POST-PRODUCTION GEOLOGY at COPPER MOUNTAIN

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THE mineralization at Copper Mountain Mine south of Princeton was discovered late in the 19th century and development went on through the first quarter of this century. About 1925 the property was obtained by Granby but a major attack on the orebody did not begin until about 1937. Work continued through to 1957. Immediately following the war years a step up in exploration extended the mine's ore reserves appreciably. At this time the writer came to be connected with the operation. The final shut down was directly due to world copper price reductions with the stabilization of copper markets after post-war reconstruction period. At the mine, ore grade was low and the mine and mill equipment was worn out and obsolete. Higher grade underground ore was exhausted and prospects of continuing to operate at a profit were poor.

A total of about 35 million tons of ore had been mined over the life of the operation. Most of the ore was removed by underground mining methods but in final years half of the daily production of about 6,000 tons was being produced from open pit operations. Present reserves of the mine show about 7 million tons of ore which could be mined only with some considerable improvement in world copper prices. This ore would all be produced by open pit methods. An indefinite tonnage of caved and broken rock which is known to carry appreciable copper values exists over the old underground mining area. Due to continual subsidence to stopes deeper down, test work or production from this material could not be carried out during the past. Ground will now be stabilized and this can be considered as a potential production area.

The mine operation, with its extensive underground workings, has provided a detailed picture of the geology of an ore occurrence in the Nicola rocks. Some of the critical features which may be of value in the location and identification of similar ore bodies elsewhere in these rocks are outlined below and the present theories of ore genesis at the mine are described.

Description of Mine and Ore Bodies

The ore bodies of Copper Mountain Mine occur as replacements and vein fillings in favorable rocks along steep north-westerly and north-easterly trending fracture systems. These zones are intersected by a post ore system of felsite and quartz porphyry dykes which have a general north-south trend. These dykes are up to 150 feet thick. They divide the ore zones into individual stoping blocks with relatively large vertical dimensions so that various types of shrinkage stoping have been used as methods of underground ore extraction. In open pit operations felsite dyke material is usually easily separated from ore on a basis of color.

The mine outcrop area on top of the ridge east of Similkameen River ranges in elevation from 3900 to 4200. A haulage tunnel at 3200 elevation drew ore to a crushing plant on the steep side of the river valley and crushed ore was transported by C.P.R. to the concentrator at Allenby, about 10 miles to the north where the more open valley provided plant site. Tailings were transported by wood stave pipe for another 5 miles to disposal areas on the flats to the south-east of Princeton. The copper concentrate was shipped to the Tacoma Smelter by rail. Power for the whole operation was supplied by a steam plant located near Princeton using local coal as fuel.

Alteration

At Copper Mountain alteration is obscure. A definite zone of sericite-kaolin alteration can be defined microscopically and this may be critical but its importance has not been proven. This may be related to the granodiorite and pegmatite period period preceding the ore.

Mineralization

The ore minerals at Copper Mountain are bornite and chalcoyprite. In the high grade ore bodies some chalcopyrite is usually detectable but in general bornite is predominant. There appears to be a zoning in the ore with decreasing copper and sulphur from chalcocite to bornite to chalcopyrite, to pyrite, to epidote. Magnetite, though plentiful in the older igneous rocks as a primary constituent, does not occur significantly with relation to the ore. Minor amounts of gold, silver, lead, zinc, molybdenum and antimony can be found in the ore zones.

Stratigraphy of Copper Mountain Rocks

The Copper Mountain ore bodies occur in tuffaceous rocks of the Wolf Creek series of volcanics. The Wolf Creek series outcrop almost continuously for about 40 miles along the western border of the Okanagan batholith to the north and east of the mine but direct correlations are impossible due to cover by tertiary and recent formations and interruption

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by several smaller igneous intrusions. From lack of definite markers in the Wolf Creek series, the exact location of the Copper Mountain horizon in outcrops of the Wolf Creek formation away from the mine have not been identified.

The most favorable part of the formation at the mine is a series of thinly stratified tuffs totalling about 350 feet in thickness. Due to tilting toward the Copper Mountain Gabbro, this formation includes all of the deeper ore bodies of the mine. Thick layers of coarse fragmental tuff immediately below and of massive andesite above are almost barren but still higher beds carry the ore bodies of the old upper mine. Total strata represented are about 2,000 feet.

Fracturing

Intense fracturing is one of the most prominent features of the Copper Mountain Mine. Apparently at least four periods of fracturing are recorded, two earlier and two subsequent to the ore deposition. As a result of this, in the less competent tuffaceous rocks of the ore zone, fractures occur every couple of inches or less. In the massive formations above and below, fractures are much less prevalent. Alteration close to the gabbro contact and the main fault has had a similar favorable effect on the amount of fracturing, and even in the unfavorable massive formations fracturing is increased in this zone of alteration.

The main fault with a trend to the north-west with regional structures has apparently had several movements extending through geological history, probably from late Jurassic time when it was formed as a late phase of the disturbance which marked the intrusion of the Copper Mountain Gabbro stock and the regional granodiorite.

Folding

An open fold structure can be defined in the Wolf Creek series at Copper Mountain. Much of the ore occurs on the crest of the anticline. However, with the several ore controls already suggested, the particular importance of this structure is not clear. The fold appears to have a north-south axis and possibly plunges to the south. The scale of the folding is such that the crest to crest distance of similar folds would be half a mile or more with a vertical dimension of 400 or 500 feet.

Relation of Ore to Igneous Intrusives

The several periods of fracturing at Copper Mountain are filled by several different types of dykes. These dyke types can be related to various larger intrusive and extrusive rock masses can be dated by their relation to stratified rocks so the ages of the fracturing and related mineralization can be inferred with relation to the stratified rocks and the geological timetable.

By this dating process, the oldest intrusive rocks in the area appear to be a system of diorites and feldspar porphyry dykes filling north-south and east-west fractures in the Wolf Creek Series. This is related to and followed by the gabbro stock intrusion. Northwest fractures and east-west trends appear to have controlled the gabbro intrusion. Pegmatite and syenite dykes possibly related to the granodiorite of the Okanagan Batholith cut the preceding rocks following north-east trending fractures. No granodiorite outcrops are known in the mine area. Mineralization follows slight fracturing of these dykes on north-west and north-east lines.

The plentiful felsite and quartz porphyry dykes of the mine are unmineralized. These rocks can be related to the Otter granite. They follow north-south and north-east fractures. These dykes show deflection along the main fault and at the same time are cut by late movement on the fault. Away from the mine they are dated as late cretaceous or tertiary in age. Andesite dykes lie along the main fault and some of the north-east trending fractures. These are probably feeders for the lava flows of Miocene time which are well represented a mile or so to the north of the mine.

Conclusions as to Genesis and Controls of Ore at Copper Mountian

By dating, the ore at Copper Mountain is now placed as late Jurrasic or early Cretaceous, being a late stage in the regional granodiorite intrusive period.

Copper mineralization is related to the intersection of two fracture systems; first a north-south faulting with auxiliary fractures and secondly a north-west faulting with reopening of some of the earlier fractures by auxiliary forces. Several periods of later faulting have cut and offset the ore zones.

The tuffaceous horizons in the Wolf Creek Series have been especially subject to fracturing and this has provided favorable conditions for ore deposition in the mine area.