Figure 1). Mineralization at the Goldstrike #1 showing (Bizar, MINFILE 82M 267) was discovered and staked by prospector/geologist Leo Lindinger in 1998 and the claims are currently under option to Cassidy Gold Corp. Five short holes were drilled in October, 1999.

The property is underlain by micaceous quartzite and quartz-muscovite-biotite-garnet schist of the Shuswap metamorphic complex (Unit 1c of Campbell, 1963). The foliation in the schist is subvertical and strikes northwesterly at the Bizar showing. Orthogneiss of probable Devonian age outcrops approximately 2.5 kilometres northeast and southwest of the showing. Weakly to moderately sericitized, unfoliated granodiorite of probable mid-Cretaceous age occurs approximately 3.5 kilometres southwest of the showing (L. Lindinger, personal communication, 1999). Boulders of pegmatite float are common throughout the area.

At the Goldstrike #1 showing a partially overgrown roadcut exposes a 20 centimetre wide, strongly contorted, quartz-sulphide band which is conformable with the enclosing schist (Photo 4). This layer contains up to 50% sulphides in places, mainly comprising pyrrhotite and pyrite with minor chalcopyrite and traces of silvery grey, acicular bismuthinite(?). Grab samples of this mineralization returned 11.69 to 56.8 g/t Au, 769 to 5270 ppm Bi and 1939 to 3423 ppm Cu, along with anomalous values of Co, Mo, Ni, Se, Te and W (Table 1). Adjacent to the quartz-sulphide land is a 5 by 25 metre zone of stockwork and locally sheeted, limonite-stained quartz veinlets (Photo 5) which has also returned weakly anomalous Au, Bi, and Cu values (Table 1, Sample C98-098). Up to 5 veinlets per metre are locally present and range from <1 to 10 centimetres in width. Their predominant orientations are 360/30E and 300/40NE to 90.

Additional minor showings were discovered in 1999 but have had only limited sampling and exploration to date. Approximately 1.1 kilometres SSE of Goldstrike #1, a 25 centimetre wide, quartz-arsenopyrite vein dipping 65 degrees to the west, occurs in a roadcut and has returned 110 ppb Au and >10,000 ppm As (#2 showing, Table 1, Gruenwald, 1999). Crenulated biotite schist boulders with semi-concordant layers/veins of quartz, pyrrhotite and minor chalcopyrite have been located 1.5 kilometres SSE of the Goldstrike #1 showing. A grab sample of this float returned 1.71 g/t Au, 466 ppm As, 79 ppm Bi and 361 ppm Cu. These showings contain significantly more arsenic than Goldstrike #1 and may represent a different style or phase of mineralization.

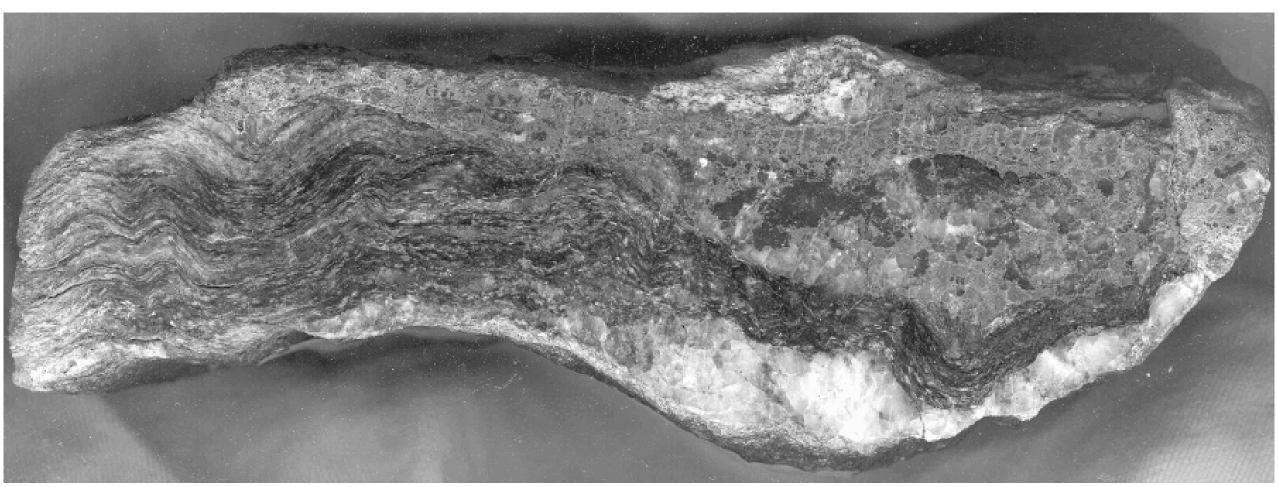

Photo 4. Folded, concordant quartz-pyrrhotite layer with high Au, Bi and Cu values in gneiss, Goldstrike 1 (Bizar) showing.

Photo 5. Goldstrike 1 (Bizar) showing. Sheeted quartz-limonite veins cutting micaceous quartzite of the Shuswap metamorphic complex.

The Goldstrike #1 quartz-sulphide mineralization appears to trend southeasterly for at least 250 metres based on anomalous gold in outcrop, float boulders and soil samples (Gruenwald, 1999). Hole 99-2 was drilled approximately 100 metres southeast of the showing and intersected several narrow, pegmatitic quartz veins with minor sulphides and anomalous Au, Bi and Cu values. The best intersection graded 6 g/t Au over 20 centimetres (Cassidy Gold Corp. news release, December 6, 1999) and comprised a pegmatitic quartz vein with minor pyrrhotite, plagioclase and green sericite and traces of chalcopyrite and pink garnet.

GQ (Second Creek)

Several new pegmatite-related Au-W-Cu-Bi occurrences were discovered northeast of Shuswap Lake in September, 1999 by geologist Warner Gruenwald. He was following up silt samples with anomalous gold values that he had collected during the summer. The showings outcrop on new logging roads in the Second Creek drainage (82M/02), a northwest flowing tributary of the Anstey River. The GQ claims were staked in fall 1999 to cover the area.

Quartz-sulphide zones have been located in outcrop over an area of about 1.5 by 1.5 kilometres on the GQ claims, and anomalous gold values have been encountered at the SW, SE and NE showings (Table 1). The mineralization is hosted by garnet-bearing paragneiss, orthogneiss and quartz-mica schist, and lesser calc-silicate rock, marble and amphibolite of the Shuswap metamorphic complex (Wheeler, 1965). These high-grade metamorphic rocks occur in the hangingwall of the Monashee décollement, to the west of the Frenchman's Cap gneiss dome, part of the Monashee complex (McMillan, 1973). Massive to foliated, granitic intrusive rocks of the mid-Cretaceous Long Ridge pluton (92-94 Ma, U-Pb, Parrish, 1995) occur a few hundred metres to the west of the SW showing. The schist/gneiss package is also intruded by abundant pegmatite dikes, some of which contain tourmaline and minor pyrrhotite.

Mineralization consists of 10 to 30 centimetre wide lenses of quartz, calc-silicate and sulphides which occur along the margins of conformable or slightly discordant, locally tourmaline-bearing pegmatite sills, where they are in contact with marble or schist. Sulphide content ranges from a few percent up to 20-30% in semi-massive pods, consisting mainly of pyrrhotite, minor pyrite and traces of chalcopyrite and scheelite. In all cases, the mineralization has an unusual granular texture with euhedral hexagonal to rounded apatite(?) and quartz grains surrounded by sulphides (Photo 6). In addition to gold values ranging from 115 ppb to 1.73 g/t Au, many of the grab samples from the showings have anomalous geochemical values for Bi (20 to 235 ppm), Cu (305 to 734 ppm), Te (5.7 to 11.2 ppm), and W (33.6 to 1210 ppm).

It is interesting to note that the government Regional Geochemical Survey (RGS) had no sample sites in the Second Creek drainage, and that those few samples in the general GQ property area showed low gold values. Nevertheless, Gruenwald's detailed stream sediment sampling in this area identified several anomalous drainages, including one very strong Au, W, Bi anomaly in a drainage where no mineralization has yet been found. This case highlights the problem in relying on widely spaced government RGS data for gold exploration, and demonstrates the effectiveness of detailed stream sediment sampling and roadcut prospecting.

NELSON-SALMO AREA OCCURRENCES

There are a wide variety of mineral deposits and occurrences and mid-Cretaceous and Middle Jurassic intrusions in the West Kootenays region. An evaluation of British Columbia for the potential for intrusive-related, gold-tungsten-bismuth quartz veins (Lefebure *et al.*, 1999) identified several prospective areas in the

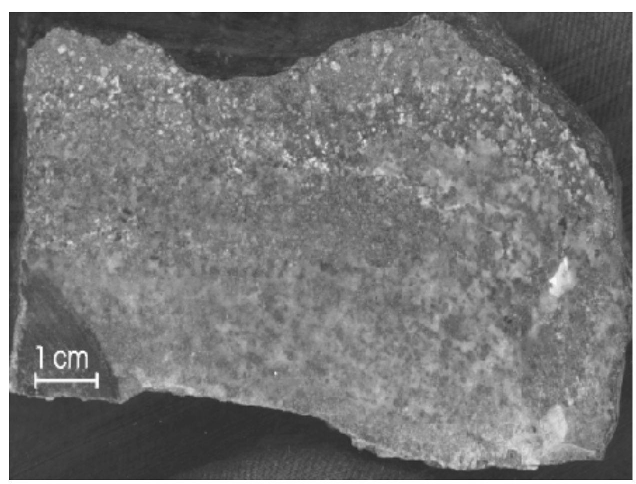

Photo 6. Auriferous quartz-sulphide layer with anomalous Bi, Cu, Te and W from the SW showing, GQ claims. Note granular texture with euhedral hexagonal to rounded apatite(?) and quartz grains surrounded by "net-textured" pyrrhotite.

TABLE 2
POSSIBLE PLUTONIC-RELATED GOLD OCCURRENCES IN THE NELSON-SALMO AREA

Name	Status	Commodities
ALPINE GOLD	Past Producer	Au, Ag, Pb, Zn, Mo, W
VALPARAISO	Past Producer	Zn, Pb, W, Au, Ag, Cu
GOLD BASIN	Prospect	Pb, Cu, W, Au, Ag
SARAH 2ND	Past Producer	Ag, Au, Pb, W, Cu, Zn
BUNKER HILL (L.2939)	Past Producer	Au, Ag, W, Mo
EMERALD TUNGSTEN	Past Producer	W, Mo, Bi, Au
DODGER (L.12083)	Past Producer	W, Mo, Au
KOOTENAY BELLE	Past Producer	Au, Ag, Pb, Zn, W
KENVILLE	Past Producer	Ag, Au, Pb, Zn, Cu ,Cd
VENANGO (L.4757)	Past Producer	Au, Ag, Pb, Zn, W
ROYAL CANADIAN (L.633)	Past Producer	Au, Ag, Zn, Pb, W
ATHABASCA (L.1569)	Past Producer	Au, Ag, Pb, Zn, Cu, W

Kootenays, including the Salmo Mining Camp, Bayonne batholith and parts of the Nelson batholith. The same study identified a number of occurrences in the region with some of the characteristics of plutonic-related gold deposits (Table 2).

In drawing comparisons to the Tintina Gold Belt in Yukon and Alaska, the most promising targets are the Cretaceous granitic intrusions, such as the Bayonne batholith and the Wallack, Lost Creek, Salmo and other smaller stocks in the Salmo mining camp. Initial investigations of the Bayonne batholith by Logan (this volume) and Lett and Jackaman (this volume) have produced more evidence for plutonic-related gold mineralization associated with particular phases. In the Salmo mining camp at the southern end of the Kootenay Arc, bismuth-gold zones near the mid-Cretaceous stocks have been identified and are described in the following section.

Other plutonic-related gold occurrences identified by Lefebure *et al.* (1999) are associated with phases of the Middle Jurassic Nelson batholith. One of these, the Rozan (Figure 2), is also discussed below.

Bismuth-Gold Zone (Jersey Emerald Property)

Lead-zinc-silver, tungsten and gold mineralization occurs on the Jersey Emerald property which is located approximately 10 kilometres south of Salmo (Figure 2). The first claims on the property were staked in 1896 on a high grade gold showing called the Emerald located in the general vicinity of the Emerald tungsten deposit. Subsequent prospecting found lead-rich mineralization in 1906 at the Emerald lead deposit (082FSW310, Figure 3) which produced more than 25 850 tonnes of ore containing 6 788 936 kilograms of lead, 705 292 grams of silver, and 19 771 kilograms of zinc by 1925 (MINFILE). In 1938, skarn tungsten and molybdenum mineralization was discovered in the area of original staking for gold. This became the Emerald tungsten mine which was operated by a Federal Government Agency from 1942 until 1944 and from 1947 until 1958 by Canadian Exploration Ltd. The Emerald deposit (082FSW010) provided the majority of the ore (about 74 %) with the rest coming from the Feeney (082FSW247), Invincible (082FSW218) and Dodger (082FSW011) deposits. Aggregate production totaled 1.45 million tonnes of ore grading 0.76 % WO_3 (Troup, 1994). Canadian Exploration Ltd. discovered the Jersey zinc-lead deposit (082FSW009) and mined it from 1949 to 1970. It produced 7.23 million tonnes grading 1.95% Pb and 3.83% Zn with minor silver (Troup, 1994).

The oldest rocks on the property are micaceous quartzites and quartzites of the Cambrian Reno Formation which outcrop southeast of the Jersey mine (Fyles and Hewlett, 1959). Most of the Jersey Emerald property is underlain by sedimentary rocks of the Cambrian Laib Formation which conformably overlies the Reno Formation and has been subdivided into Lower and Upper parts by Fyles and Hewlett (1959). The Lower Laib is composed of three members - the Truman, Reeves and Emerald, while the Upper Laib is not subdivided because it lacks well-defined marker beds. It consists of green phyllite and micaceous quartzite with minor beds of argillaceous limestone. The Truman Member is a sequence of phyllite, argillite and minor limestone which is primarily brown argillites on the property. The Reeves Member consists of the calcareous rocks, typically grey and white or black and white, fine to medium-grained limestone. It has gradational contacts with the bounding units so the basal contact is defined as the uppermost argillite or phyllite of the Truman Member, while the upper contact is placed at the lowest argillaceous bed of the overlying Emerald Member. The limestone is locally altered to dolomite which is believed to be due to epigenetic replacement associated with Pb-Zn mineralization (Fyles and Hewlett, 1959). Black argillites and phyllites make up the Emerald Member. On the eastern side of the property, the Ordovician Active Formation outcrops as black argillite and slate with minor limestone and dolomite. The sedimentary units have been complexly deformed; Fyles and Hewlett (1959) have identified three phases of folding and thrust and high-angle faults. The principle structure on the property is a north-northeast trending anticline called the Jersey anticline (Figure 3) which has complex recumbent isoclinal folding and thrust faulting (Thompson, 1974).

The layered units are cut by the informally named Dodger and Emerald biotite granite stocks of mid-Cretaceous age. The granitic stocks are coarse to medium grained and cut by aplite or felsite dykes. Pegmatite occurs as small patches (< 0.5 m) in some places in the granite; the Dodger stock has a 4 by 5 metre quartz pegmatite outcrop exposed at the south end of the stock, near the north adit. A potassium-argon biotite age from the Dodger stock yielded 100.0 +/- 3.0 Ma (Dandy, 1997). Underground workings and drillholes show the Dodger and Emerald stocks are joined at depth (Lawrence, 1997). Other intrusive phases are a two-mica granite of possible Cretaceous age that outcrops near the Jersey open pits and Tertiary augite monzonite stocks of the Coryell suite (Figure 3).

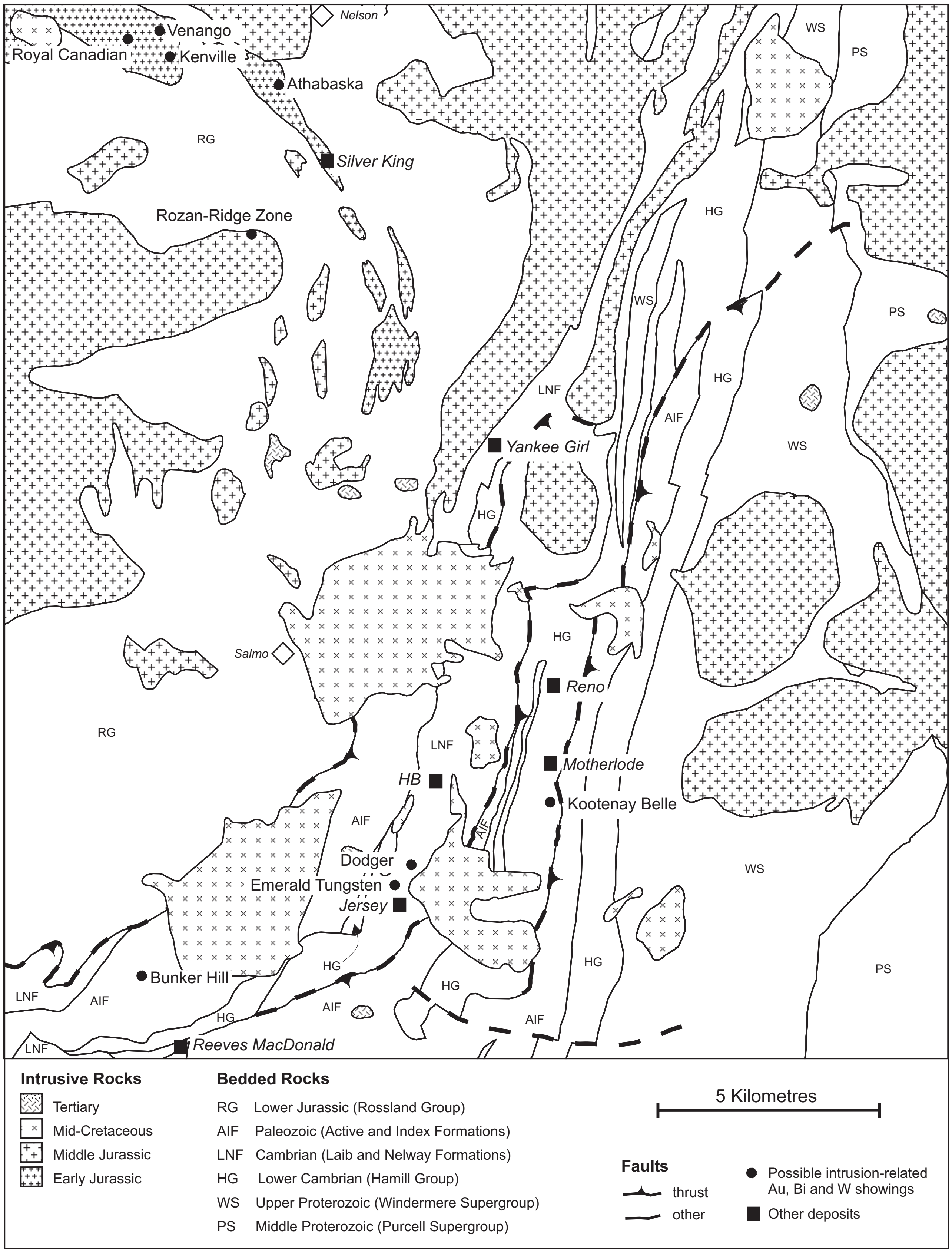

Figure 2. Generalized geology of the Nelson-Salmo area (modified after Wheeler and McFeely, 1991 and Höy and Andrew, 1989b) showing locations of intrusion-related gold prospects and granitoid intrusions.

On the Jersey Emerald property the lead-zinc, tungsten and gold mineralization are hosted largely by calcareous rocks of the Laib Formation. The Jersey lead-zinc deposit has generally been interpreted as either syngenetic sedex (Höy, 1982) and/or Irish-type replacement mineralization (Nelson, 1991), although Dawson (1996) believes it is a distal lead-zinc skarn related to the tungsten skarns. The ore occurs as five bands hosted by dolomitic limestone near the base of the Reeves Member. Dolomitic Reeves limestone also hosts similar base metal deposits, including the HB to the north and Reeves MacDonald to the south (Fyles and Hewlett, 1959) which have no associated skarns. The tungsten skarn mineralization at Jersey Emerald occurs as disseminated scheelite with small amounts of powellite, rare wolframite and scattered flakes of molybdenite (Rennie and Smith, 1957; Fyles and Hewlett, 1959) replacing both Reeves Member limestone immediately adjacent to the granite stocks (*e.g.* Emerald, Feeney, Invincible and Dodger 4400 orebodies), or as replacement zones in limy argillite of the Truman Member close to the intrusions (*e.g.* East Dodger; Lawrence, 1997). Typically the skarn is a green and brown banded rock containing diopside, garnet and calcite. The skarns are believed to be mid-Cretaceous in age and younger than lead-zinc mineralization (Thompson, 1974). The Bismuth Gold, Emerald and Leroy gold zones occur near, or at, the base of the Reeves limestone. Both the Bismuth Gold and Emerald zones are found within tens of metres of tungsten skarns and mid-Cretaceous intrusions (Dandy, 1997).

Canadian Exploration Ltd., while drilling off the Jersey lead-zinc deposit in the 1940s and 1950s, intersected a pyrrhotite-rich zone in several holes overlying the lead-zinc mineralization (George Cross News Letter No.27, February 7, 1997). The zone had a low base-metal content and was not followed-up at that time, although in 1994 it was recognized to be part of the Bismuth Gold zone (Sultan Minerals Inc. Annual Report, 1995). In 1963, Canadian Exploration Ltd. assayed four samples from a native bismuth-arsenopyrite zone. These contained up to 3.4 g/t Au (Troup, 1994); however, they did not follow this up because of low gold prices. In 1983 Lloyd Addie and Bob Bourdon, both of Nelson, panned fine particles of free gold from the tungsten tailings and eventually identified three parallel gold-bearing zones over the Dodger, Emerald and Leroy occurrences (Figure 3; Troup, 1994). Sultan Minerals Inc. optioned the property in late 1993. Since that time they have investigated both the gold and base metal potential of the property with a combination of surface exploration and drilling. The following description of the Bismuth Gold and Leroy-Tungsten Gold zones is based largely on work by staff of Sultan Minerals Inc.

The Bismuth Gold Zone is located on the east side of the Jersey anticline and immediately east of the underground workings of the Jersey lead-zinc deposit (Figure 3). The mineralization is at the contact between the limestone and dolomite of the Reeves Member and is not exposed on surface. The zone varies from 1.2 to 18.0 metres thick and averages approximately 75 metres in width, although it can be up to 200 metres wide (Linda Dandy, personal communication, 1999). It roughly parallels and overlies part of the east limb of the Jersey lead-zinc orebody (Figure 4).

The Bismuth Gold zone contains pyrrhotite, arsenopyrite, quartz, native bismuth and stibnite (Troup, 1994) It is exposed in the Jersey mine workingsnear the east end of the Dodger cross cut (Figure 3). Two grab samples from underground exposures returned assays of 3.43 and 5.49 g/t Au across 4.0 and 1.0 metres respectively with 0.26% and 0.14% tungsten (Troup, 1994). Two drill holes in 1996 by Sultan Minerals Inc. intersected a pyrrhotitic horizon up to 9 metres thick with gold grades ranging from 2.0 to 8.3 g/t Au, including intersections of 2.0 metres grading 8.33 g/t Au and 3.0 g/t Ag in DDH G96-5 and 9.4 metres grading 3.23 g/t Au and 22.9 g/t Ag in underground drillhole 1-96 (Sultan Minerals Inc. press releases, October 10, 1996 and January 10, 1997). Sultan Minerals Inc. traced the zone in four drill holes for a distance of 200 metres, and correlate it with Canadian Exploration Ltd. drill intersections which would extend it another 1100 metres to the south (Dandy, 1997).

Pyrrhotite is typically the most abundant sulphide in the Bismuth Gold zone, however, there are areas where arsenopyrite and bismuth minerals are more common, including several underground exposures in the Jersey mine. There is no visible gold in the zone; no petrographic work has been done to identify the location of the gold. Microprobe analyses of the pyrrhotite, arsenopyrite and quartz mineralization from the Bismuth Gold zone from site A by Ray and Webster (page 60, 1997) identified other minor to trace minerals, including Mg-rich sideritic carbonate, bismuth tellurides (tetradymite, pilsenite and joesite-B), bismuthinite and bismuth selenides. Their analyses also showed that the mineralization is anomalous for Ag, Cu, As, Sb, Bi, Te, Se and Be (Table 3).

On the west limb of the Jersey anticline, Sultan Minerals Inc. has defined two other gold zones, called the Emerald and Leroy (Figure 3). The Emerald zone is coincident with the Emerald Tungsten skarn deposit workings, although the gold mineralization is a separate body. The horizon may be represented by bismuth-rich sulphides (site B, Table 3) and/or a quartz zone hosted by argillite in the south end of the Emerald open pit. The latter grades 5.39 g/t Au and 22 g/t Ag over a 1 metre width (Linda Dandy, personal communication, 1999). It is believed that the same zone is exposed as 1 to 2 metre wide, massive pyrrhotite band in trenches and old pits which follow the Reeves limestone and Emerald argillite contact for over 300 metres south of the open pit (Dandy, 1996). It was also intersected in two drill holes located 300 and 600 metres south of the Emerald pit; the latter hole intersected 0.9 metres grading 27.3 g/t Au and 34.4 g/t Ag (October 10, 1996 press release).

The Leroy zone is exposed in a series of old trenches and crosscut by a short adit. It consists of a quartz band, sometimes with marginal pyrrhotite and minor pyrite mineralization, that is well exposed on surface for 250 metres and may correlate with exposures in pits extending another 450 metres (Dandy, 1996). The quartz/pyrrhotite

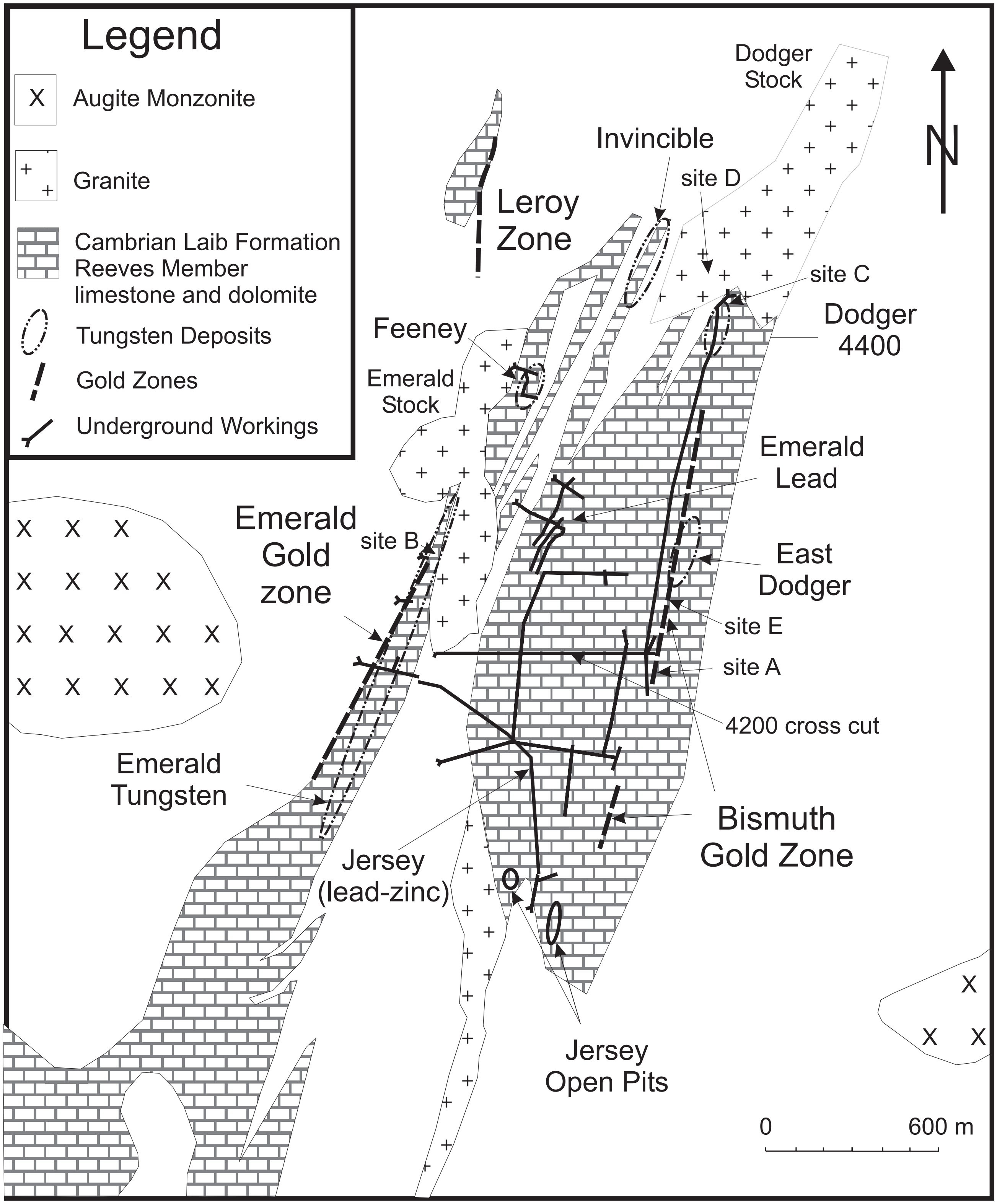

Figure 3. Mineral occurrences of the Jersey Emerald property (derived from Fyles and Hewlett, 1959 and Webster, Ray and Pettipas, 1992).

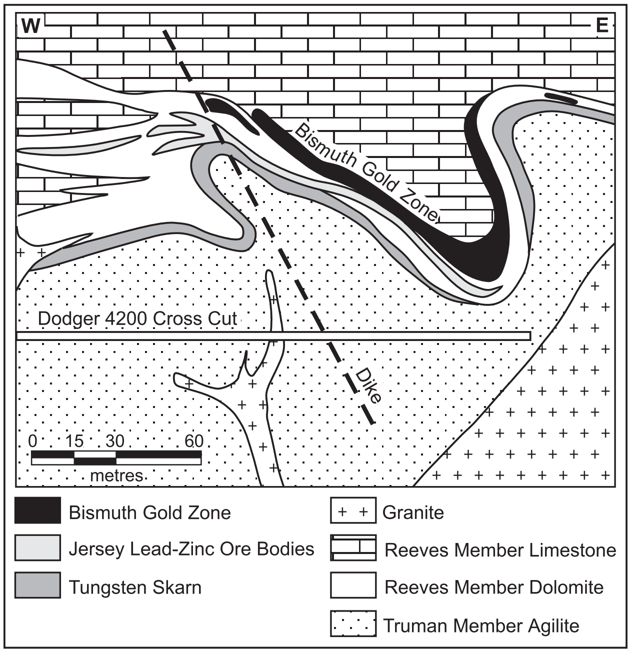

Figure 4. Schematic cross section of the Bismuth Gold zone near the Dodger 4200 crosscut (from Sultan Minerals Inc. 1995 annual report).

band is at the contact between the Reeves limestone and Emerald argillite, the same stratigraphic position as the Emerald gold zone. There are no intrusive rocks or skarn exposed in the immediate area. The quartz band is generally about one metre wide, although locally it is up to 3 metres, with generally less than a couple of percent of arsenopyrite. The veins contain native bismuth which correlates with the best gold values in the quartz (Dandy, 1996). Sulphides can occur over widths of up to a metre on either, or both margins, of the quartz band. Grab sample assays from the Leroy Zone vary from below detection limits up to 30.8 g/t Au and 9256 ppm Bi (Dandy, 1996). A two metre chip sample along the wall of the adit of both host rock and pyrite and pyrrhotite with quartz stringers from the Leroy zone, contained 0.37 g/t Au, 7.4 g/t Ag, 106 ppm Cu, 163 ppm Bi and 100 ppm W (Dandy, 1997).

The importance of stratigraphic position in determining the location of the gold mineralization has been noted by Troup (1994). The two favourable horizons occur in the basal Reeves limestone (Bismuth Gold zone) or at the Reeves limestone and overlying Emerald argillite contact (Emerald and Leroy zones).

More work needs to be done to properly define the characteristics of the three gold zones on the Jersey Emerald property. Obvious common features are:

TABLE 3
SELECTED GEOCHEMICAL ANALYSES OF GOLD-BISMUTH PROSPECTS IN THE NELSON-SALMO AREA, BRITISH COLUMBIA

Property	Showing	Sample #	Au	Ag	As	Bi	Co	Cu	Mo	Ni	Pb	Sb	Se	Te	W	Zn	Comments
Rozan	Ridge Zone	PD-55131	3100	1.4	1.9	14.2	3	18.1	1.9	2	8.7	0.2	1	11.3	40*	10.3	Phelps Dodge sample, Ridge zone
		PD-55132	253	2.5	4.5	4.2	12	29.5	204	4	16.9	<1	<1.5	1.5	9*	3.4	Phelps Dodge sample, Ridge zone
		DVL98-126	305	0.6	1.4	23.5	6	80	80	10	<2	0.2	0.2	21.1	2*	<1	Grab; moly and py on fracture in qtz vn from Main vein dump, Site A, Fig.
		DVL98-127	15	<0.2	1.7	0.4	7	2	2	7	6	0.2	0.2	0.2	5	13	Grab; pegmatitic qtz veinlet (80%) cutting granodiorite (20%), Site B,
		DVL98-128	5	<0.2	0.9	0.2	4	2	2	8	4	0.1	0.1	<0.2	<2	37	Grab; bt qtz diorite with scattered qtz pheno's up to 1 cm, Site C, Fig. 5
		DVL98-129	5	<0.2	1.7	0.1	5	6	6	10	<2	0.1	0.1	<0.2	<2	7	Grab by D. Lefebure; laminated 2 cm qtz vn - 5-10% dilution, Site D, Fig. 5
		DVL98-130	10	<0.2	2.8	0.6	6	3	3	8	4	0.8	0.8	<0.2	<2	15	Grab; sheeted white qtz vns, up to 3 cm wide, trace py, Site D, Fig. 5
		DVL98-131	5	<0.2	1.8	0.3	10	2	2	8	6	0.2	0.2	<0.2	<2	40	Grab; sheeted qtz veinlets, Site D, Fig. 5
Jersey Emerald	Emerald Gold?	GR94-170	3510	4.7	250	823	200	838	55	52	6	7.3	0.1	25	8100	45	Grab, collected by G. Ray, bismuth-rich sulphides, Site B, Fig. 3
	Bismuth Gold	GR94-171	2390	18.1	310	658	11	259	2	16	79	76	2.4	19	8	38	Grab; G. Ray, aspy-po-bismuthinite sample, underground, Site A, Fig. 3
		GR94-172	7630	43.2	160000	2159	45	22	2	9	459	520	12.8	0.3	10	26	Grab; G. Ray, aspy-quartz zone underground, Site A, Fig. 3
		GR94-173	9820	467	140000	9362	110	62	7	12	1651	740	24	6.7	10	45	Grab; G. Ray, aspy-quartz zone underground, Site A, Fig. 3
	Dodger 4400	IWE91-59	1380	19	17800	5	140	720	10	27	51	185	11	14	820	45	Grab; I. Webster, massive po-aspy, portal, Dodger 4400 adit, Site C, Fig.
		DVL98-138	10	0.4	42.9	2.8	2	5	10	23	4	0.3	0.1	0.2	<2	6	Grab; on road; 10 cm qtz vn with vugs, Site D, Fig. 3
	East Dodger	DVL98-136	10	<0.2	12.6	1.5	2	5	1190	11	4	0.7	0.2	0.2	<2	<1	Grab; qtz vn with py, moly; 140' on Dodger ramp, Site E, Fig. 3
		DVL98-137	855	2.6	9910	15.2	10	12	23	8	152	25.3	0.1	0.2	2	799	Grab; py in white quartz vein, 52' on Dodger Ramp, Site E, Fig. 3

Notes:
All values in ppm except Au in ppb
Samples collected by authors unless otherwise noted
All elements by ICP except Au (fire assay with AA finish), unless otherwise noted. GR and IWE samples - Au, As and W by neutron activation, Se and Te by hydride AAS
W by total digestion/ICP except: * by aqua regia (partial) digestion/ICP
n/a not available

- a generally conformable nature with stratigraphy;
- an association with contacts with Reeves Member limestone;
- absence of faults and shears controlling ore lenses;
- the presence of pyrrhotite and arsenopyrite with bismuth minerals (usually native bismuth);
- the existence of both sulphide and quartz-rich zones that appear to grade from one to the other along strike;
- generally similar mineralogy and geochemistry to sulphide-rich tungsten skarn mineralization, although certain minerals and elements are restricted to one style;
- unpredictable anomalous gold values, unless bismuth minerals are present; and
- anomalous bismuth, antimony, arsenic, copper, molybdenum, silver, tellurium and tungsten values.

These features and the close spatial association of the Bismuth Gold and Emerald gold zones with granitic intrusives and tungsten skarns have led Sultan Minerals Inc. staff and Ray and Webster (1997) to interpret the Bismuth Gold zone as skarn-type replacement mineralization. Given the lack of calc-silicate minerals and blanket-like nature of the mineralization, these gold zones could also be called mantos. Mantos are known to occur much further from their related intrusives than skarns, which may explain why the Leroy zone occurs a considerable distance from any known skarn or intrusive. It would also increase the exploration potential of the property distal from intrusions.

The Jersey Emerald property exhibits many of the characteristics of the geological environment of the Tintina Gold Belt in Alaska and the Yukon, including mid-Cretaceous granitic intrusions with associated pegmatites and aplites cutting continental margin host rocks. The presence of tungsten and gold-bismuth replacement zones is a positive metallogenetic indication that the southern Kootenay Arc is prospective for plutonic-related gold-quartz veins similar to deposits found in the Tintina Gold Belt.

Rozan - Ridge Zone

The Rozan property (082FSW179) is located near the summit of Red Mountain, 10 kilometres south-southwest of Nelson (Figure 2). The first claim, called the Golden Eagle, was surveyed on the lower slopes of Red Mountain in 1899. However,serious exploration only began in 1928 when prospector Bill Rozan was attracted to the area because of placer gold in nearby Hall Creek. Rozan searched the mountainside for lode sources of the placer gold for more than 40 years. He started on the lower slopes and eventually discovered several gold-quartz veins, including the Main vein, near the headwaters of Rozan Creek (Figure 5). Following Bill Rozan's death in 1972, Eric Denny of Nelson and Frank Cameron of North Vancouver purchased the property. Since then they have explored the property and optioned it at various times to Harrison Drilling, Hiawatha Resources Inc. and Yukon Revenue Mines Ltd. who completed surface mapping, sampling and trenching on the property (Sevensma, 1988; Craig, 1997).

The region has been mapped by Höy and Andrew (1989a) who show that the area is underlain by argillite and siltstone of the Archibald Formation and andesitic tuff and lapilli tuff of the Elise Formation, both of the Lower Jurassic Rossland Group. These have been intruded by granodiorite and quartz monzonite which is believed to belong to the Middle to Late Jurassic Nelson batholith (Höy and Andrew, 1989b). The biotite granodiorite on the property has sparse quartz and plagioclase phenocrysts up to 1 centimetre in length. It is strongly magnetic and has a pronounced contact metamorphic aureole with disseminated pyrrhotite in hornfelsed sediments that weather a distinctive reddish-brown colour (hence the name Red Mountain). Later minor lamprophyre dykes of probable Cretaceous age (Höy and Andrew, 1989b) cut the property. There are minor aplite, pegmatite and lamprophyre dykes on the property that cut both the Elise Formation tuffs and the granodiorite (Figure 5).

Gold in quartz veins has been the focus of all exploration on the Rozan property. Until recently, the larger solitary quartz veins have attracted the prospecting and development activity. Gold assays and small shipments from the solitary quartz veins vary dramatically from traces to more than 90 grams per tonne gold. The quartz veins have associated minor pyrite and rare visible gold, molybdenum, sphalerite, galena and chalcopyrite. The Main vein, hosted by granodiorite (Figure 5), produced 104 tonnes of hand-selected ore grading 38 g/t Au, 42 g/t Ag, 1.95 % Pb and 1.04 % Zn (MINFILE) between 1928-1958 (Sevensma, 1988). It has been followed for approximately 90 metres underground and is typically 10 to 30 centimetres wide, although it reaches more than a metre in one location (mapping by Santos in Sevensma, 1988). Striking generally north, the Main vein dips from 54 to 70 degrees to the east. A grab sample of quartz from the Main vein dump returned anomalous Au, Bi, Mo, and Te values (Table 3). A number of other solitary quartz veins on the property have been trenched or pitted; although none have produced any ore. The largest is the West vein, located approximately 200 metres west of the Main vein and exposed in several trenches.

The current interest was sparked by the discovery of a more than 1 kilometre-long gold-in-soil anomaly (>30 ppb Au with large areas with >90 ppb Au) with associated anomalous tungsten and copper values (Sevensma, 1988). It extends southeastward from the western boundary of the property along the southern side of Red Mountain and covers most of the area shown in Figure 5, the principle exception being the northeastern corner. Some of the samples within the gold anomaly are also weakly anomalous for bismuth (Jack Denny, personal communication, 1998). Ron Granger of Yukon Revenue Ltd. identified the Ridge zone of auriferous, sheeted quartz veinlets on a ridge near the northeastern limit of the

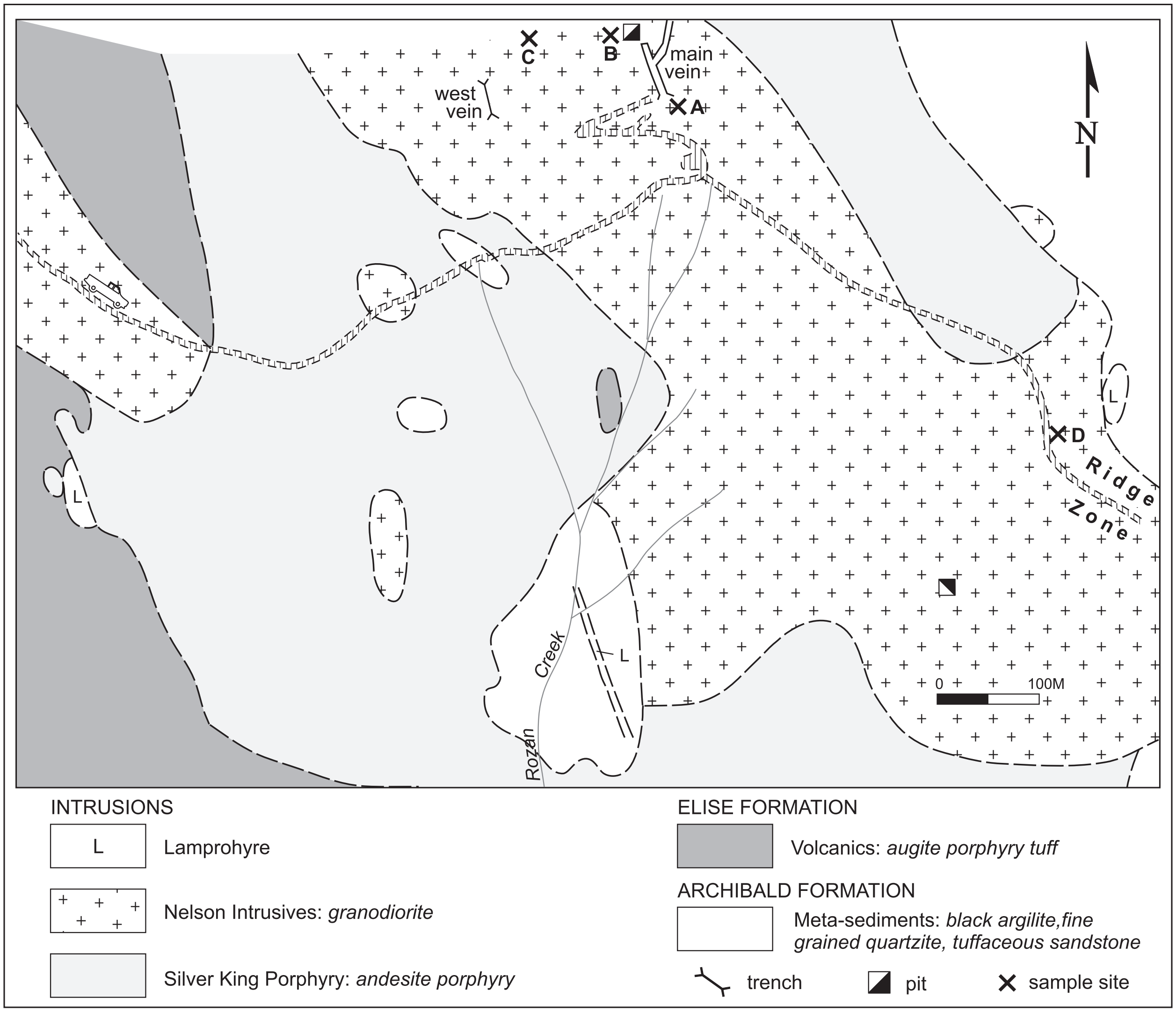

Figure 5. Geology of the central part of the Rozan property (from Sevensma, 1988).

anomaly (along and near the road, southeast of sample site D, Figure 5). Craig (1997) panned three soil samples on the ridge; two showed fine gold dust and small grains of scheelite in two samples. The grey to white veinlets are up to 3 centimetres wide (Photo 7) and generally occur in parallel or sheeted sets with numerous veinlets visible over a 1 to 2 metre wide outcrop. Several sets trend from 140 to 178 degrees with steep dips. There are no obvious wall rock alteration selvages on the veins, although all the feldspars in the granodiorite hosting the veins appear to be weakly altered to clay(?). Trace pyrite grains occur in some veinlets, but not in the host rock. The veinlets are typically featureless, although one quartz veinlet was banded with grey and white quartz.

Seven of twelve samples by collected by Phelps Dodge in 1997 from the Ridge zone carried more than 34 ppb Au and two contained 3604 and 5450 ppb Au with anomalous Bi, Cu and W values (two anomalous samples shown in Table 3). Chip sampling in trench #2, located

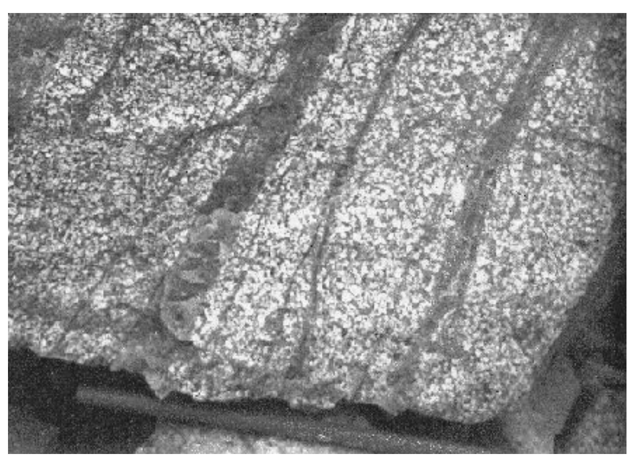

Photo 7. Sheeted quartz veinlets hosted in granodiorite from the Ridge zone of the Rozan property. Field of view is 15 centimetres.

just west of the road along the Ridge zone and approximately 25 metres south of site D, returned 0.93 g/t over 17 metres, including a section with 2.37 g/t Au over 4.5 metres (unpublished report by Yukon Revenue Ltd., Eric Denny, personal communication, 1999). The difficulty in macroscopic identification of auriferous quartz veinlets is shown by sampling at site D. These veinlets appear to be identical to others on the ridge, however, the 3 samples collected here do not contain anomalous Au values (Table 3).

The sheeted auriferous quartz veinlets of the Ridge Zone on the Rozan property look identical to low grade mineralization at the Fort Knox mine in Alaska and Dublin Gulch property in the Yukon. The intrusive host, lack of alteration selvages, low sulphide contents and anomalous Bi, Mo and Te values are consistent with these types of plutonic-related gold deposits.

DISCUSSION AND CONCLUSIONS

Several new showings of gold or tungsten mineralization, with or without associated bismuth, copper, molybdenum, arsenic and tellurium values have been found in southern British Columbia in recent years. In most cases, these showings occur within, or have a close spatial relationship, to mid-Cretaceous intrusive rocks. The exception is the Rozan which is hosted by the Middle Jurassic Nelson batholith. Preliminary work by Logan (this volume) and Logan *et al.* (2000) suggests that some of the mid-Cretaceous intrusions in southern B.C. have broad similarities in age, petrochemistry and depth of emplacement with the prospective Tombstone Plutonic Suite in Alaska-Yukon, which is associated with significant gold deposits such as Fort Knox and Pogo.

The styles of mineralization represented by the new showings include intrusion-hosted solitary veins (Cam-Gloria), intrusion-hosted sheeted veinlets (Rozan, Cam Gloria and Little Creek), skarn (float in "Water Tank" area, Lucky Bear claims), manto? (Bismuth-Gold and E-D 1), and quartz-sulphide layers/veins in upper amphibolite grade metamorphic rocks (Goldstrike and GQ). This array of styles is broadly consistent with proximal to distal portions of plutonic-related gold systems as described by McCoy *et al.* (1997), Thompson *et al.* (1999) and Baker *et al.* (submitted).

The showings described in this paper are mainly gold or tungsten prospects with anomalous values for some or all of the following elements: bismuth, arsenic, copper, molybdenum, lead, zinc and tellurium. The geochemical association of gold with tungsten, bismuth and tellurium in the new B.C. occurrences is a key similarity with the well known deposits in Alaska and Yukon. One important geochemical difference, however, is the relatively high copper content (100 to 1000 ppm) and low arsenic content (<100 ppm) of the B.C. showings relative to the "Tintina Gold Belt" deposits. The exceptions are the arsenopyrite-rich Jersey-Emerald gold occurrences and two minor showings on the Goldstrike property. The genetic significance of this geochemical difference is not understood at this time.

The new discoveries provide useful insights into successful exploration strategies. The importance of using new deposit models to search for gold mineralization on known properties is aptly demonstrated at the Rozan and Jersey Emerald properties. In both cases, continued exploration on well known properties identified new gold zones with many of the characteristics of plutonic-related gold deposits.

In addition, several showings described here were found by conventional prospecting in poorly explored, plutonic and metamorphic terranes. Cam-Gloria was found by follow-up of anomalous gold values in a government till survey, however, several of the other occurences (Goldstrike, GQ, Lucky Bear) were found in areas with no regional geochemical anomalies. This may reflect the poor reliability of gold and tungsten values in silt samples, lack of availability of data for the pathfinder elements bismuth and tellurium, and wide sample spacing and large stream size of conventional government regional geochemical stream sediment surveys. Significantly, the Cam-Gloria and Goldstrike occurrences could have easily been found some time ago as they are both on partially overgrown logging roads.

Conventional grassroots prospecting should focus on locating quartz zones with associated anomalous Au, Bi, Te, W values, in and around mid-Cretaceous plutons, with abundant pegmatite and aplite dikes. Intrusions of Middle Jurassic age (*e.g.* Nelson batholith) also have Au-Bi-W showings (*e.g.* Rozan, Alpine Gold) and should not be ignored. Finally, high-grade metamorphic terranes, such as the Shuswap metamorphic complex, contain multiple ages of intrusive rocks and are under-explored for gold in southern British Columbia. These belts may be worthy of prospecting for deposits similar to multi-million ounce gold, high-grade Liese zone on the Pogo property, Alaska.

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