92H/7,8 1972 IGC Excursion

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COPPER MOUNTAIN (and INGERBELLE): By V. A. G. ~~Preto.~~

LOCATION: Lat. 49° 19.4′ — Long. 120° 31.2′ — On Copper Mountain 19 km south of Princeton; Ingerbelle about 2 km northwestward on the opposite site of the Similkameen River on Highway 3.

OWNERSHIP: Similkameen Mining Company, Limited (a subsidiary of Newmont Mining Corporation of Canada Limited).

The Copper Mountain mine is the first porphyry deposit to be mined in Canada, although it was not recognized as such then and not universally now. The reason for this is partly because the bulk of the ore is in volcanic rocks and the associated intrusions are of the syenite clan.

Copper was first discovered in the area in 1884 and was mined intermittently from 1900 to 1957 by the Granby Mining Company Limited mainly by underground methods at the Copper Mountain mine east of the Similkameen River. Total production in this period was about 34 million tons of ore having a gross value of approximately 321 million dollars in copper, gold, and silver. In 1967 interest in the low-grade open-pit potential of the area was aroused by discovery of copper mineralization west of the Similkameen River at the Ingerbelle property. Some of this mineralization outcropped on the Hope Princeton highway. Further investigation of the Copper Mountain side of the river established two other ore zones centred on two earlier small open pits. These three deposits, which at present are being prepared for production, are estimated to include a total of 76 million tons of ore averaging 0.53 per cent copper and small but significant values of gold and silver. Production is scheduled to start in 1972 at 15,000 tons per day from the Ingerbelle orebody.

Regional Setting

Copper Mountain is situated near the southern terminus of the so-called Nicola Belt which is a terrain extending from Kamloops to the United States border which is united by similar stratigraphy and tectonics, and noted for the large number of copper mines and prospects. The terrain has as its fundamental unit the Upper Triassic Nicola Group which is some 7,000 metres thick and composed mainly of basaltic andesite flows and pyroclastic rocks with greywacke, argillitee, and reefoid limestone. The belt is very largely bounded by plutons but has older rocks on part of its eastern periphery.

Local Geology

In the Copper Mountain area (*see* Fig. 23) the Nicola Group is represented by the Wolf Creek Formation composed dominantly of fragmental andesite, tuff, and volcanic siltstones. These generally display very mild metamorphism and deformation, except in the immediate vicinity of intrusive bodies. A number of quartz-poor plutons, collectively known as the Copper Mountain intrusions (Montgomery, 1967), cut the Nicola rocks and are spatially and genetically related to the ore deposits. The largest, the Copper Mountain stock, is a concentrically differentiated intrusion, elliptical in plan and approximately 16 km^2 in area. Its long axis is approximately 10 km long and strikes north 60° west. This stock ranges in composition from diorite at its outer edge through monzonite to syenite and perthosite pegmatite* at the core (Montgomery, 1967). Two smaller satellites, the Smelter Lakes and Voigt stocks, to the north and northeast respectively, show no differentiation, but are similar in composition to the outer phase of the Copper Mountain stock. A complex of intrusive rocks ranging in composition from diorite to syenite, and generally porphyritic, occurs mainly north of Copper Mountain, extending from Wolf Creek to a major northerly trending fault that lies west of the Hope-Princeton highway. These rocks, known as the Lost Horse intrusions, show widespread albitization, saussuritization, and pink-feldspar alteration that can be intense. They do not occur as a continuous mass, but as a complex of dykes, sills, and irregular bodies that display variable and complicated contact relationships with rocks of the Wolf Creek Formation. Because of their complexity, the Lost Horse intrusions could only be divided into two groups: one composed of irregular bodies of variable size and shape; the other of well-defined dykes of biotite-latite porphyry or biotite-pyroxene-microsyenite porphyry

*Perthosite pegmatite contains about 97 per cent perthite with minor amounts of leucoxene or sphene, quartz, and fine-grained colourless micas.

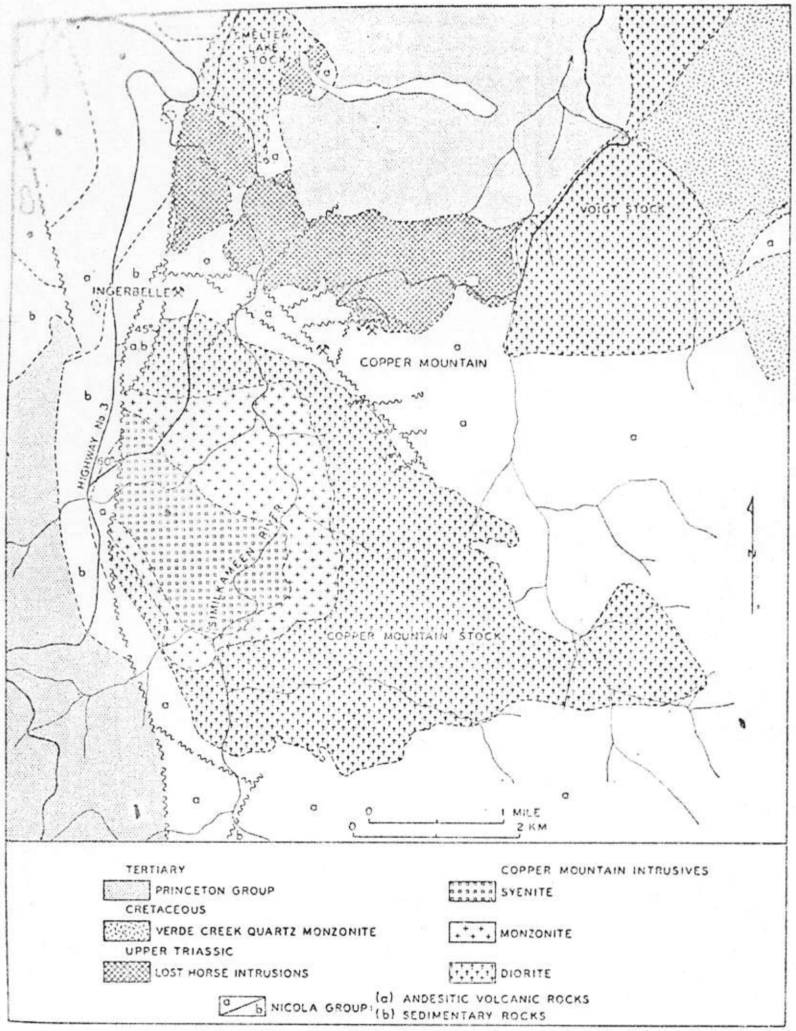

Fig. 23. Geology of Copper Mountain Area.

that cut the older Lost Horse rocks. The Lost Horse intrusions are believed to be genetically related to the Copper Mountain stock, and in fact to be late phases of the stock, although contact relationships are nowhere clearly displayed in the field. They are also closely related to the orebodies spatially and, it is believed, genetically. All these intrusive plutons have ages that are closely similar to the Upper Triassic Nicola volcanic rocks they intrude. The average apparent age from eleven potassium-argon analyses is 193±8 million years (Preto, White, and Harakal, 1971).

Northeast of Copper Mountain, diorite of the Voigt stock and older volcanic rocks are cut by a quartz monzonite (Verde Creek granite) that has an apparent age of about 100 million years. This pluton and the older rocks are cut by a swarm of northerly trending dykes of felsite, quartz feldspar, and feldspar porphyry which are called the mine dykes at Copper Mountain.

All of the above intrusive, volcanic, and sedimentary rocks are cut and unconformably overlain by intrusive, volcanic, and sedimentary rocks of the Princeton Group of Middle Eocene age. In the mine area these include a shallow trough of boulder conglomerate which overlies the trace of an important fault.

Structure

The Nicola volcanic rocks form a gently warped west-trending syncline that is abruptly truncated at its southern margin with the Copper Mountain stock and laced with irregular bodies and dykes of Lost Horse intrusions at the north (*see* Fig. 25). Faulting and fracturing are very intense between the two groups of intrusions. Major steep faults trend north 80 to 90° east, north 35° east, north 20° east, and north 45° west (see Fig. 24), and are important structural controls to mineralization. This is suggested by the prominence of the long-known northeasterly trending "ore fractures" in some parts of the camp, by the fact that all of the major faults run through or along the edge of orebodies at least for a good part of their course, and by the fact that structures such as the Pit and Copper Mountain faults have definite "tails" of copper mineralization, albeit not economical, leading out along them from known orebodies. Most of the best-known mineralization on Copper Mountain occurs in the central part of the area shown on Figure 24, where all the above-mentioned faults are strongest, best developed, and intersect one another. A cylindrical breccia pipe of importance occurs near the intersection of the Pit and Ada faults. A regional post-mineral normal fault that trends northerly and dips 60° west cuts off the Ingerbelle orebody at the west and, farther south, truncates the western part of the Copper Mountain stock (see Fig. 23).

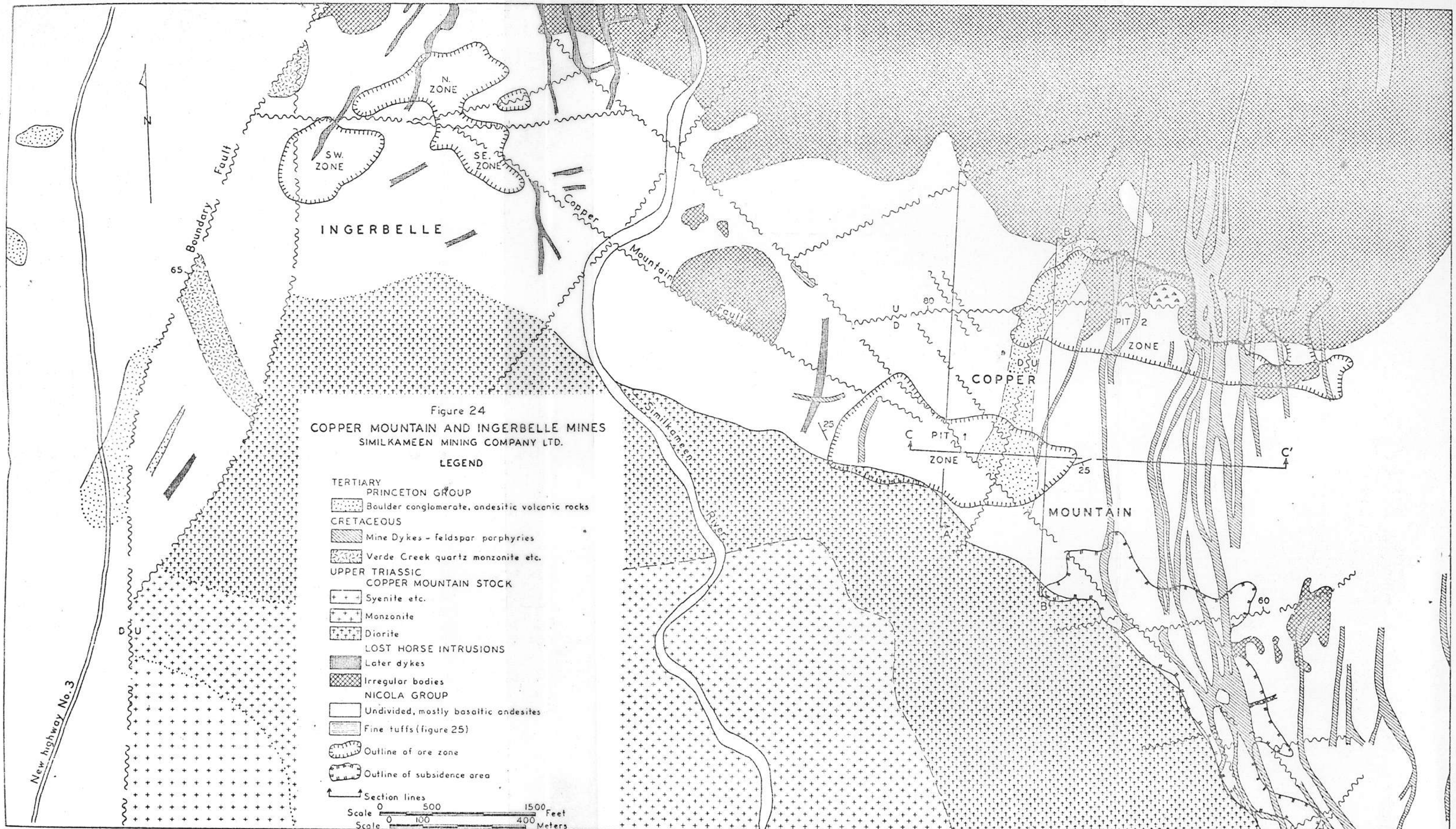

Figure 24
COPPER MOUNTAIN AND INGERBELLE MINES
SIMILKAMEEN MINING COMPANY LTD.

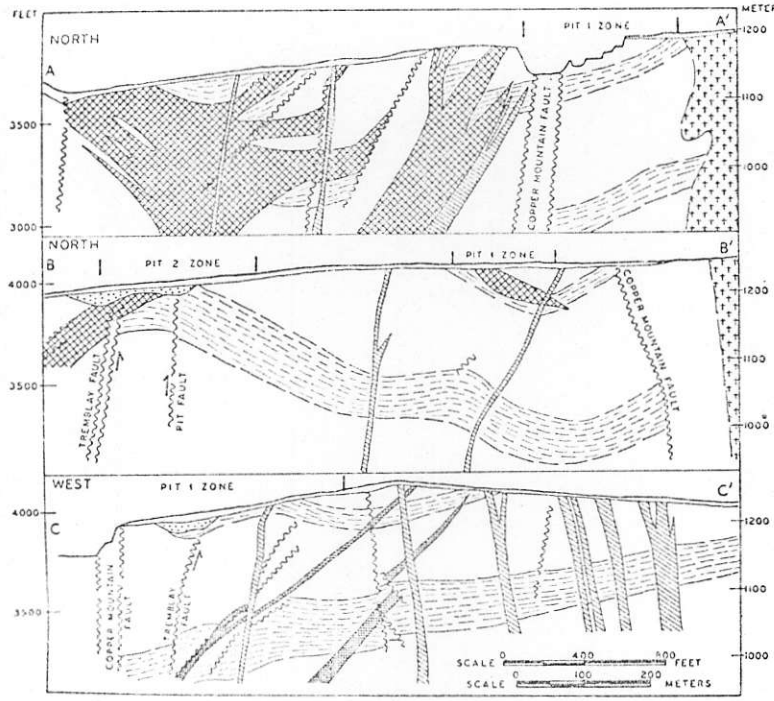

Fig. 25. Cross section of Copper Mountain deposits. For Legend see Fig. 24.

Alteration and Mineralization

The Nicola rocks in the vicinity of Copper Mountain exhibit a mild type of regional alteration consisting essentially of moderate saussuritization of the feldspars and variable replacement of the matrix by carbonate. Intermediate volcanic rocks commonly contain epidote, chlorite, sericite, carbonate, tremolite-actinolite, and, occasionally, veinlets of prehnite. Within 60 metres of the Copper Mountain stock this alteration is overprinted by a narrow aureole of contact metamorphism characterized by granoblastic development of diopsidic pyroxene, green hornblende, brown to reddish brown biotite, epidote, intermediate plagioclase, and minor quartz.

In the vicinity of the Copper Mountain and Ingerbelle deposits a distinctive kind of metasomatic alteration is found affecting rocks of the Nicola Group and of the Lost Horse suite, and bearing a close spatial relationship to faults, fracturing, and bodies of Lost Horse rocks and hence highly variable in its distribution and intensity.

Several successive stages can be recognized and may be summarized as follows:

(1) Development of biotite appears to have been the earliest stage and has been obliterated by later stages. It was probably widespread as remnants of it are found at widely separated localities.

(2) Development of albitic plagioclase and epidote was the next stage and was accompanied by removal of biotite and of disseminated magnetite, and the bleaching of pyroxene. Secondary sphene, apatite, and pyroxene are locally developed. Where this stage of alteration is only slightly developed it is restricted to small envelopes of the fracture stockwork. With increasing intensity it spreads outward from these fractures, eventually permeating the whole rock. Where this has occurred, a rock that originally was a fragmental andesite is transformed into rock that has a texture which makes it very difficult to distinguish from an altered diorite.

(3) The development of pink feldspar along fractures is the next stage and generally occurs in zones where albite-epidote alteration is strong. At Ingerbelle this "pink veining" comprises both potash feldspar and pink oligoclase, whereas at Copper Mountain it is mostly potash feldspar and is commonly accompanied by sulphide-bearing pegmatite veins characterized by selvages of coarse biotite along the edges and bornite, chalcopyrite, potash feldspar, and calcite at the centre.

(4) The last stage of alteration consists of scapolite veining and is confined almost entirely to the Ingerbelle area where it is prominent and locally intense. On Copper Mountain scapolite is very rare and is found as sub-microscopic veinlets in some of the more intensely altered volcanic rocks close to large bodies of intrusive rocks.

Copper mineralization at Ingerbelle and at Copper Mountain differs somewhat in character and in sulphide minerals present. The main characteristics may be summarized as follows:

(1) Ingerbelle ore consists typically of fine disseminations and delicate fracture fillings of pyrite and chalcopyrite.

TABLE 3. SUMMARY OF CHARACTERISTICS OF MINES VISITED

DAY	MINE	PLANT SIZE in S. Tons/Day	RESERVES in Million Tons, GRADE in Percentage Cu (C) MoS2 (M)	PRODUCTION in S. Tons to end 1970
1	BRITANNIA	3,000	3.7 1.5 C	500,000 Cu 125,000 Zn
2	TEXADA	3,500		16,500 Cu 8,500,000 Fe
3	ISLAND COPPER	33,000	280, 0.52 C 0.029 M	-
	RED BIRD	-		-
	BERG	-		-
4	GRANISLE	6,000 14,000*	89.6 0.44 C	47,750 Cu
5	ENDAKO	27,000	209, 0.15 M	39,000 Mo
6	GIBRALTAR	30,000	358, 0.37 C 0.016 M	-
7	ALWIN	500*	1, 2.51 C	
	BETHLEHEM	15,000	49, 0.51 C 190, 0.48 C	145,000 Cu
	HIGHMONT	25,000*	150, 0.285 C 0.051 M	-
	LORNEX	38,000	293, 0.427 C 0.014 M	-
8	VALLEY COPPER	40,000	870, 0.52 C	-
	COPPER MOUNTAIN) INGERBELLE)	15,000	76, 0.53 C	307,000 Cu

MINE	CLASSIFICATION: MASSIVE SULPHIDE	SKARN	VEIN	PORPHYRY: CALC-ALK	SYENITIC	SIMPLE	ELABORATE	COMPLEX	PLUTONIC
BRITANNIA	X								
TEXADA		X							
ISLAND COPPER				X				X	
RED BIRD				X		X			
BERG				X			X		
GRANISLE				X			X		
ENDAKO				X					X
GIBRALTAR				X					?
ALWIN			X						
BETHLEHEM				X				X	
HIGHMONT				X				X	
LORNEX				X				X	
VALLEY COPPER				X				X	
COPPER MOUNTAIN					X			X	
INGERBELLE		X			X			X	

MINE	MAJOR METALLIC MINERALS: BORNITE	CHALCOPYRITE	CU OXIDES	MOLYBDENITE	SPHALERITE	MAGNETITE	PYRITE	HEMATITE
BRITANNIA		X			X		X	
TEXADA		X				X	X	
ISLAND COPPER	X	X		X		X	X	X
RED BIRD		T		X			X	
BERG		X	X	X			X	
GRANISLE	X	X		T		X	X	X
ENDAKO		T		X		X	X	
GIBRALTAR	X	X	X	X		X	X	
ALWIN	X	X	X				X	X
BETHLEHEM	X	X	X	X			X	T
HIGHMONT	X	X		X			X	X
LORNEX	X	X	X	X		X	X	X
VALLEY COPPER	X	X	X	X			T	X
COPPER MOUNTAIN	X	X					X	
INGERBELLE		X					X	

MINE	ALTERATIONS: GREISEN	SKARN	BIOTITE HORNFELS	SILICIFICATION	BORON	POTASSIC	PHYLLIC	ARGILLIC	PROPYLITIC	GYPSUM-ANHYDRITE	APPARENT AGE IN MILLION YEARS
BRITANNIA				X			X		X	X	100 ± 10
TEXADA		X							X		
ISLAND COPPER					X	X	X	X	X		154 ± 6
RED BIRD			X	X		X	X	X			50 ± 2
BERG	X		X	X		X	X	X	X	X	50 ± 2
GRANISLE						X	X		X		51 ± 2
ENDAKO						X	X	X			141 ± 6
GIBRALTAR							X	X	X		?
ALWIN							X	X			198 ± 8
BETHLEHEM					X		X	X	X		"
HIGHMONT					X	X	X	X	X	X	"
LORNEX							X	X	X	X	"
VALLEY COPPER						X	X	X			"
COPPER MOUNTAIN						X			X		193 ± 8
INGERBELLE		X				X			X		

* Projected
T = Trace

Bornite is very rare. Molybdenite and sphalerite are mere curiosities. The ore zones are found in a crudely L-shaped area that straddles a major east-west fault and has arms oriented northeast and northwest. The distribution of sulphides and of rock alteration does not appear to be related to the Copper Mountain stock.

(2) On Copper Mountain sulphide mineralization is mostly fracture filling and ranges from bornite-chalcopyrite close to the Copper Mountain stock to pyrite-chalcopyrite away from the stock. In the old mine the stopes were mostly along or close to the stock contact, and the tenor of the ore was determined by the all-important "ore fractures" oriented approximately at right angles to the contact and along which most sulphides occurred. The main mineral was bornite, and pyrite was nearly absent. A few hundred feet away from the contact chalcopyrite is the most important mineral, pyrite becomes more abundant, and bornite is scarce or rare. The Pit 2 ore is typically pyrite-chalcopyrite fracture filling in altered volcanic rocks. Fracturing is very intense and probably an important ore control, but the regular, parallel "ore fractures" that are found close to the Copper Mountain stock contact cannot be clearly recognized here. More important appear to be rock alteration, east-west faulting, and the proximity of a large mass of rocks of the Lost Horse suite.

end

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