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TAHTSA LAKE

Copper-Molybdenum

Berg
(Kennco Explorations, (Western) Limited)
(By A. Sutherland Brown.)

(53° 127° N.E.) This property is in the Tahtsa Range 6 miles north of Tahtsa Lake and 9 miles west of Sibola Peak. It consists of 108 recorded claims held by Kennco Explorations, (Western) Limited (1030 West Georgia Street, Vancouver 1; J. A. Gower, manager of exploration). The property is serviced by a 26-mile cat road from Twinkle Lake on the road from Houston to Tahtsa Lake.

The Berg was located in the autumn of 1961 as a result of geochemical reconnaissance surveys. Exploration has been continuous since 1962 and has included detailed geochemical, geological, and magnetometer surveys, and since 1964 some 13,000 feet of drilling of all types. In 1966 about 10 NX-WL holes were cored totalling about 6,000 feet. George O. M. Stewart was geologist-in-charge.

Geology

The Tahtsa and Sibola Ranges are chiefly underlain by massive and clastic volcanic rocks of the Hazelton Group of Middle Jurassic age. These are moderately folded with north trending axes. The volcanic rocks are intruded by a series of small plutons, two of which occur in the vicinity of the Berg copper-molybdenum deposit. One is a quartz diorite with a surface area of 4 or 5 square miles; the other is a subcircular plug of quartz monzonite porphyry about 2,400 feet in diameter. Both are important hosts of the ~~ore~~ mineral deposit and the porphyry appears to have a genetic relation to it. These plutons cut the Hazelton rocks on the west flank of a north trending anticline. In the vicinity of the deposit, dips of 20 to 35 degrees to the east are characteristic.

are these Compatible

MINERAL COMPOSITION, INTRUSIVE ROCKS AT BERG COPPER-MOLYBDENUM DEPOSIT

VOLUME PER CENT

	PHENOCRYSTS							TOTAL						
	Quartz	Plagioclase	Orthoclase	Hornblende	Biotite	Opaques	Matrix	Quartz	Plagioclase	Orthoclase	Hornblende	Biotite	Opaques	Average of
Quartz diorite (1)	-	-	-	-	-	-	-	10.8	57.6	8.0	16.6	4.6	3.9	5
Quartz monzonite porphyry (2)	4.1	27	2.4	2.1	3.5	1	58.9	20.3	38.8	30.0	3.0	6.1	1.4	4
Latite monzonite porphyry (4)	3.0	20	-	7.5	3.7	1.5	64	4.2	49.0	23.0	13.5	5.0	3.0	2
Andesite (5)	-	-	-	-	-	-	-	6.5	68.0	-	18.5	1.5	5.5	2

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Geology close to the quartz monzonite porphyry plug is shown on Figure . Much of the area is covered with felsenmeer so that true outcrop is relatively rare. In the map-area the Hazelton rocks are cut by a series of five intrusive bodies which in the probable order of intrusion from oldest (1) to youngest (5) are:

(1) Quartz diorite and diorite stock.

(2) Quartz monzonite porphyry plug.

(3) Quartz monzonite porphyry breccia pipe.

(4) Monzonite porphyry dykes.

(5) Small andesite dykes.

The order of breccia pipe and monzonite porphyry dykes may be reversed but both seem to post-date the main sulphide mineralization. The breccia pipe is just south of the map-area. Its areal extent is poorly known because it occurs in a deeply drift-covered area.

The accompanying table lists the average mineral compositions of the main intrusive phases. Percentages were estimated using charts for all specimens and some were checked by point count. The petrology of all intrusive phases and the wallrocks is discussed in sequence.

The Hazelton rocks in the immediate vicinity are dominantly andesitic tuffs, lapilli tuffs, and volcanic sandstones. Minor marine shales occur. The andesite tuffs where only slightly metamorphosed are dark green to purple rocks composed of irregular fragments most of which are of identical mineralogy if differing grain size. These are microporphyritic rocks of felted to trachytic texture composed of andesine and hornblende in a cryptocrystalline matrix. The lapilli are contained in a fine dust of similar composition plus much non-sulphide opaque matter. Such rocks in the hornfelsic aureole may be converted into rusty weathering purply brown biotitic hornfels or into skarns (METASOMATIZED ROCKS) in which the original texture is scarcely visible if at all. The most common

We have not seen anything in drill holes that we would call skarn, i.e. lime silicate rocks. Would be interested to know where these occur-skarn is composed of a mosaic of fine new quartz, biotite, and potassium feldspar with palimpsest remnants of original grains shown by varying proportions of these minerals and earlier chlorite, plagioclase, and kaolinite. Locally, mottled greisen-like rocks are produced by the metasomatism.

Quartz diorite (1) specimens range either side of 10 per cent quartz so that some are diorites, others quartz diorites, but the average is the latter. The fresh quartz diorite is a fine medium-grained light grey rock that contains scattered hornblende phenocrysts. The average grain is slightly coarser than 1 millimetre in diameter. The hornblende phenocrysts are up to 8 millimetres long and are commonly aligned in a lineation and vague foliation not evident in the other minerals. Predominant slightly rounded laths of labradorite occur surrounded by cuspate and poikilitic hornblende with random minor biotite and opaque minerals. Plagioclase is uniformly zoned from An_{60} to An_{50} and Carlsbad albite twins are common. Quartz and slightly perthitic orthoclase occur in both interstitial accumulations and in small dispersed anhedral grains. Most feldspar is fresh but homblende and biotite may be altered to chlorite.

Near their contacts these rocks are chilled to fine nearly aphanitic rocks that are generally quartz poor. Where thermally metamorphosed these greatly resemble hornfels derived from volcanic rocks so that the contact appears gradational over short distances. The main metamorphic change in the quartz diorite within the hornfelsic aureole of the quartz monzonite porphyry is that hornblende has entirely been converted to new brown biotite.

Quartz monzonite porphyry (2) is a coarsely porphyritic rock that is grey where fresh but in natural outcrops is coated with geothite and on freshly broken surfaces the feldspars are stained brown. Characteristic features include abundant feldspar tablets, prominent biotite books, and irregularly scattered corroded quartz. Maximum grain size of phenocrysts approaches 1 centimetre long. Biotite books may be 3 to 4 millimetres in section and up to 7 millimetres in the Z crystalographic axis. Phenocrysts form 35 to 50 per cent of the rock. Plagioclase phenocrysts are stubby crystals commonly showing combined form and complex twinning. Carlsbad albite twins, however, are absent. Most crystals show many oscillatory zones, seven to nine being common. Average composition is about An_{30}. Most plagioclase is partly sericitized and some in addition is altered partly to kaolinite and calcite. The potassium feldspar is slightly perthitic orthoclase. Biotite folia may be bent and may be interleaved with chlorite. Hornblende is completely altered to chlorite plus opaque minerals. The matrix has an average grain size of 0.02 to 0.04 millimetre and is chiefly a mosaic of either subequal amounts of plagioclase and orthoclase with less quartz or of perthite with quartz. Chlorite and opaque minerals are minor.

The breccia (3) is a cream to faintly green coloured rock dominantly composed of fragments of quartz monzonite porphyry with minor other types such as unmetamorphosed siltstone and andesite. Most fragments are irregular to subangular and of 15 millimetres or less contained in an abundant similar finely comminuted matrix. Large fragments are very rare. The breccia is altered by intense kaolinization of feldspar and complete change of biotite to muscovite, and minor carbonatization. Widely disseminated well-crystallized pyrite, on which octahedral faces are prominent, is common but chalcopyrite is very rare. Some fragments contain quartz veinlets.

The quartz-bearing monzonite porphyry (4) is superficially very similar to the quartz monzonite because its phenocrysts, mineralogy, and content are similar. It is, however, distinguished readily in thin-section by the relative absence of quartz in the matrix and by the abundance of hornblende both in the matrix and as middle-sized grains. By Kennecott geologists it has been called quartz-latite porphyry. The fresh rock is grey and contains about 30 to 40 per cent phenocrysts. Chilled monzonite porphyry is dark grey and slightly foliated. Quartz phenocrysts are nearly as common as in the quartz monzonite porphyry but are very deeply embayed and skeletal. Plagioclase is also similar, about An_{35}, but seemingly not as highly zoned. It may be fresh, or sericitized. Biotite occurs chiefly in books elongated in Z direction. Bent plates are common. Hornblende is much commoner than in the quartz monzonite porphyry and occurs in long prisms of diamond-shaped section. Sphene is a common accessory phenocryst. It is in the matrix that most difference occurs between the quartz monzonite porphyry and monzonite porphyry. Here visible quartz is nearly absent and a very fine-textured plagioclase, hornblende, and opaques occur surrounded by slightly larger poikilitic potassium feldspar. Alteration of monzonite porphyry is rarely intense but some replacement of plagioclase and hornblende by epidote and chlorite is fairly common.

The andesite dykes (5) are small middle grey aphanitic dykes that contain up to 2 per cent feldspar phenocrysts. They have a texture that is between trachytic and felted, and consist of plagioclase, chlorite after hornblende, quartz, opaques, and minor biotite. Plagioclase is generally highly altered to kaolinite and calcite and hornblende to chlorite and calcite.

Structure

The quartz diorite stock and the quartz monzonite porphyry plug cut the tilted panel of Hazelton rocks without visible distortion. Reliable attitudes are rare in the metamorphic aureole but generally confirm that the walls have been deformed only locally if at all. The quartz diorite was intruded first for, although it is not in contact at the surface with the quartz monzonite porphyry, it is metamorphosed by the latter. Also some small inclusions have been found in the quartz monzonite that are similar to the quartz diorite. The quartz monzonite porphyry plug is subcircular in outline but its margins are quite irregular. One or more large tongue-like masses extend from the main mass. Despite the plug's small size the wallrocks have been intensely metamorphosed. On the whole the plug resembles a volcanic neck. The breccia pipe is near the south margin of the plug in an area that would be expected to be in the ore zone but it is only mineralized with minor pyrite and rare chalcopyrite probably originally present in the fragments. The monzonite porphyry is almost certainly a late phase of the quartz monzonite porphyry even though it is less silicic. It forms a blob-like mass roughly co-axial with the quartz monzonite plug and from this a group of segmented dykes extends to the northeast and southwest (striking north 40 to 80 degrees east). The monzonite porphyry has a chilled foliated facies in contact with the quartz monzonite porphyry. Dykes cut mineralization but contain no significant mineralization themselves. The quartz-bearing andesite dykes are not only younger than the mineralization and monzonite but also unrelated to the quartz monzonite porphyry. Most are small steep dykes striking about north 60 degrees west, hence nearly normal to the monzonite.

Primary Mineralization

The Berg deposit consists of a broad annulus co-axial with the quartz monzonite porphyry plug and is contained in this body and its peripheral hornfels and diorite. Primary mineralizing sulphide minerals include chalcopyrite, molybdenite, and pyrite with minor sphalerite, galena, and arsenopyrite. A gossan zone from weathered pyrite extends over an area slightly larger than that of Figure . Deep oxidation, leaching, and enrichment have affected the deposit so that chalcocite ~~is an important ore mineral and~~ and ferrimolybdite ~~is~~ are common.

Mineralization extends from well within the porphyry to approximately 800 feet beyond. Economic mineralization is mostly outside the plug. Primary copper and molybdenum mineralization overlap but in general the best molybdenum mineralization is near the quartz monzonite contact and may be just within the plug whereas the best primary copper mineralization is 200 feet or more beyond the contact. Primary mineralization occurs principally in a fine-textured stockwork of quartz-filled veinlets, and as disseminations in a few major veins. A fracture stockwork extends over a wider zone than the quartz veining and includes most of the quartz monzonite plug and well beyond the mineralization into the walls. This stockwork does not have obvious preferred orientations where it is intense but a flat joint set striking about north 20 degrees west and dipping 15 to 25 degrees southwest is common in the less fractured areas with other sets less uniform. Fracturing occurred in at least three stages and probably more. Well-defined fracture-filling stages include an early quartz-pyrite-molybdenite-chalcopyrite stage, a later pyrite or pyrite-sphalerite-galena stage, and finally an anhydrite-gypsum stage. It is likely that the main mineralizing stage was divided into overlapping substages. Molybdenite is chiefly found in the stockwork in quartz veinlets or more rarely as dry fracture coatings. Chalcopyrite occurs in these modes but also in the higher grade areas occurs as widespread disseminations replacing secondary biotite in diorite or hornfels. Pyrite likewise occurs disseminated and in veinlets. Dry pyrite-filled fractures extend well beyond the economic mineralization and appear to represent products of both the first and second stages. Anhydrite-filled fractures cut the late andesite dykes as well as the breccia pipe although they are rare in the latter.

We haven't seen this ?
RIGHT

Alteration

The effects of hydrothermal alteration are not entirely separable on the basis of present study from the thermal metamorphism and metasomatism, and in fact probably were closely related in time. Hydrothermal alteration did however continue after the period of significant sulphide mineralization. The characteristic thermal metamorphic mineral is fine felted biotite which replaces former mafic minerals and also feldspars. Silicification is characteristic of the metasomatism and this grades into widespread hydrothermal alteration, in which plagioclase is initially sericitized and finally kaolinized, and biotite is converted to muscovite and some plagioclase is mantled or partially replaced by orthoclase. The rocks of the breccia pipe which post-date mineralization are intensely kaolinized and biotite entirely converted to muscovite. Widespread anhydrite-gypsum veining and local minor replacement are a still later stage.

Amount of chalcocite is not sufficient to cause significant enrichment (only about .05 - 0.10% Cu)

Secondary Mineralization

The primary mineralization of the Berg deposit has been subjected to intense oxidation, leaching, and enrichment. The depth of leaching is related to the topography and to present and past water tables. In interfluve areas barren leached rock may extend to 200 feet or more below the surface and ~~enriched areas~~ [secondary mineralization] may extend to 400 feet or more. In present stream valleys the barren zone may be just a few or a few tens of feet deep. Molybdenum has been oxidized to ferrimolybdite over a lesser depth than chalcopyrite has been leached. Chalcocite ~~first~~ appears as coatings on disseminated pyrite ~~and may (not so) completely replace pyrite in areas of maximum enrichment~~. Secondary copper mineralization partly obscures the original good zonation of copper and molybdenum.

— extremely limited - I have never seen cc that wont readily scrape through to pyrite etc

Distribution

It is evident that the southeastern half of the annular zone contains the highest grade material. This area is the one of greatest complexity as a result of multiple intrusion and has the greatest variety of host rocks, quartz monzonite porphyry, volcanic hornfels, and quartz diorite. The company has made no statement regarding grade or reserves.

Mercury Soil Profile

Figure   is a profile showing analyses by Lemaire S-1 mercury detector of soil samples taken at points shown on the map (Fig.   ). If the organic samples are rejected, the profile is of interest because both peaks and background readings are so low. Nevertheless, the "anomalies" are symmetrical with regard to the ~~ore~~ [sulphide] zones. A possible explanation of the low

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resulted in ?

readings is that deep weathering and leaching of sulphides ~~with attendant~~ early release of mercury.

[Reference: Minister of Mines, B.C., Ann. Rept., 1965, p. 87.]