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BRIDGE RIVER GOLD CAMP

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April 9 1986

Introduction

Bridge River mining camp lies just east of the Coast Plutonic Complex, 180km north of Vancouver and 100km west of Lillooet (Figure 1). It occupies about 300km2 in an area encompassing the Cadwallader and lower Hurley valleys, head of Carpenter Lake, and lower reaches of Gun Creek to Tyaughton Lake (Figure 2). Access is by good gravel road from Lillooet on the Fraser River or by a poor gravel road over the Hurley Pass from Pemberton on Highway 99.

The area has rugged topography and the climate typical of the interior side of the Coast Ranges of British Columbia. Elevations range from 600 - 3000m above sea level with land forms characteristic of alpine glaciation; drift, extensive at lower levels in the valleys, conceals most of the bedrock.

History

Placer gold was found in the Hurley and Cadwallader valleys in 1863 as an outcome of the Fraser gold rush (Barr, 1980). However, it was not until 1897 that the main lode deposits were found, starting with discovery of the hanging-wall split of the main Pioneer vein some 20m above the floor of Cadwallader valley. It was exposed fortuitously by a mud side after heavy rains. In spite of many attempts by various companies, it was not until 1920-1930 that significant underground development took place with the formation of the Pioneer and Lorne companies. Bralorne Mines was formed by the amalgamation of Bradian Mines and Lorne Mines in 1935. The Pioneer mine closed in 1962 soon after its amalgamation to form Bralorne-Pioneer Mines Ltd. Bralorne itself closed in 1971, ironically just before the rise in the price of gold that took place in 1972.

Of the many other prospects in the camp, only eight had recorded production and of these only a few (Congress, Gloria Kitty, Minto, and Wayside) were of significance. Most were active in the 1930-1940 period (Harrop and Sinclair, 1986).

Production from the camp totalled a little over 7 million tonnes of ore grading about 18g/t Au, principally from the Bralorne-Pioneer system. Total recorded production is 130 000kg (4 million oz) of gold and 30 000kg (1 million oz) of silver (Barr, 1980).

Tectonic Setting

The Bridge River terrane (Tipper, 1981) comprises a fault-bounded slice of oceanic rocks sutured between the "super-terranes" of Wrangellia on the west and Stikinia on the east (Monger, 1984). It could represent ocean floor obducted onto Stikinia during the closing of the ocean separating Wrangellia from the contintental margin in the Cretaceous. Or it may be composed of a collapsed back-arc basin (the Bridge River Group : Potter, 1983) thrust onto the continent together with its offshore volcanic arc (the Cadwallader Group of similar age: Rusmore, 1985). The whole

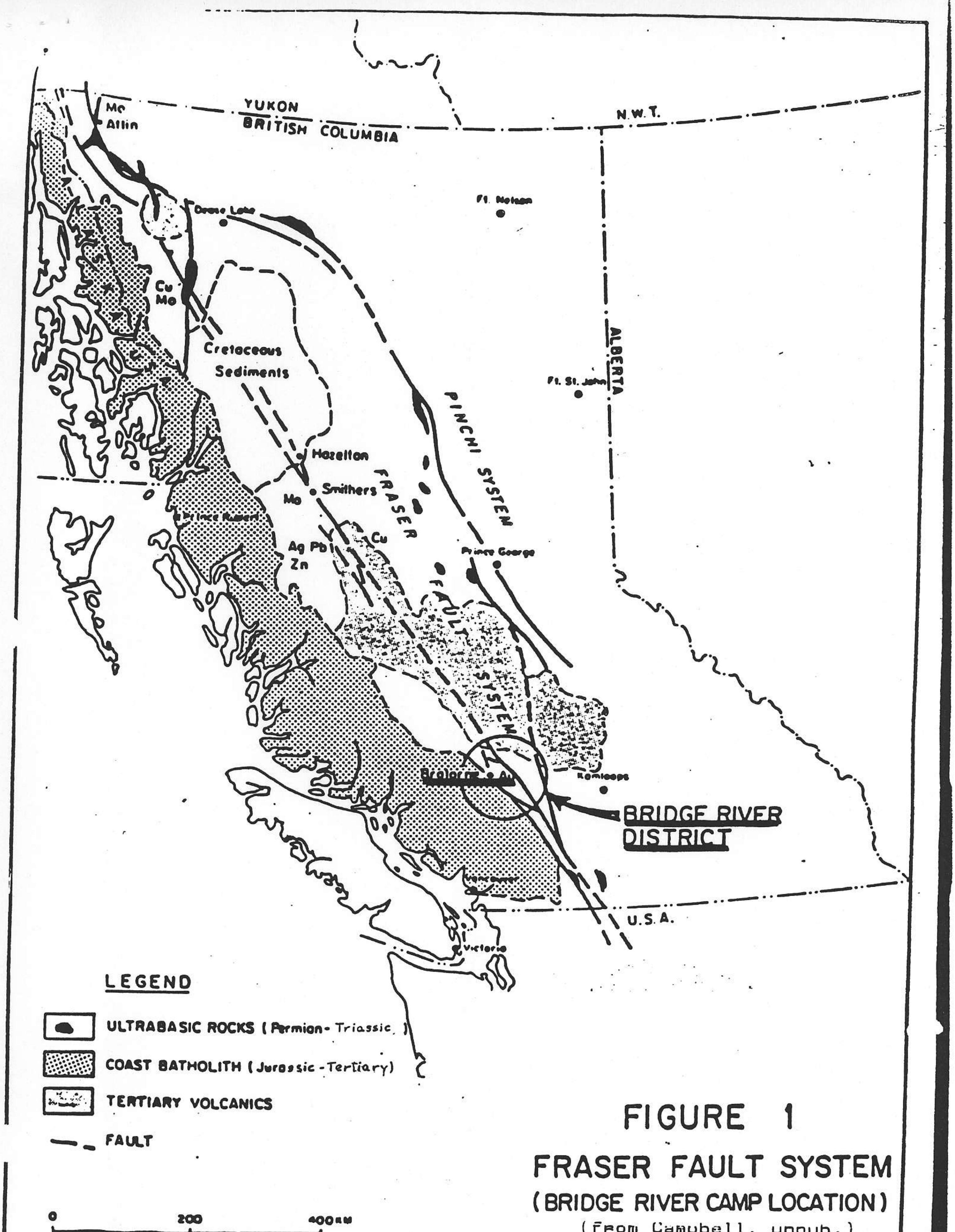
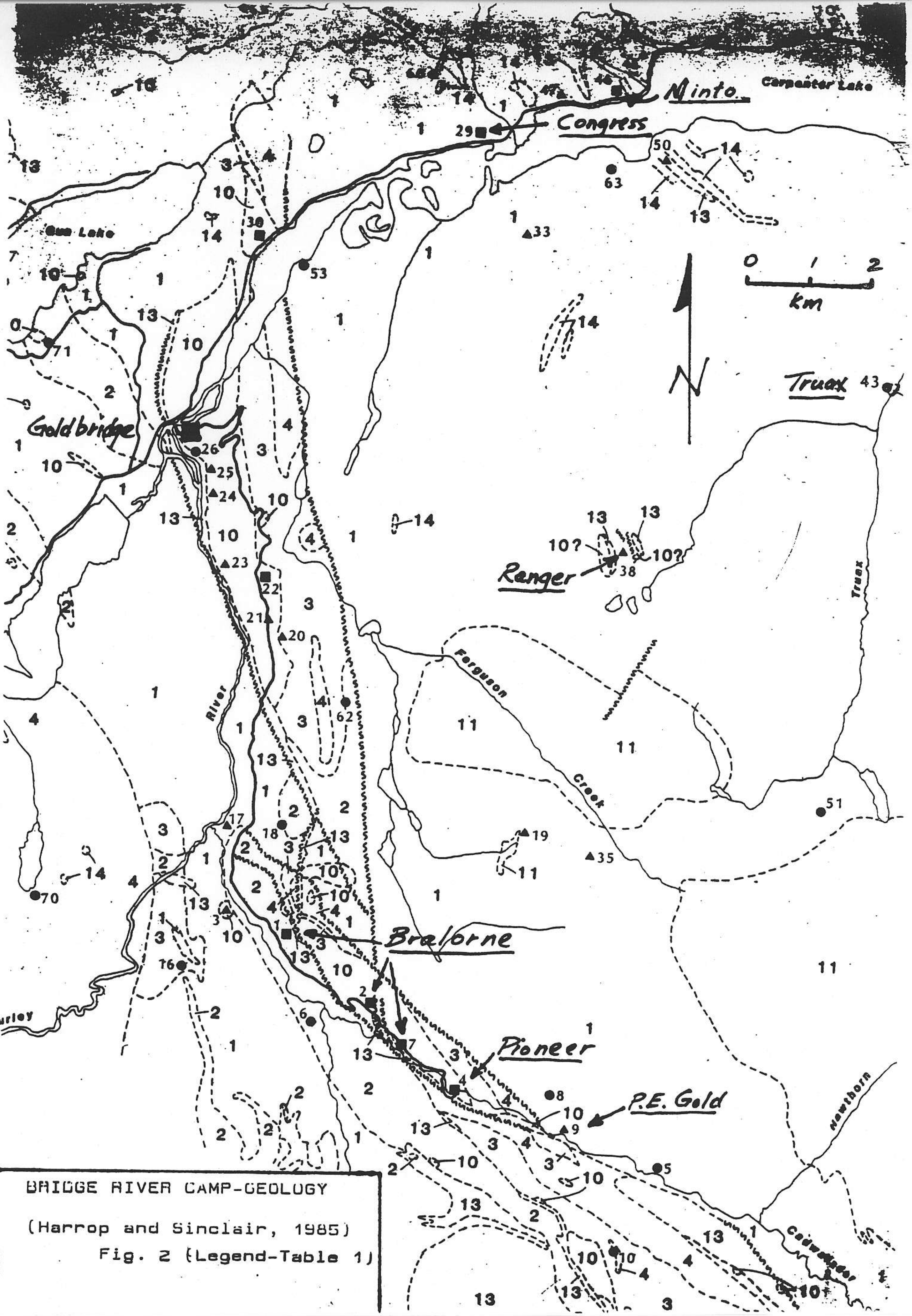


FIGURE 1

FRASER FAULT SYSTEM
(BRIDGE RIVER CAMP LOCATION)

(From Campbell, unpub.)



BRIDGE RIVER CAMP-GEOLOGY

(Harrop and Sinclair, 1985)

Fig. 2 (Legend-Table 1)

may then have been further tectonized during the accretion of Wrangellia to form the "Bridge River Sandwich" (Cooke, 1986). Finally, the Bridge River terrane was probably displaced northward from correlative rocks of the Hozameen terrane (host to the Carolin mesothermal Au deposits) by Tertiary movement on the Fraser strike-slip fault of up to 170km (Figures 1 and 3).

Both the Bralorne and Carolin mesothermal deposits have similarities to the major gold vein camps of the Canadian Shield, several of which produced over 300 000kg (10 million oz) of gold (Bertoni, 1983). The main similarities lie in the presence of oceanic basaltic volcanics and ultramafics, with the deposits lying on major structures and at or near a sedimentary-volcanic contact. The presence of felsic igneous rocks and carbonate (+fuchsite) alteration is also common (Hodgson et al., 1982).

Regional Geology

The latest published geological compilation of the area (92 J) is by Woodsworth (1977) at 1:250 000. Several recent but unpublished regional compilations have been made by Rusmore (1985), Harrop and Sinclair (1985) and Cooke (1984). Table 1 gives the prinoipal units based on compilation of available data by the author; their distribution is shown in Figure 2.

The stratigraphy is dated in only a few places. Mid-Upper Triassic conodonts were found in Bridge River Group linestone lenses in the northern part of the area (Cameron and Monger, 1971) and recently Rusmore (1985) found conodonts of similar age in the Cadwallader Group rocks. Roddick and Hutchinson (1973) considered the Cadwallader to be conformable on the Permo-Triassic Bridge River Group, but Pearson (1975) presents evidence for a middle Jurassic deformation prior to Cadwallader deposition. Rusmore (1985) on the other hand uses Potter's (1983) study with her own to show that both were probably contemporaneous.

So far, all radiometric dates for the Bralorne intrusives associated with mineralization in most of the camp have been by K-Ar only and cluster around the Cretaceous-Tertiary boundary (range 78 - 45Ma), which is the time of the Coast Plutonic Complex. It is possible that U-Pb dating of zircons now in progress will make it possible to see back through the metamorphic veil of the Coast Plutonics to the true age of the local intrusives in the mineralized zone. A U-Pb age on zircons by Rusmore (1985) shows that the main imbrication of rocks within the Bralorne fault zone took place prior to 85Ma. Both Harrop and Sinclair (1986), and Cooke (1986) however considered the Bralorne intrusives to be about 65Ma old.

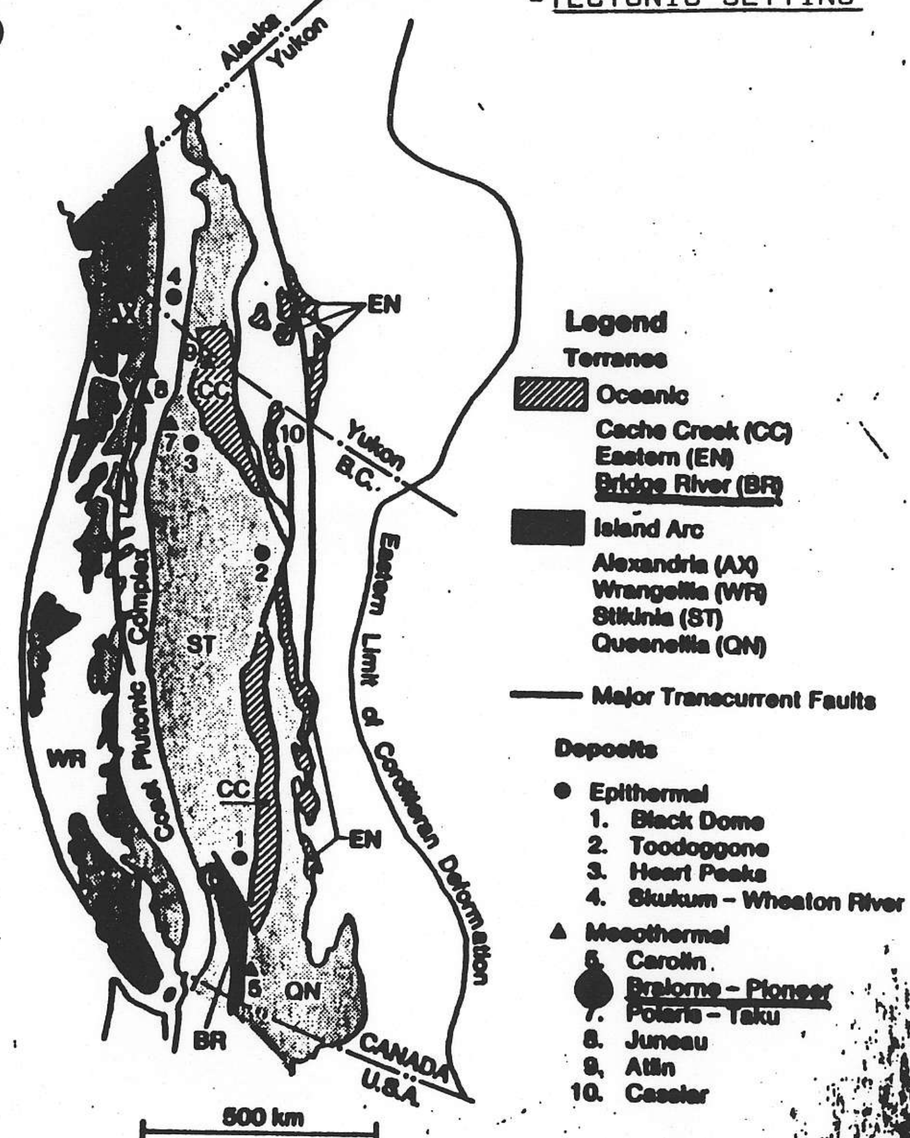
Bralorne Geology

The geology of the camp is best exposed in the extensive underground workings at Bralorne, and is applicable to most deposits in the camp except those to the north, where the Congress, Olympic, Truax, etc. are hosted by Bridge River Group basaltic rocks.

Bralorne diorite makes up the bulk of the elongated stock hosting the vein deposits (figure 4a, from Leitch and Godwin, 1986). Contact relations with the intruded Pioneer "greenstone" (andesites-basalts according to Rusmore's chemical analysis) are complex. Together with compositional and mineralogical similarities, they indicate a comtemporaneous, comagmatic origin for both diorite and volcanmics. Thus the so-called "hybrid diorite-greenstone" was probably formed as a result of high-level

Figure 3: Nesbitt et al., (in press)

-TECTONIC SETTING



-ISOTOPE SIGNATURES OF LODE AU DEPOSITS

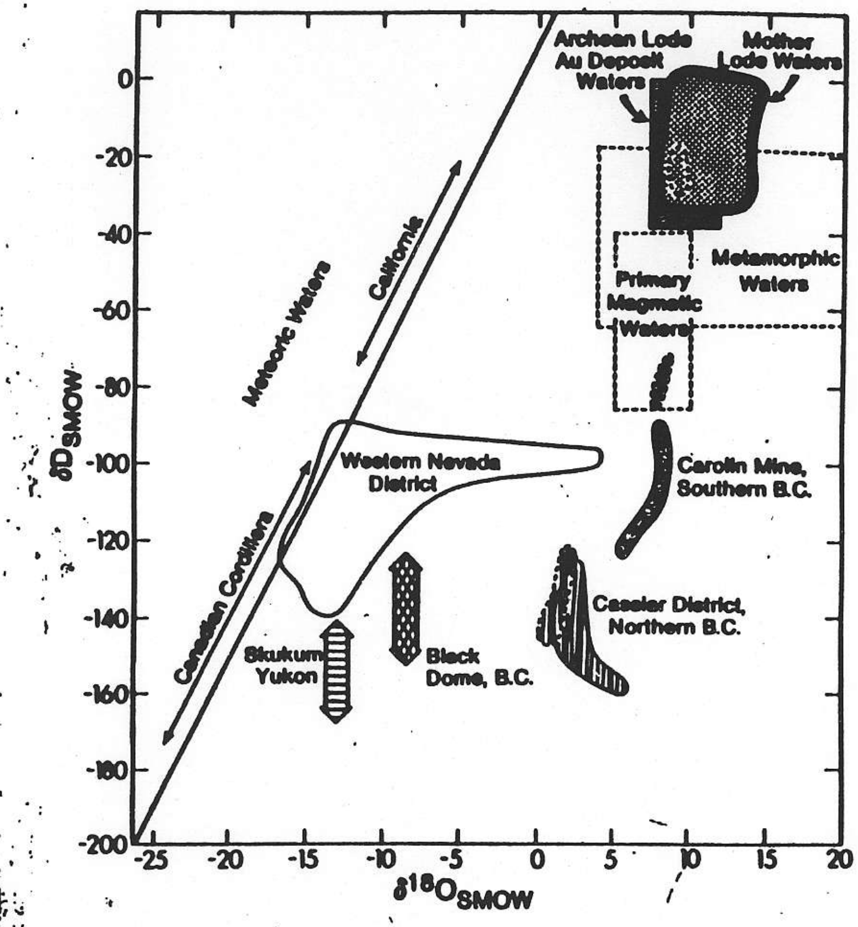


Table I Generalized Stratigraphic Section

Unit[1]		Age	Name	Description
14		T	Dykes	e.g. feldspar Ø at Congress
13		?	President/Sumner	serpentinized ultramafic, gabbro
12		?M	Rexmount	rhyolite porphyry
	10	T		lamprophyre dykes: black biotite-cpx Ø
9,11		K-T	Coast Plutonics, Bendor	granodiorite, qtz diorite, granite
8		uK	Kingsvale Group	arkose, gwke, shale, cgl, andesites
7		lK	Taylor Cr. Group	chert peb. cgl, shale, tuff, bxa, andesite
6		J-K	Tyaughton, Relay Mt. Groups	shale, siltstone, greywacke
10	9	uTR	Bralorne Intrusives	green hornblende Ø dykes (post-mineral)
	8			buff "albitite" dykes (intra-mineral)
	7			Soda Granite: albite quartz diorite
	6			Diorite: hornblende (quartz) diorite (sodic plagioclase; rare augite)
	5			Ultramafic: serpentinized peridotite, pyroxenite
4	4	mTR	Cadwallader Group	Hurley Fm.: calcareous argillite, phyllite, minor lst, tuffaceous andesite
3	3			Pioneer Fm.: andesite flows, bxa, tuffs; minor dacite. Basalt, greenstone
2	2			Noel Fm.: poorly defined unit of black argillite, tuffaceous sediments
1	1	TR-J	Bridge River Grp. (Fergusson Series)	Basalt (locally pillowed), andesite, tuff minor lst; ribbon chert, argillite

Note 1): First column is numbered according to Harrop and Sinclair (1986); second column according to Leitch and Godwin (1986).

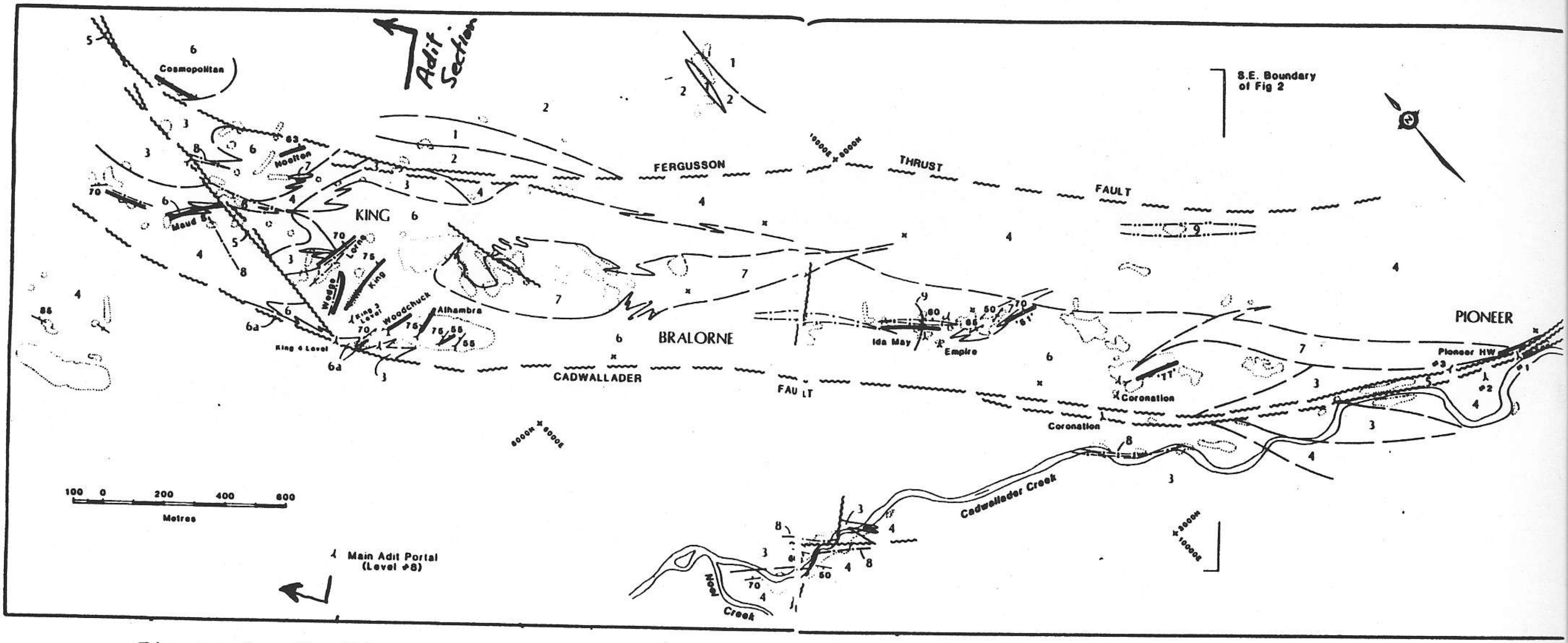


Figure 4a. Surface geology at Bralorne. Units defined in Table 1. (Leitch and Godwin, 1986)

intrusives invading volcanics from the same magma chamber. The comagmatic suite seems to continue with the differentiation and intrusion of the "soda granite" (actually a quartz diorite but with albite as the feldspar). The relation of soda granite to diorite is very similar to that between diorite and greenstone, with a 200m wide contact zone of small-scale complex dyking and interfingering, resembling a migmatite in places. The compositional and mineralogical similarity of intrusives extends even to the intra-mineral dyke phases, with an albitite dyke set composed of albite, quartz, and altered hornblende remnants (like the soda granite), and a post-mineral green hornblende porphyry dyke similar to the diorite. The intra-mineral dykes both cut and are cut by mineralized quartz veins. Scattered black lamprophyre dykes of probable Tertiary age post-date the mineralization and are composed of euhedral biotite, clinopyroxene, and apatite phenocrysts in a matrix of the same minerals plus glass.

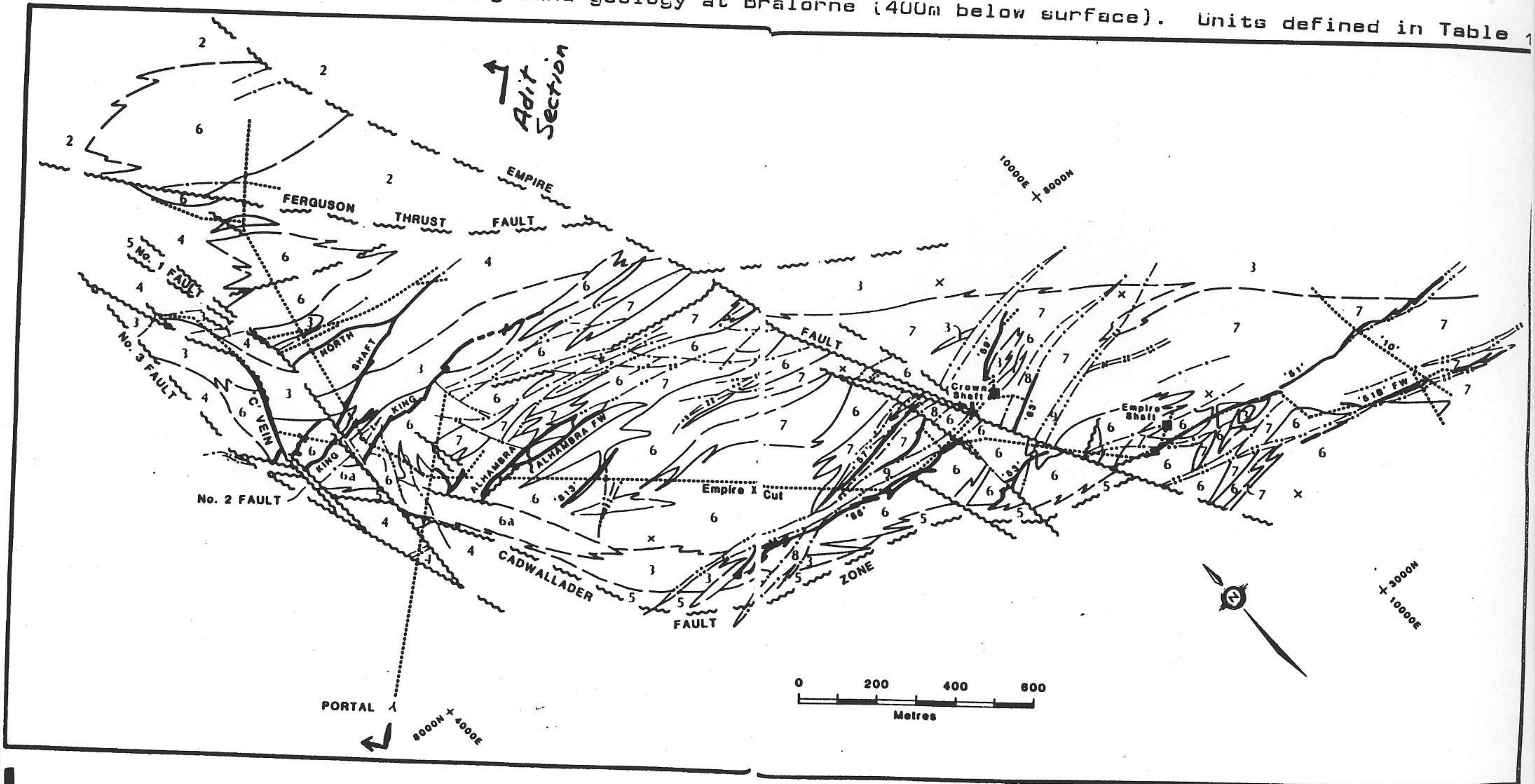
Serpentinized "President" ultramafics at Bralorne have been variously placed as late intrusions (Cairnes, 1937) to early volcanics (McCann, 1922). There may have been two periods of emplacement of ultramafics, in the upper Paleozoic to lower Mesozoic (Permo-Triassic as elswhere in B.C., and possibly Triassic-Jurassic). Their present physical location probably owes more to tectonic emplacement than to intrusion, as would be expected of obducted sea-floor material. Thus their boundaries are usually faulted and cannot aid in determining their relative age. Exposures at surface and in underground core at Bralorne suggest that a complex contact zone (Figure 4b) exists between the diorite, a mafic border phase termed "hornblendite" and the serpentinized ultramafic. However, dykes of diorite and soda granite do seem to cut both hornblendite and ultramafic. To further complicate the issue, the hornblendite appears to be transitional to the ultramafics, with cores of clinopyroxene visible in the late magmatic hornblende. Plagioclase, on the other hand, is only seen in the hornblendite, not the serpeninite; it is albitic, as are all the feldspars seen in the Bralorne intrusives.

Mineral Deposits

Detailed descriptions of the many mineral deposits of the Bridge River camp may be found in Cairnes (1937) or in Stevenson (1958). A thorough listing of the 70 or more important properties has been made by Harrop and Sinclair (1986). Types of deposit present range from the main large gold-quartz veins (Bralorne-Pioneer) to more silver-rich sulfide replacements with stibnite, arsenopyrite and tetrahedrite (Congress), to even lower temperature assemblages containing cinnabar (Figure 5). These deposits are roughly grouped according to their distance from the center of the camp (or distance from the Coast Plutonic Comples: see Woodsworth et al., 1977, or Pearson, 1977). However the "zoning" thus displayed must be treated with caution since it is not sure that all these different deposits are of the same age.

In the main deposits at the centyer of the Bralorne camp, it is clear that most of the gold is hosted in veins in the competent Bralorne intrusives and Pioneer greenstone, commonly in proximity to the President serpentinites. Veins pinch out in adjacent sedimentary rocks and in the serpentinized ultramafics. A case has been made for the restriction of productive ore shoots to the periphery of soda granite masses (Figure 7) because the soda

Figure 4b. 8th Level Underground geology at Bralorne (400m below surface). Units defined in Table 1



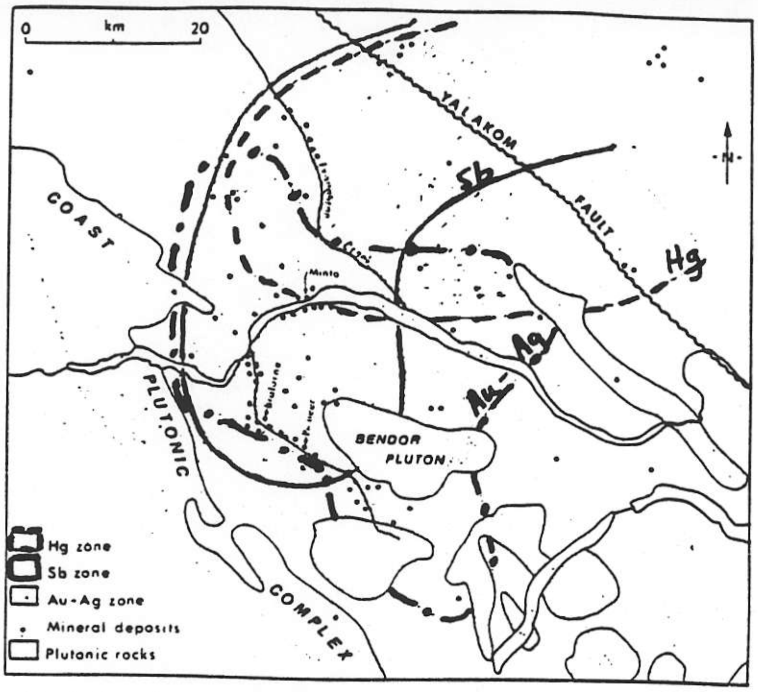


FIG. 6. Generalized metal zoning pattern in Bridge River area as inferred from computer-produced metal-distribution maps.

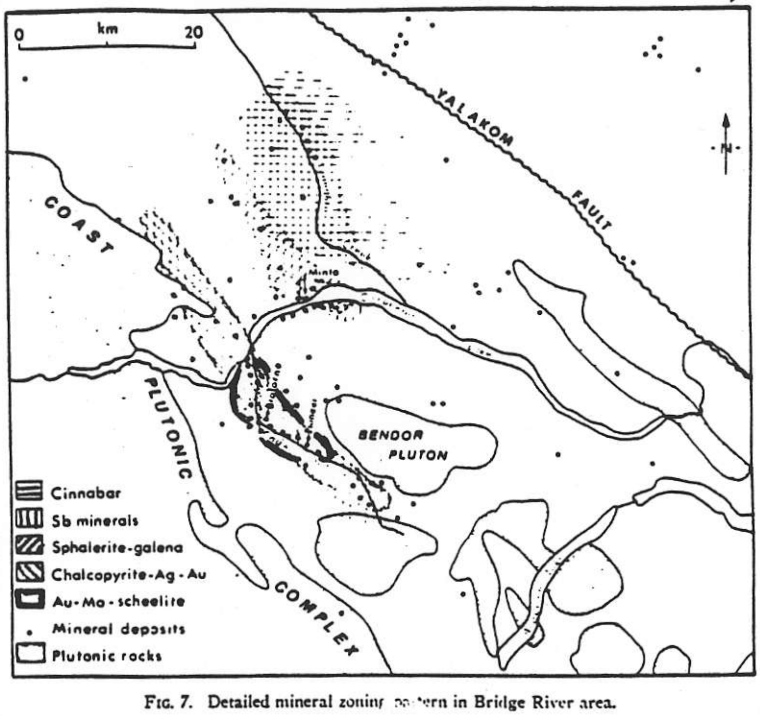


FIG. 7. Detailed mineral zoning pattern in Bridge River area.

being related to the Bendor pluton; Cairnes considered the diorite porphyry dikes to be older than the pluton, whereas McCann favored a post-Bendor age.

Because of the asymmetry of the cinnabar zone with respect to the rest of the zonal pattern, one might question its genetic affiliation with other mineral deposits in the Bridge River camp. Cinnabar and stibnite occur together, however, in mineral deposits northeast of the principal gold deposits, and both minerals appear to be hypogene. Furthermore, the changes in mineralogy and nature of the veins from southwest to northeast appear gradual rather than abrupt.

The two centers of zonation shown in Figure 7 can be interpreted as centers from which ore fluids moved

cause of its thermal instability in the presence of a moving vapor phase (Krauskopf, 1964; Dickson, 1964). Cinnabar, rather, would be deposited in the cooler areas to the northeast at temperatures of perhaps 100° to 200°C.

This line of reasoning suggests that the mineralization of the Bridge River camp was contemporaneous with, or perhaps somewhat younger than, emplacement of plutonic rocks that form the eastern side of the Coast Plutonic Complex. Thus, mineralization may have occurred about 50 m.y. ago. Some mineral deposits, however, do appear to be genetically related to the Bendor pluton. For example, in the contact aureole along the southwest margin of the pluton, small deposits containing chalcopyrite and scheelite occur in calcareous rocks of the Bridge River Group. Some of the calcareous beds have been altered to a granite was too brittle to sustain large fractures. Many references have been made to the proximity of veins to albitite dykes (e.g. Stevenson, 1958). Veins are confined to an elongate NW-SE trending block of sub-vertically dipping Cadwallader Group rocks, bounded on the SW by the CVadwallader fault and on the NE by the Fergusson fault (Figure 6). Both are high angle regional faults, possibly splays off the Fraser fault system, and have major strike-slip movement.

The structural analysis of Joubin (1948) still seems to be applicabler, with the main quartz veins developed on only one of the shear planes oriented at 35-40 degrees about the maximum compressive stress. These strongly ribboned (sheared) principal veins strike about 095-110 degrees on average, dip steeply (70 degrees) north, and have striations plunging 45 degrees east which display a reverse sense of latest movement. Tension gash veins, oriented at about 060 degrees, are more massive quartz and may contain erratic but locally spectacular coarse gold. Ore shoots (developed stopes) tend to rake westerly, perpendicular to striations, at about 50 degrees (James and Weeks, 1961) as can bee seen in Figure 7. The shoots averaged 1-3m wide by 100-200m long by 300m down plunge, but were up to 6m by 1500m (77 Vein; Bellamy and Saleken, 1983).

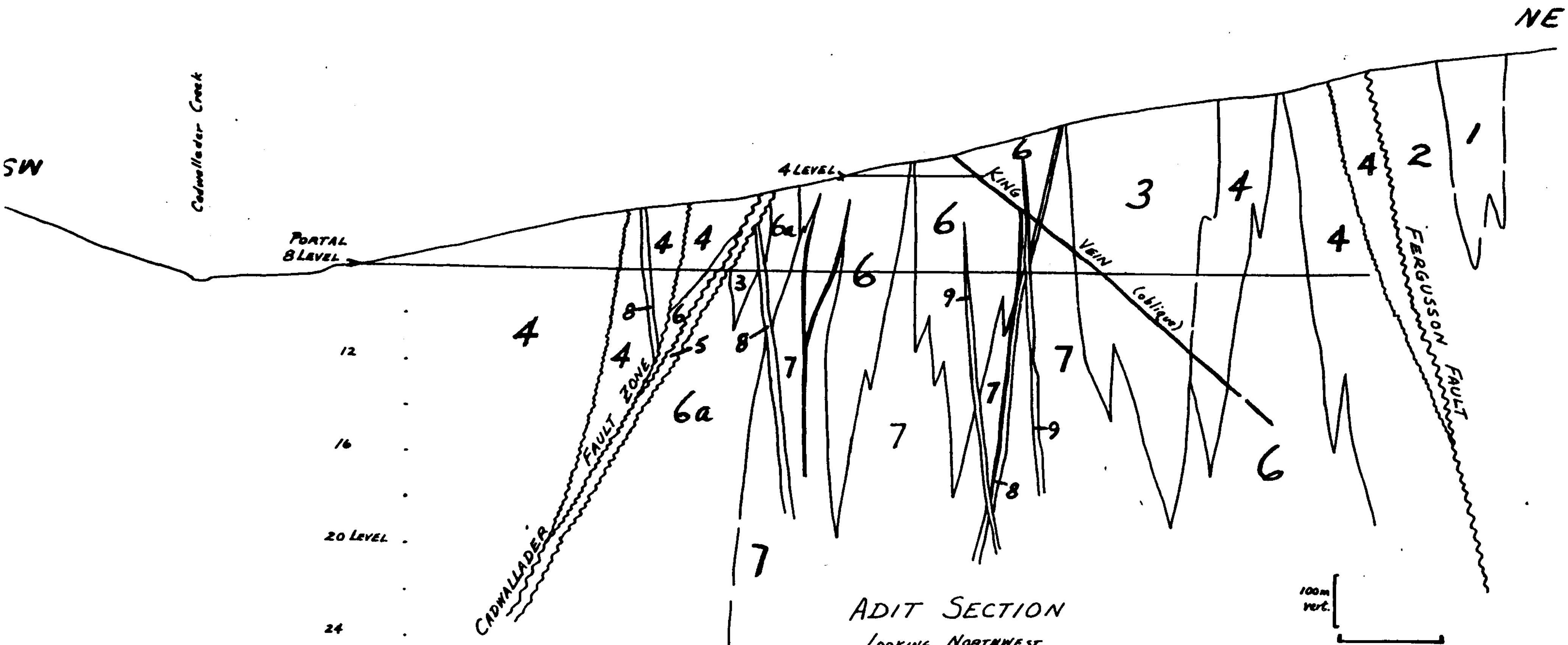
<u>Mineralogy</u>

Most of the productive veins in the Bralorne camp comprise 1-5cm quartz ribbons separated by thin septae of finely smeared sulfides and native gold (electrum), 95% of which was free-milling and recoverable by gravityy methods (Bellamy and Saleken, 1983). A few very rich veins such as the Pioneer 27 contained coarse erratic gold in milky white massive veins and vein breccias (up to 100-300g/t Au, or 4-10oz/ton; Stevenson, 1958). Calcite is a common accessory gangue mineral; traces of scheelite, barite, fuchsite and sericite are reported (Knight, 1984). The major sulfides (pyrite and arsenopyrite) form only 1-3% of the veins on average, while only traces of sphalerite, galena, chalcopyrite, and pyrrhotite have been noted. The presence of tetrahedrite, stibnite, marcasite, and possibly even a gold telluride (sylvanite) is less well established (Cairnes, 1937). Complicated sequences of deposition of the sulfides and their gangues in the veins have been worked out (e.g. Dolmage, 1934) but they are somewhat questionable in light of what is now known about deformation and remobilization of sulfides (Stanton, 1972).

<u>Alteration</u>

Hydrothermal alteration in the camp is restricted mainly to the margins of quartz veins, although in the center of the Bralorne mine the veins are sometimes close enough together that envelopes coalesce to form pervasive alteration. South of the Pioneer on the Pacific Eastern (P.E.Gold) property (Figure 2), pervasive zones of silica, sericite, and biotite are developed around stockworked zones (Gary Nordin, 1986, pers. comm.) although it is not clear how much these may be due to hornfelsing effects around dykes of soda granite and albitite.

Underground at Bralorne, altered envelopes up to tens of meters wide are visible. They consist of: 1) green chlorite after hornblende in the original diorite, succeeded inward by 2) buff



ADIT SECTION
LOOKING NORTHWEST

Fig. 6 C.H.B.L. April 86

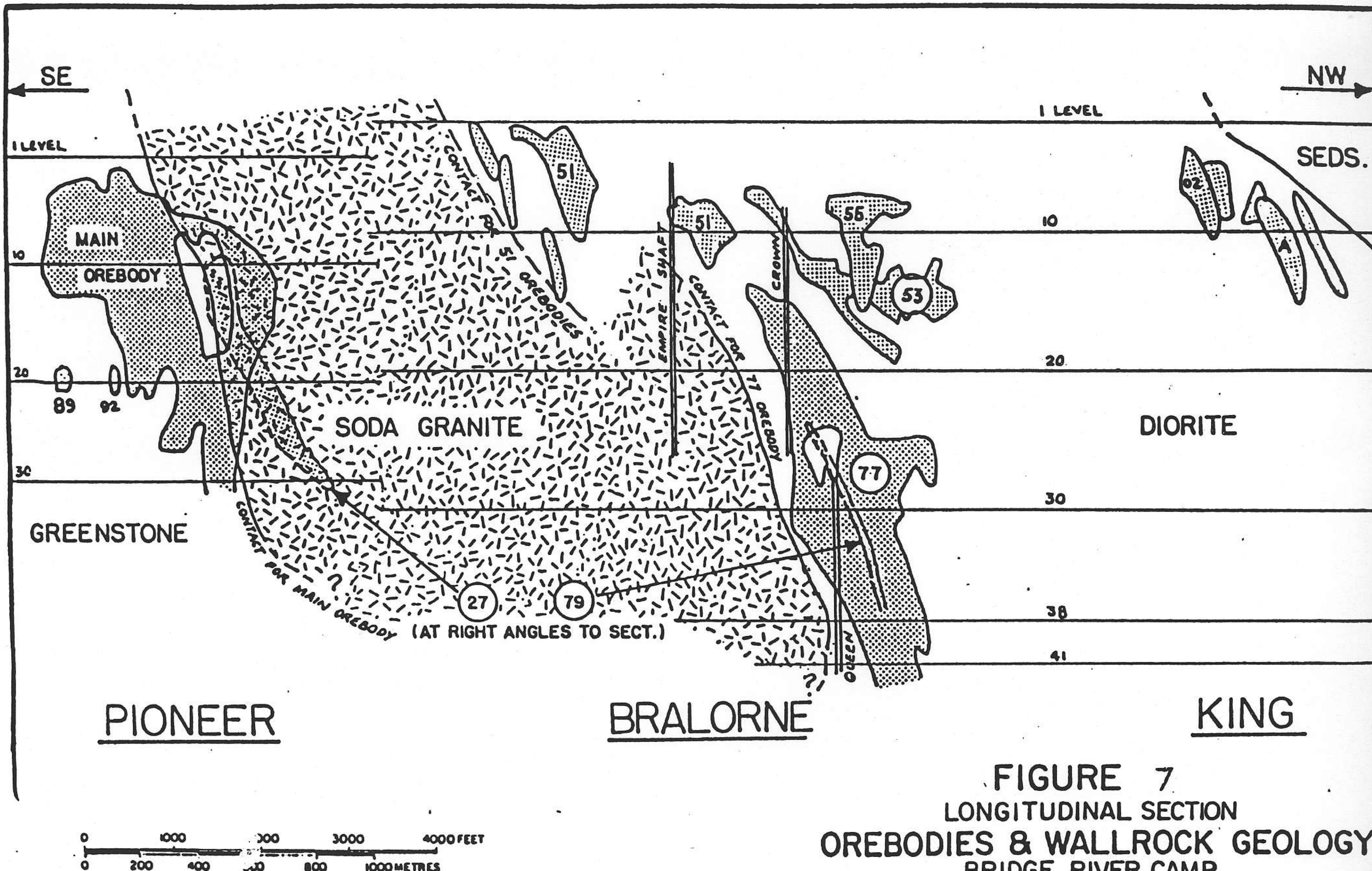


FIGURE 7
LONGITUDINAL SECTION
OREBODIES & WALLROCK GEOLOGY
BRIDGE RIVER CAMP

(From Campbell, unpub.)

carbonate after the hornblendes, but still with intact intrusive texture; 3) more intense buff-brown carbonate-epidote replacement with destruction of texture, and 4) cream-coloured, intensely sheared quartz-sericite-carbonate-fuschite "paper schist". Disseminated sulfides, mainly pyrite, are present from the carbonate zone inward, ranging up to as much as 10%. Some of the strongly altered material contains enough gold that Mascot Gold Mines, the present operator, included it in reserves (Bellamy, 1985). Albitization is only rarely visible in thin section as an envelope to veins. However, the seemingly pervasive presence of sodic feldspars in all phases (including the hornblendite, which contains augite remnants) and especially in the soda granite, may indicate widespread soda metrasomatism (or greenschist facies metamorphism).

Chemical changes on approaching the veins (corrected for constant volume: Boyle, 1979) show similarities to those noted for the Yellowknife deposits. There is a marked increase in the $K_2O/Na2O$ ratio and a consistent decrease in the silica/carbonate and silica/volatiles; the Au/Ag ratio shows an increase. Thus the alteration appears to be carbonatization, with addition of carbonate, potash, sulfur, and arsenic, and the possible removal of soda and silica.

Elsewhere in the district, alteration also appears to be principally to carbonate, which is often ankeritic according to other workers, e.g. Cooke (1986) at the Congress. However, the alteration appears to be less intense and possibly of lower temperature away from the central Bralorne-Pioneer area. This is noticeable even at the P.E. Gold property to the south, and at the Truax property to the east at higher elevation (Figure 2).

Ore Genesis

It is readily apparent that the ore deposits of the camp are closely related spatially to intrusives - for instance, the Bralorne intrusives hosting the Bralorne-Pioneer mine or the smaller bodies of similar intrusives associated with the P.E. Gold stockworks, or the feldspar porphyry dykes at the Congress mine. In detail, the location of the veins is controlled by structures, presumably related to movement on the Cadwallader and Fergusson faults. These faults have always been labelled "normal" and "reverse", respectively, by previous workers. However, their regional extent, relationship to the Fraser fault, and associated serpentinized ultramafics suggests that they may actually be either sutures marking the boundary of accreted terranes of strike-slip faults marking the slivering of such terranes. Strike-slip movement could have caused a zone of "crackling" between the two faults, localizing intrusions and channeling hydrothermal fluids.

Whether the intrusives are themselves the sources of the flnids or whether they merely supplied the heat source to move meteoric fluids is a matter for debate. A recent study of the oxygen and hydrogen isotopes by Nesbitt et al. (in press) suggests that the mesothermal "Mother Lode" type veins at Bralorne have isotopic values consistent with deep circulation oand extensive evolution of meteoric waters in major fault structures associated with the accretion of oceanic and island arc terranes onto North America. Even more far-reaching is their statement that Archean lode gold deposits of the Canadian Shield may have formed in the same way. Other authors have drawn attention to the similarities between the

Bralorne veins and the Mother Lode camp in California (Campbell, undated). The two camps have striking similarities in vein mineralogy, wallrocks, alteration, and association with a flexure in a major fault zone marked by elongate serpentine bodies flanking a major granitic batholith.

The oft-noted association of serpentinized ultrtamafics with gold deposits has led to the suggestion that a possible source for the gold is in the ultramafics, which may be enriched in gold (up to 10ppb compared to 1-2ppb in granitic rocks). This evidence would favour the leaching of the gold from adjacent rocks by circulating meteoric waters heated by the felsic intrusives. Alternatively, many workers in the Canadian Shield (Franklin, 1984; Colvine et al, 1984) are convinced that the fluid inclusion data and isotopic data support a derivation of the ore fluid from metamorphic waters expelled by amphibloite or granulite facies metamorphism at depth.

Exploration

It is highly unlikely that the existing underground reserves in the mines of the district (Bralorne: 1Mt of 9g/t Au; Congress: 0.7Mt of similar grade) can be developed at the present price of gold. The nature of these reserves, as shoots in rather narrow veins requiring expensive underground mining methods, and the technical problems at depth in the Bralorne mine (rock bursts and high temperatures of 57 degrees Celsius) make them unattractive. This is in spite of the fact that good-grade ore was known below the bottom level in the mine (2m by 200m by 100m deep and open of 35g/t Au: Bacon, 1978). It would take the discovery of a large new vein similar to the famed Pioneer 27 or Bralorne 77 with high grade (over 15-20g/t Au) ore to make the camp come alive again. To this end, exploration of some of the lesser-known properties fringing the central area would appear to have merit. Here low-temperature indications such as stibnite and cinnabar suggest the possible presence of the top of a mineralized vein system which could grade down into another Bralorne type deposit.

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A compressed-air locomotive was purchased during the year. It was used successfully to haul broken rock from the shaft-sinking operation.

The compressor-house was enlarged to provide room for a compressor of a capacity of 425 cubic feet of air per minute. A timber-shed was also constructed. The average number of men employed was fifteen.

L.A.P. Mining Co., Ltd. Company office, 626 Pender Street West, Vancouver. L. A. Prosser, manager; M. Retan, superintendent. Capital: 3,000,000 shares, $1 par value. This private company holds seventeen claims and seven fractions formerly held by Wayside Gold Mines, Limited. The property is on the Bridge River road approximately half-way between Minto and Gold Bridge.

In 1948 the winze was unwatered. On 5 level a hoist-room and two 500-ton capacity ore-pockets were cut and 86 feet of rope-raise was driven. On 9 level south the main drift was extended 20 feet; two diamond-drill crosscuts, totalling 35 feet in length, were driven on the foot-wall side of the main drift; 125 feet of raise was driven between 9 and 8 levels; and a crosscut, to be used for a diamond-drill station, was started in the hanging wall at a point 230 feet south of the winze.

Diamond-drilling to the west from the south end of 9 level disclosed a 5-foot quartz vein 713 feet from the drill-hole collar. Total diamond-drilling completed was 1,002 feet. The average number of men employed was ten.

Gold-Antimony.

Congress Gold Mines, Ltd.* Registered office of company, 640 Pender Street West, Vancouver; mine office, Minto Mine P.O. A. E. Jukes, president; Miss J. Whitehouse, secretary-treasurer. Capital: 4,000,000 shares, $1 par value. This company owns the following Crown-granted mineral claims: El Dorado (Lot 6618), Stibnite No. 1 (Lot 7236), Stibnite No. 2 (Lot 7237), Stibnite No. 3 (Lot 7238), Stibnite No. 4 (Lot 7239), David Fraction (Lot 7241), Robert Fraction (Lot 7242), Snowflake Fraction (Lot 7243), T.X. No. 1 Fraction (Lot 7244), Turner X (Lot 7245), Turner X No. 2 (Lot 7246), Turner X No. 4 (Lot 7247), T.X. Fraction (Lot 7248), T.X. No. 6 Fraction (Lot 7249), R.E. (Lot 7250), Ramsen No. 1 (Lot 7251), Ramsen No. 2 (Lot 7252), Mac Fraction (Lot 7253), Mac No. 1 Fraction (Lot 7254), and R.E. Fraction (Lot 7255). Some of these claims were staked in 1928 and 1929, but most of them were staked in 1933 and 1934; they were all brought to Crown grant on September 21st, 1936. These claims lie immediately north of the Bridge River, and most of them south-west of Gun Creek; their exact position is shown on Mineral Reference Maps Nos. T269 and 25T269 of the British Columbia Department of Lands and Forests.

The mine buildings and principal workings are adjacent to the Bridge River motor-road, about three-quarters of a mile west of the settlement of Minto Mine P.O. The underground workings are shown in Figs. 8 and 9, and include three adit-levels, an internal inclined shaft and, from it, three short levels.

The property has been described by O'Grady† and Cairnes.‡ The developments since 1943 and features of the geology and mineralization disclosed by the recent work are described in this Report.

This property was originally known as the Stibnite, first located by E. J. Taylor and J. Shuster and relocated in 1915 by C. H. Allan and associates. During that year the upper adit was driven 85 feet and several tons of high-grade antimony ore bagged, ready for shipment. It was again relocated in 1929, and in 1934 it was acquired by the present company, which increased the holdings from the original four claims to twenty-one and started the first important underground work. During 1934 and until early 1935 this company did the initial work in Nos. 1, 2, and 3 levels. For about three months during the summer of 1935 Victor Spencer and associates held an option and did considerable drifting, principally on No. 3 level, and completed the raise from No. 2 to No. 1 levels. After rebuilding the camp, destroyed by fire late in 1935, Congress Gold Mines, Limited, renewed mining operations, drove the raise from the No. 3 to the No. 2 level and cut the station, with rope-raise and ore-pocket, for the new shaft. In 1936, at a point 1,200 feet east of the Congress workings, the company started a new adit to intersect a principal shear parallel to the one developed in the mine; in 1946 the portal was caved and the adit inaccessible. It is reported that early in 1937 about 500 tons of antimony ore from No. 3 level was tested in the Wayside mill, but the results do not appear to have been satisfactory. Work was discontinued in 1938, and nothing more done on the property until 1940, when P. Shultz and E. Lorntzsen obtained an option on a part of the property north of the underground workings, found several mineralized showings, and had several open-cuts and strippings dug on them. This option was relinquished and nothing more done on the property until 1945, when the company itself renewed underground development. During that year a compressor-house housing a 500-cubic-foot compressor, a blacksmith-shop, change-house, office, pump-house, and water-tank were built. At the same time the portal of the No. 3 level was cleaned out and retimbered, a new track laid from the portal to the shaft-station, and the rope-raise for the present shaft completed. During 1946 a two-compartment inclined shaft was sunk at an angle of 56 degrees on the foot-wall of the shear, and the No. 4 and 5 levels were driven at points 125 feet and 280 feet slope distance down the shaft from No. 3 level. On No. 4 level a total of 180 feet of drifting and crosscutting was done, and on the No. 5 level a total of 167 feet, all crosscutting, was done. From the end of the crosscut on the No. 5 level, four diamond-drill holes were drilled. Shaft-sinking was continued below No. 5 level and by the end of 1946 was 150 feet slope distance below the level.

* By John S. Stevenson, based on examination made in July, 1946.

† O'Grady, B. T.: Congress Gold Mines, Ltd., *Minister of Mines, B.C.*, Ann. Rept., 1936, pp. F 10-F 13.

‡ Cairnes, C. E.: Geology and mineral deposits of Bridge River mining camp, British Columbia, *Geol. Surv., Canada*, Mem. 213, 1937, pp. 102-105; Geology and mineral deposits of Tyaughton Lake map area, British Columbia, *Geol. Surv., Canada*, Paper 43-15, 1943, pp. 29-30.

In 1946 Sheep Creek Gold Mines, Limited, began providing funds for development-work; this arrangement was terminated and work was suspended in February, 1947. An air-lift was installed in the shaft, all equipment left intact, and a watchman left at the mine. When work was stopped in February, 1947, the shaft had reached a total depth, on the slope, of 430 feet and the station for No. 6 level had been cut. The property is still (October, 1948) under the care of a watchman.

The property was examined by the writer in July, 1946; the work done between then and February, 1947, when the property was closed down, is not covered in this Report but the extent of the additional work is indicated in Fig. 9.

The rocks in the workings include lavas, argillites, and a feldspar porphyry dyke, but the lavas, including both green and purple varieties, are the predominant rocks. The green lava shows well-developed pillows in many places, and in some places good amygdaloidal texture. The purple lava also shows pillows, but is usually much more amygdaloidal than the green lava. The green lava is widespread throughout the workings, but purple lava is much less abundant and in the new workings is found only on No. 5 level 80 feet from the station. The contact between the purple and green lavas on No. 5 level and the attitude of the pillows seen in several places indicate that the lava-flows strike from north 10 to 15 degrees west and dip from 75 degrees north-eastward to almost vertical.

Argillites, conformable with the lavas, and a 60-foot wide feldspar porphyry dyke, strike north-westerly and dip steeply south-westward, occur in the upper workings (Fig. 8) but not in the lower workings. However, films of argillite found in slips within the purple lava on No. 5 level suggest that argillite may be near-by.

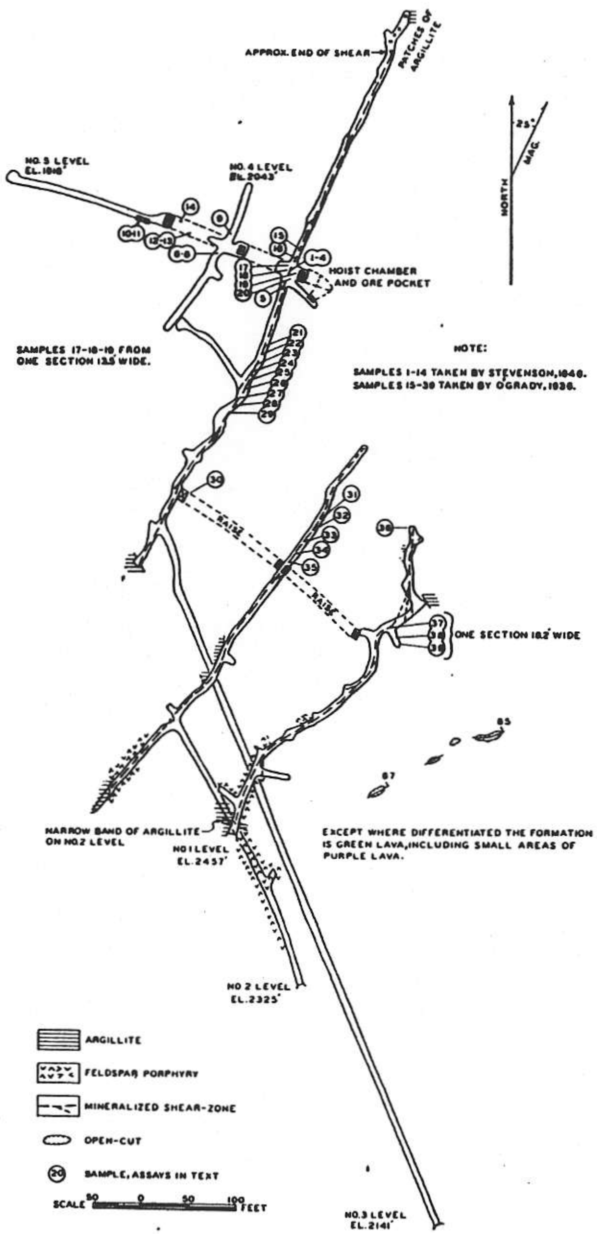

Fig. 8. Congress Gold Mines, Ltd.—plan of workings.

Sample No.	Width.	Gold.	Silver.	Antimony.	Description of Sample.
Taken by Stevenson, 1946.	Inches.	Oz. per Ton.	Oz. per Ton.	Per Cent.	
1	42	0.30	Trace	*	Samples Nos. 1 to 4 were taken across the better-mineralized parts of the carbonate-zone near the shaft on No. 3 level.
2	42	0.24	Trace	*	
3	18	0.36	Trace	*	
4	18	0.18	Trace	*	
5	6	0.05	*Nil*	*	Quartz vein within the carbonate-zone.
6	24	0.63	Trace	*	Mineralized carbonate-zone in south-west corner of face, July 23rd, 1946.
7	6	0.14	0.4	1.5	Quartz vein in same face as No. 6.
8	4	0.04	7.4	39.6	Across lens of stibnite, 4 inches wide by 5 feet long, in south-east corner of same face as No. 6.
9	6	0.56	Trace	4.3	Quartz vein containing scattered stibnite, north-east face, July 23rd, 1946.
10	3	0.24	Trace	*	Quartz vein, 3 feet from top of raise.
11	2	0.35	Trace	*	Quartz-calcite vein, 6 feet from top of raise.
12	6	0.66	Trace	1.4	Quartz vein.
13	15	0.28	Trace	*	Tan carbonate rock bordering No. 12.
14	24	......	......	......	Mineralized carbonate rock.
Taken by O'Grady, 1936.	Feet.				
15	5.8	Trace	Trace	......	
16	5.8	0.20	0.2	......	
17	4.4	0.54	Trace	......	
18	4.7	0.46	Trace	......	
19	4.4	0.28	0.1	......	
20	11.0	0.40	1.0	......	
21	4.6	0.14	Trace	......	
22	3.7	0.02	0.4	......	
23	4.6	0.04	Trace	......	
24	7.0	0.20	0.2	......	
25	5.0	0.42	0.6	7.2	
26	5.0	0.34	0.05	......	
27	5.0	0.34	0.6	......	
28	6.0	0.10	0.2	......	
29	5.2	0.08	0.6	......	
30	3.2	0.36	0.05	......	
31	5.1	0.20	0.6	......	
32	4.5	0.20	0.6	......	
33	4.0	0.09	0.2	......	
34	4.2	0.09	0.6	......	
35	5.0	0.06	0.6	......	
36	3.6	Trace	Trace	......	
37	3.5	0.22	0.1	......	
38	6.0	0.29	Trace	......	
39	8.7	0.24	Trace	......	

* Antimony in sample less than 0.3 per cent.

Where cut by shears, the rocks have been altered to tan carbonate rock. In the lavas the alteration has been extensive, but it is only slight in the feldspar porphyry dyke and practically absent in the argillite. Intermediate stages in the carbonate alteration of the lavas are shown by elliptical masses of unreplaced lava within the area of alteration.

A principal mineralized carbonate-zone, 2 to 30 feet wide, borders a shear several inches wide, strike north-easterly and dip 35 to 55 degrees north-westward, that along much of its length and depth is followed by a quartz or quartz-sulphide vein. This carbonate-zone and shear have been developed by underground workings along the strike for approximately 900 feet and down the dip for approximately 830 feet. The shear cuts the lavas, argillaceous sediments, and the feldspar porphyry dyke. It is well defined in the lavas and feldspar porphyry dyke, but peters out in the argillites, possibly because of the weakness and incompetency of the argillites in comparison with the other rocks.

Other less well-mineralized carbonate-zones have been found, mainly in the new workings and diamond-drill holes; one of these on the No. 5 level is 30 feet wide and is approximately parallel to and apparently separate from the principal zone; some carbonate-zones, from a few inches to 2 feet wide, strike toward and are flatter than the principal zone, and are apparently along shears that branch from the principal shear. The carbonate-zones, formed by alteration of greenstone outwards from fissures, consist principally of ankeritic carbonate, but in many places the zones are cut by hair-like stringers of fine-grained sulphides, including pyrite, arsenopyrite, and rarely sphalerite.

The antimony, for which the property was originally staked, occurs in short, discontinuous lenses along a quartz vein, from a few inches to 1 foot wide, that follows the central shear of the principal carbonate-zone. The stibnite-lenses are usually a few inches wide and a few feet in length, but lenses up to a foot wide and 25 feet long have been found. In addition to the lenses, a small amount of stibnite occurs disseminated as fine needles throughout much of the vein-quartz. Short quartz veins that branch from the main vein into the drift-walls at a few places contain small lenses of stibnite.

The gold on the property is mainly found in the mineralized carbonate rock and appears to be associated with the narrow sulphide stringers.

Small amounts of cinnabar are reported (Cairnes, 1937, p. 104) in narrow fractures and as scattered grains between the fractures in the hanging-wall rocks in the west drift in No. 2 level.

Work done prior to 1945, and directed to the general exploration of the principal shear and associated carbonate-zone, encountered mineralized material that was generally low in gold and, except for occasional lenses of solid stibnite, was generally low in antimony. However, gold values were reported to have been better on the No. 3 than on the No. 1 or No. 2 levels, the improvement being correlated with an increase in arsenopyrite and decrease in stibnite below No. 2 level. Twenty-three samples, taken by O'Grady from the Nos. 1, 2, and 3 levels, gave assays from a trace to 0.54 oz. of gold per ton and from a trace to 1 oz. of silver per ton, over widths from 3.5 to 18.2 feet, and one section 5 feet wide, typical of strong stibnite mineralization, assayed 7.2 per cent. antimony (*see* table on p. 109 and Fig. 8). Cairnes* reports an assay value of 0.196 oz. of gold per ton over an average width of 5.6 feet along the drift on No. 3 level and reports ore reserves, estimated officially late in 1936, as 301,144 tons averaging $5.48; 168,818 tons averaging $7.44; and 58,000 tons averaging $11.11.

The work done during the period 1945–47 was more localized than the earlier work and was directed toward exploring mineralization in a wide part of the principal carbonate-zone exposed on No. 3 level near the top of the inclined shaft. This part of the carbonate-zone is up to 20 feet wide and is unusually well mineralized. The mineralization consists of numerous hair-like veinlets of quartz and one persistent quartz vein 3 to 6 inches wide, all approximately parallel with the shear along which the carbonate occurs. The grade of this material is indicated by Samples Nos. 1 to 5 and 15 to 20 (*see* table of assays on p. 109 and Fig. 8).

The downward extension of this mineralized carbonate-zone from the shaft-station, following the strike and dip of the shear as developed in the upper levels, was found in a short test-raise 50 feet down the shaft from No. 3 level and on No. 4 level, where mineralization within the carbonate-zone is moderately strong. Sample Nos. 6 to 9 indicate the grade of this mineralization.

* Cairnes, p. 29.

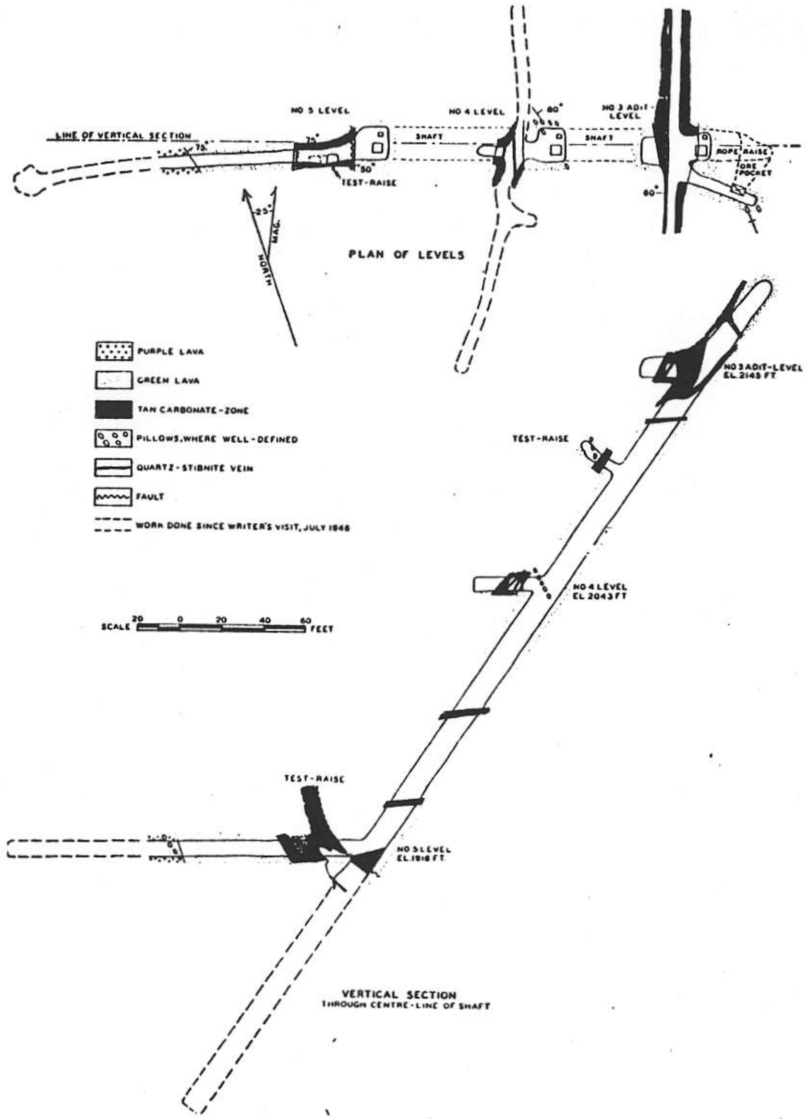

Fig. 9. Congress Gold Mines, Ltd.—plan and section of recent workings, tape and compass survey.

A wide mineralized carbonate-zone was found in No. 5 level (Fig. 9). Although this is mineralogically similar to the upper zone that extends from No. 1 to No. 4 levels, it is doubtful that it is the downward extension of the upper zone. The carbonate-zone on this lower level possesses hanging-wall and foot-wall dips that are in the opposite direction to those of the carbonate-zone in upper levels. It also lacks the central quartz vein dipping north-westward with the dip in the zone above, and has instead several, almost flat, narrow veins of quartz, well shown in the test-raise, on No. 5 level (*see* vertical section, Fig. 9) that dip across the zone. These flat veins are not correlated either with the quartz vein along the principal carbonate-zone in the upper levels or with any of the branches from this vein. Sample Nos. 10 and 11 were taken across the two best-defined veins in the test-raise. Five channel samples, taken across the carbonate-zone on No. 5 level, assayed *nil* in gold.

Four flat-lying carbonate-zones, from 2 to 3 feet wide, are intersected by the shaft (*see* vertical section, Fig. 9). In each of those between Nos. 4 and 5 levels and at the station on No. 5 level, a flat central quartz vein, 2 to 4 inches wide, is found. Sample Nos. 12 to 14 indicate the grade of these quartz veins and the associated carbonate rock.

Several samples of unaltered and unmineralized rock taken underground assayed *nil* or trace in gold.

The work done by Schultz and Lorntzsen in 1940 between 1,400 and 2,000 feet north of the portal of No. 3 adit on the Stibnite No. 4 and T.X. No. 1 Fraction claims exposed several well-mineralized carbonate-zones. These showings are north-west of the projected position of the principal carbonate-zone developed by the underground workings, but may correlate with some of the carbonate rock reported to have been intersected by the diamond-drill holes drilled north-westerly from the face of No. 5 level.

Gold.

Conannex Mining Co., Ltd. Company office, 800 Hall Building, Vancouver. President, A. E. Sjoquist, Kamloops. This private company owns eight claims adjoining the Congress Gold Mine's property on the Bridge River road, 2 miles west of Minto. In 1948, 350 feet of trenching and 500 feet of surface-stripping was done with the aid of a bulldozer.

Cobalt-Gold-Uranium.

Little Gem.* This property, on Roxey Creek, consists of the mineral claims Little Gem No. 2 (Lot 7566), Little Gem No. 4 (Lot 7567), and Little Gem No. 6 (Lot 7568), recorded in 1934 and brought to Crown grant in 1948, and the following claims held by record: Little Gem No. 11, recorded in 1935; Little Gem No. 15 and Little Gem No. 16, recorded in 1946; Little Gem No. 17 and Little Gem No. 18, recorded in 1947. The claims are owned jointly by J. M. Taylor, 2419 Forty-ninth Avenue West, and R. R. Taylor, 1320 Walnut Street, Vancouver. The claims were located to cover cobalt-gold-bearing mineralization, with which, in 1948, uranium was found to be associated.

The ground covered by the claims extends from Roxey Creek, a northerly flowing tributary of Gun Creek, easterly over a high ridge into the upper basin of Jewel Creek, also a northerly flowing but smaller tributary of Gun Creek. As the recorded claims have not been surveyed, their exact outlines and position are not known; however, the three Crown grants have been surveyed, and they are shown on Mineral Reference Map No. 21T269 of the Department of Lands and Forests, Victoria.

Access to the property is in part by motor-road from the Bridge River highway and in part by pack-horse trail. The Tyaughton Lake road, which leaves the highway

* By John S. Stevenson, based on examinations made in August and September, 1948.

at a point 2 miles east of Minto mine, is followed for 3½ miles to a branch road that follows up Gun Creek road for 8½ miles. From the end of this road, 3,440 feet elevation, Gun Creek is crossed by a bridge suitable for horses, and thence a pack-horse trail is followed for 1¾ miles to a fork in the trail at the crossing of Roxey Creek, and the right-hand fork, which crosses the creek, is followed for 1½ miles to a single log cabin at the camp-site, 5,580 feet elevation, on the south-east bank of Roxey Creek, near the middle of the Little Gem No. 6 claim. The principal workings, at about 6,200 feet elevation, are south-easterly up the mountain-side from camp in the north-eastern part of the Little Gem No. 2 claim and are reached by a foot-trail approximately three-quarters of a mile long, suitable part of the way for pack-horses.

The camp-site, on the creek, is in timber abont 300 feet below timber-line, but the adits and showings are several hundred feet above timber-line on precipitous mountain-slopes characterized by steep rock bluffs and long talus-slides. Adequate mine-timber is available at the camp-site, and Roxey Creek appears to maintain a good flow of water from the many glaciers at its headwaters.

The principal workings consist of two adits, elevations of 6,182 feet and 6,240 feet respectively (Fig. 10), that explore grcund immediately below lenses of cobalt mineralization exposed in natural outcrop and surface-strippings. Additional workings include two open-cuts and strippings farther up the mountain-side, just below the top of the ridge at a point 450 feet above and 600 feet easterly from the upper adit.

The original surfaee showings of cobalt-bearing minoralization on the Little Gem, recognized by the abundance of pink cobalt bloom on weathered material, are reported to have been found by W. H. Ball in 1934 while working as a partner of William Haylmore. Mr. Haylmore acquired one-half interest shortly thereafter and held a part or the whole interest in eleven mineral claims and fractions until 1937, when J. M. Taylor acquired four claims—the Gem Nos. 2, 4, 6, and 11. The other claims lapsed, but part of the ground formerly held was covered in 1946 and 1947 by the Gem Nos. 11, 15, 16, 17, and 18 claims.

In 1938 the United States Vanadium Corporation acquired an option on the property and held it until 1939. During the life of the option this company drove the upper adit and most of the lower adit, the work being under the general supervision of J. M. Hill. In 1940 the Bralorne Company held an option for part of the year, during which time the lower adit was extended and the two raises from that level were driven. Since 1940, although surface work has been done by the owners elsewhere on the property, little except sampling has been done on the cobalt showings.

The property is in an area of Coast Range intrusives, and the showings are only about half a mile south-westerly from a principal contact of these with older rocks. The enclosing rocks are, with the exception of three feldspar porphyry dykes, uniformly granodiorite. One of these dykes, about 25 feet wide, outcrops on a rocky spur about 200 feet south of the upper adit, with a northerly strike and an approximately vertical dip. Another dyke, 50 feet wide, outcrops in a draw about 100 feet north of the uppor adit and is traceable, with strike north 60 degrees east and dip 75 degrees south-eastward, north-easterly up the draw and over a spur. In the upper adit the granodiorite is cut by a feldspar porphyry dyke 10 inches wide, strike north-easterly and dip 70 degrees south-eastward. These dykes do not appear to have any genetic or structural relation to either the ore-bodies or the carbonate-zones to be described later.

The ore-bodies consist of mineralized pegmatite-lenses containing cobalt, gold, and uranium. The cobalt and gold values are closely associated with mixed sulpharsenides that occur in large amounts within all the pegmatite-lensea. The uranium, in the mineral uraninite,* is associated with the non-metallic gangue minerals within the same pegmatite-lenses. These lenses occur sporadically as the "plums in a pudding" in an

* Uraninite is a crystalline mineral composed principally of uranium oxide.