SHEBA COPPER MINES LTD
HIGHLAND VALLEY PROPERTY

REPORT OF EXPLORATION WORK - 1967 - 1968

PART 2 GEOLOGY

92-I-13

By: Y.Hirata

SHEBA COPPER MINES LTD.

HIGHLAND VALLEY PROPERTY

REPORT OF EXPLORATION WORK 1967 - 1968

PART 2 GEOLOGY

BY. Y. HIRATA

TABLE OF CONTENTS

LIST OF MAPS ACCOMPANYING REPORT

GENERAL GEOLOGY

After the intrusion of the Guichon Batholith sometime in the late Triassic to middle Jurassic age, an acidic composite stock, consisting of phaneritic, porphyritic, and porphyry rocks, was successively intruded near the core of the batholith in the present Highland Valley area.

The deformation brought about by the intrusion produced shear and tension cracks around the stock. At the same time, stoping occurred and explosions ensued at the top of tiny cupolas around the stock as a result of the change of pressure caused by the cooling of the magma. Thus the characteristic breccia pipes which now can be seen on the Bethlehem property were formed by the brecciation.

At the last stage of magmatic differentiation of the stock, hydrothermal solutions successively brought alteration and mineralization, selectively, into the fractures and breccia pipes. These are the ore deposits which are distributed in the Highland Valley area, the younger intrusives being the principal cause of the mineralization.

Some confusion has arisen regarding these younger intrusives because the authors of the principal reports to date have used different names and definitions for the various rock units.

White et al (1957) divided the composite stock into two rock units, "Bethsaida granodiorite and "Younger complex". The Younger complex consists mainly of Bethlehem quartz diorite and a few kinds of porphyries and is considered to be equivalent to the early marginal phase or cupola phase of the Bethsaida granodiorite.

Chown (1958) on the other hand, classified the composite stock as "Porphyry complex" and "Bethsaida complex". In his definition, the

distribution of Porphyry complex was limited to the north side of the Valley and he included Bethlehem quartz diorite as defined by White in the "Porphyry group".

Chown grouped White's Bethsaida granodiorite and the quartz diorite which is distributed in the south side of the Valley and defined them as "Bethsaida complex".

Therefore, according to Asarco's map, Bethsaida rock extends eastward into direct contact with Guichon rock at the east side of the Sheba property.

With regard to the relationship of "Bethsaida stock and "Porphyry", he writes as follows: "Relationship of Bethsaida stock to the Porphyry complex outcropping is not established, because the two rock types are not in contact".

Carr (1960) divided the composite stock into "Porphyry" and "Younger quartz diorite". Younger quartz diorite formed a large elongate mass extending from Gnawed Mountain northward to the Bethlehem Copper property.

Porphyry is distributed over an area of 6 miles by 6 miles on the south side of the Bethsaida property, intruding Younger quartz diorite. It consists of porphyritic granodiorite and a chilled margin of aphanitic porphyry.

Therefore, the fact is that the porphyry which Carr described in his report is White's Bethsaida granodiorite. According to the geological map of the Highland Valley area which Carr compiled in 1966, he renamed the Younger quartz diorite as Bethlehem quartz diorite.

Lindberg (1965) and also geologists of Lornex used the name "Skeena quartz diorite" for a rock unit, but with different definitions.

Lindberg defined "Skeena quartz diorite" as the rock which

intruded the Guichon quartz diorite on the east part of Sheba property and is distributed on the Skeena property and east to the Guichon contact.

On the other hand, geologists of Lornex named the rock which is intruded by Bethsaida granodiorite as "Skeena quartz diorite".

However, White et al (1957) are of the opinion that the rock which is widely distributed on the Skeena property is the Guichon quartz diorite. The writer, has therefore, classified the rock units according to the following definitions.

DESCRIPTIONS AND DEFINITIONS OF THE ROCKS

(1) Guichon quartz diorite

It is the principal member of which the Guichon batholith is composed. In the southern part of the Valley, it occurs on the eastern part of the Sheba property, and also on the west side of Calling Lake.

This rock is a grey to dark grey coloured, medium-grained mixture of plagioclase, hornblende, biotite and quartz. It is quite uniform in texture and composition. Colour index is approximately 20.

(2) Bethlehem quartz diorite and its porphyry phase

Younger complex (White), Porphyry complex (Chown), Bethlehem quartz diorite (Carr), and also some part of Skeena quartz diorite (lindberg) are equivalent to the above.

The rock facies show two gradational change from phaneritic in the central part of the rock mass, to porphyritic outward from the center and to porphyry on the margin.

All phases of the Bethlehem mass have in common the fact that where they are found in contact with Guichon quartz diorite, they have a chilled margin against the latter.

There are several porphyry dikes which intrude Guichon and Bethlehem rocks. Although there are a few questions left about their classification, the writer has included them in the Bethlehem group for the present.

2.1 Bethlehem quartz diorite.

It is the rock which is most widely distributed on the Sheba property. The property is occupied mostly by this rock in the west of the contact against Guichon quartz diorite that is in the east of the Sheba property.

This rock is leucocratic and its colour index ranges from five to fifteen. The grain sizes of rock forming minerals are not uniform. It contains hornblende, biotite, quartz, plagioclase and some orthoclase. The ratio of hornblende to biotite varies considerably. Hornblende appears in the form of relatively large, well-shaped crystals enclosing small crystals of plagioclase. Quartz crystals are characteristically spotty and rounded.

2.2 Porphyries

These appear as a marginal phase of the Bethlehem mass and as dykes. Porphyry which is a marginal phase of Bethlehem mass is pale-coloured and contains plagioclase, hornblende and rounded quartz as phenocrysts. Hornblende sometimes shows poikilitic texture.

As there is a gradational change between this marginal porphyry and the normal Bethlehem quartz diorite the writer showed it on the geological map as Bethlehem quartz diorite.

Porphyries which occur as dykes are all leucocratic and contain hornblende and plagioclase as phenocrysts. Hornblende phenocrysts are commonly well shaped and sometimes show poikilitic texture.

The ground-mass is usually aphanitic, and sometimes phanerocrystalline.

These rocks are divided on the presence or absence of quartz phenocryst.

a) P_1 - porphyry (andesite porphyry)

Porphyry of no quartz phenocrysts and porphyry of rare quartz phenocryst.

b) P_3 - porphyry (dacite porphyry)

Porphyry of abundant quartz phenocrysts with rounded shape.

2.3 Aplite

It is recognized everywhere in the property as small dykes of maximum one foot width intruding Bethlehem quartz diorite. However, it is too small to show in the map of 1" = 400' scale.

(3) Bethsaida granodiorite

There is no typical Bethsaida granodiorite on the Sheba property, but the porphyry of a small stock or dike form on the north slope of Gnawed Mountain may be considered to be a porphyry phase of the Bethsaida granodiorite.

Though it contains large euhedral quartz phenocrysts, euhedral biotite books which can be seen in typical Bethsaida granodiorite are not found in this porphyritic phase.

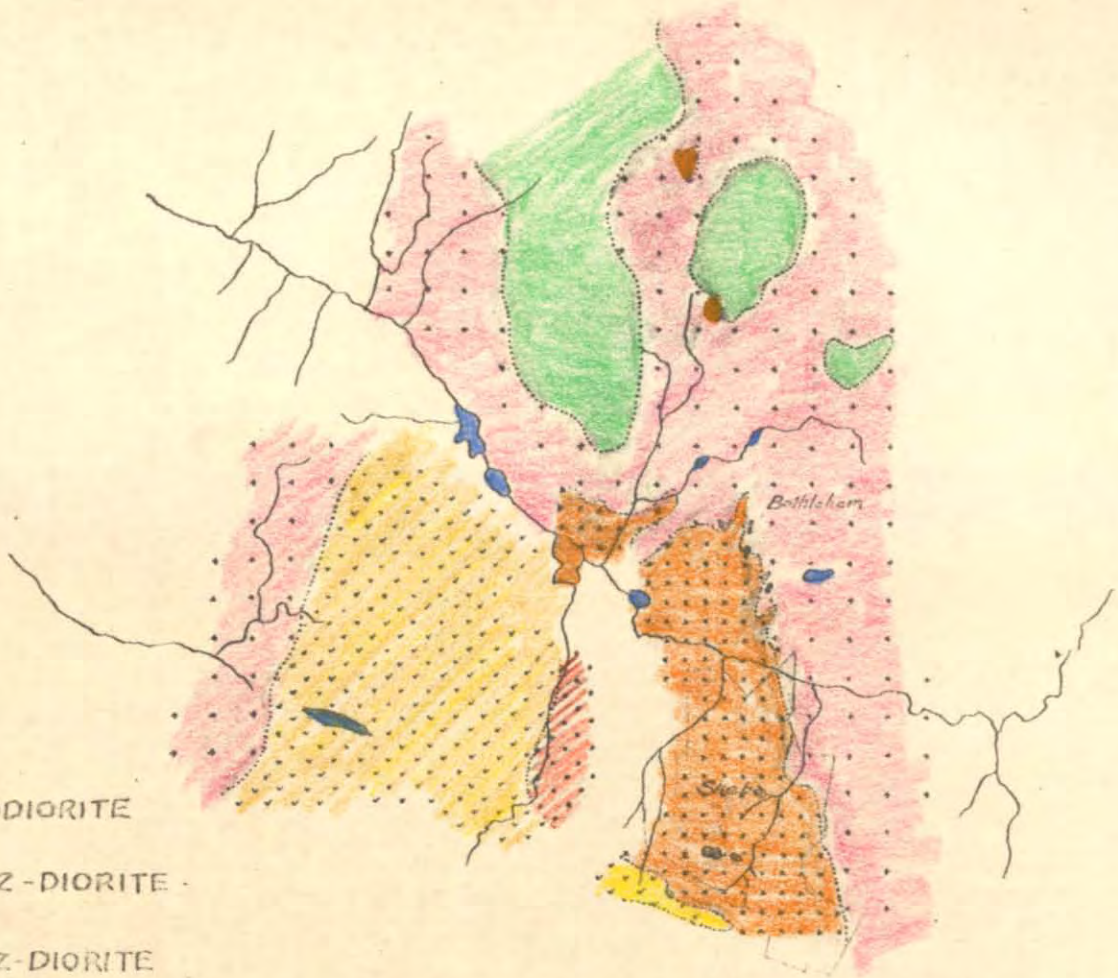
GEOLOGY OF THE SHEBA PROPERTY

Geological mapping which covers about 3 miles from south to north and 1.5 miles from east to west has been done by Sumitomo staff geologists; Y. G. Hirata, M. Obara and K. H. Otani.

A Geological mapping has been done at a scale of 1" = 100' along cut lines and 1 " = 50' on all trenches.

The result of surveying were compiled on the accompanying geological map at a scale of 1" = 400'.

The principal geological features on this property is the intrusion of the Bethlehem quartz diorite into Guichon quartz diorite



LEGEND

- Kamloops Group
- Breccia
- Bethsaida Granodiorite
- Bethlehem Quartz-diorite
- Skeena Quartz-diorite
- Guichon Quartz-diorite

inches
0 1
0 1 2
centimetres

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

Sumitomo Metal Mg. of Canada Ltd.

Geologic Map
of Highland Valley Area

Compiled by G.Y. Hulme
Feb 6 '68

and its contact extending southward from the Bethlehem Copper property across the Sheba.

In view of the known relationships, the object of exploration was the east side of the Sheba property where existence of the contact zone could be excepted. Geological, geochemical, and geophysical surveys were concentrated on the said part.

The contact between the Bethlehem mass and Guichon quartz diorite is clearly defined southward from J-31 claim, to J-15 claim. In J-15 claim its direction changes to east, but on J-35 Fr. it changes again and strikes southward to the southern part of map area.

The contact of the Bethlehem mass, except for local branches like the one to be seen between 40N and 28N does not show an irregular boundary. In many cases, the contact of Bethlehem mass has a chilled margin several inches wide.

On the Bethlehem side of the contact the porphyritic phase which contains abundant phenocrysts of feldspar has a width of about 50' - 100'. The porphyritic phase changes transitionally to normal Bethlehem quartz diorite. This transitional zone can be recognized very distinctly in the contact near 36N, 8W.

Bethlehem and Guichon quartz diorite are cut by P_3 porphyry dykes (dacite porphyry) in several places in the map area. In the northeastern part of map area, there are at least two dykes, striking N.N.E., having a width of 300' at 4S. 17E. and 350' at No. 7 trench.

Bethsaida porphyry intrudes Bethlehem quartz diorite as a dyke or small stock on the north flank of Gnawed Mountain, in the southeastern part of the property.

A breccia mass is exposed on the northeastern slope of Gnawed Mountain. It appears to be composed of fragments of Bethlehem quartz diorite cemented with a matrix composed mainly of specular iron.

However, on closer inspection, it is seen to be peculiarly altered and mineralized along closely spaced fractures in the rock. Fragments of unaltered rock, surrounded by fractures, are left in angular or subangular form.

Therefore, it is doubtful if it could be named breccia, because it does not have a sharp boundary, as intrusive breccias, nor is there evidence of rotation of the fragments.

The faults which greatly control the structure are not yet known. Fractures related to alteration and mineralization, appear mainly in the contact zone. Near the contact between 40N and 4N., the fractures have a N.N.E. strike and are almost parallel to the contact, but near trench No. 8 - No. 11, the fractures strike north, perpendicular to the contact.

ROCK ALTERATION AND MINERALIZATION

On the Sheba property, two principal types of hydrothermal rock alteration are recognized, i.e. potassic and propylitic alteration.

These types of alteration selected the fractures occurring near the contact between Guichon quartz diorite and the Bethlehem mass and appear parallel to the contact as two zone having a width of several hundred feet.

Potassic alteration appears in the contact and on its west side. The width of the zone is approximately 50' - 100'. Feldspar crystals in the rock, along the fractures developed in the rock were altered to potash feldspar with the simultaneous deposition of muscovite. Epidote seams, formed after the potash feldspars stage, can be observed along fractures.

Propylitic alteration overlapped potassic alteration, and it appears mainly within the Bethlehem mass as a zone 300' to 600' wide. This alteration can be recognized as chloritization of mafic minerals.

Generally, hornblende, especially when it shows poikilitic or sieve texture, is strongly altered. In contrast with the hornblende, biotite is often left unaltered. Magnetite is commonly observed in the grains of chloritized mafic minerals.

On the northeastern flank of Gnawed Mountain an irregular-shaped altered zone is exposed. It is considered that this zone consists of potassic alteration occurring along numerous fractures in the Bethlehem quartz diorite and a peculiar alteration which produced a combination of specular iron, chlorite and tourmaline.

High grade copper mineralization has not yet been found on the Sheba property but low grade mineralization has been found in several places, as shown on the map. Mineralization may be divided into two types, one which relates to Bethlehem quartz diorite and the other which relates to Bethsaida granodiorite.

The former is found in the north and central part of the property, and is almost overlapped with the above mentioned potassic and propylitic alteration. In the potassic altered zone, it can be observed mainly as bornite stringers along the fractures, and in the propylitic altered zone, it occurs as disseminated bornite in chloritized mafics. In both cases, chalcopyrite and molybedenite are rare, and pyrite is not observed. Quartz veins are also rare.

The second type of mineralization is distributed on the north slope of Gnawed Mountain located on the south side of the property. Compared with the former, rock alteration are weak, and only mafic minerals along the fractures are chloritized.

Mineralization appears as bornite, chalcopyrite, and molybdenite accompanied by quartz veins. Bornite and chalcopyrite occur as fracture filling and a lesser amount of molybdenite films are also recognized.

These mineralized vein and fractures have various directions, but NNE~NE systems are the most important. The frequency of mineralized veins and fractures is low and they do not form a minable ore body.

Respectfully submitted,

Yoichi Hirata

Yoichi Hirata, P. Eng.,
Senior Geologist.
Sumitomo Metal Mining Co.
of Canada Ltd.

April 30, 1968.

REFERENCES

1. Cockfield, W. E., (1949) Geology and Mineral Deposits of The Nicola Map-Area, B. C. G.S.C. Memoir 249

2. Duffell, S. and McTaggart, K.C. (1952) Ashcroft Map Area, B.C. G.S.C. Memoir 262

3. White, W. H., Thompson, R. M. and McTaggart, K. C., (1957) The Geology and Mineral Deposite of Highland Valley, B. C. Bull. C.I.M. Vol. 50, No. 544, Page 487-503

4. Chown, E. H. and Gale, R. E., (1956) Geology of Highland Valley Area, B. C., Asarco Report

5. Carr, J. M., (1960) Porphyries, Breccias, and Copper Mineralization in Highland Valley, B. C. Can. Min. Jour., Vol., V 70, P. 71 - 73

6. Hirata, Y., (1965) Geology and Mineral Deposits of The Bethlehem Properties, B. C., Canada Journal of the Society of Mining Geologists of Japan. Vol. 18 (70 - 71), P. 75-82

7. Lindberg, P., McAndrew, J. and Conto, T., (1965) Geology and Mineral Occurrences of the Gnawed Mountain Area Highland Valley, B. C. Anaconda Report.

8. Carr, J. M., (1966) Giologic Map of Highland Valley B. C. Department of Mines.

SHEBA COPPER MINES LTD.
HIGHLAND VALLEY PROPERTY
B,C.
REPORT OF EXPLORATION WORK
1967 - 1968

PART III GEOCHEMISTRY

92-I-13

SHEBA COPPER MINES LTD.

HIGHLAND VALLEY PROPERTY, B. C.

REPORT OF EXPLORATION WORK, 1967 - 1968

PART 111 GEOCHEMISTRY

INDEX

MAPS

SHEBA COPPER MINES LTD.

HIGHLAND VALLEY PROPERTY, B. C.

REPORT OF EXPLORATION WORK 1967 - 1968

PART 111 GEOCHEMISTRY

Soil sampling was conducted over most or all of 52 claims on the eastern part of the property. This represents complete coverage of the 1967-68 project area.

PROCEDURE

Samples were taken at 100-foot intervals along picket lines spaced 400 feet apart. The samples were taken from the "B" horizon immediately below the organic "A" horizon. Samples containing organic material or leached soil were rejected. The samples were sent to CHEMEX LABS LTD., North Vancouver, for analysis.

Each sample was dried and passed through an 80-mesh stainless steel screen. A $\frac{1}{2}$-gm. sample was taken from the -80 mesh material without rolling. Copper and molydenum were extracted by a hot perchloric acid-nitric acid leach. Each sample was analysed for copper by atomic absorption. Alternate samples were analysed for molybdenum by colorimetric methods.

In addition to the routine laboratory standards, the analyst ran one standard soil sample for each 30 or 40 soil samples and reported the results. The statistical distribution of the results on standard soils was highly acceptable.

RESULTS

The results of the analyses of the soil samples are shown on Drawing No. 3-1 (Geochemical Survey, Soil Sample - Master Plan). It was felt that by adding the interpretation of the results to this map, the result would be confusing. Therefore two additional maps were prepared to illustrate the

interpretation of the results. Interpretation of copper values is shown on Maps 3-2 (Geochemical Survey, Soil Sample Interpretation, North Sheet and South Sheet). The interpretation of Molybdenum values is shown on Map 3-3 (Geochemical Survey, Soil Sample - Molybdenum Interpretation). A level of 200 ppm was selected as a threshold level for anomalous copper after a rough statistical analysis of the results. A rather arbitrary higher value of 500 ppm was also selected for plotting purposes. This higher value may be too low and 700 ppm may be better, statistically. A level of 18 ppm molybdenum was selected for interpretation purposes. This also may be too low on a Statistical basis.

The principal copper soil anomalies lie southeast of Gnawed Lake on the north slope of Gnawed Mountatin. Generally the stronger anomalies lie along minor topographic depressions. Some of the anomalous copper is undoubtedly due to down-slope movement of ground water from mineralized areas higher on Gnawed Mountain. Some is due to local mineralization. It was not evident from the soil sample results how much of the anomalous copper is local and how much transported. This area has been thoroughly investigated by trenching and drilling.

In the northern and eastern part of the property, areas of anomalous copper tend to be small and/or weak and scattered. An area weakly anomalous in copper is associated with the weak mineralization observed from 10 + 00 N to 30 + 00 N and about 12 + 00 W.

A smaller and somewhat stronger anomaly lies near 12 + 00 N, 44 + 00 E and is evidently associated with known minor mineralization near the Sheba -Gaza boundary in this area. Both of these areas have been investigated by trenching and drilling.

Some minor anomalies elsewhere in the area are probably due to known minor mineralization such as 3 + 00 S, 14 E. Some of the minor unexplained

anomalies are probably due to glacial transport of copper-bearing material or concentration in swampy areas. Some of the more promising minor anomalies have been investigated by trenching and drilling.

The only soil samples with anomalous molybdenum occurred in the vicinity of Gnawed Mountain. No samples with anomalous molybdenum were observed in the northern or eastern part of the project area. The results of the soil sampling were later confirmed by trenching and drilling. Molybdenum content of the bed rock near Gnawed Mountain was low, on the average, and non-existent elsewhere in the area.

CONCLUSIONS

The area southeast of Gnawed Lake is generally anomalous in copper and molybdenum. Lesser copper anomalies occur at two places in the northern and north-eastern part of the project area. Small and weak copper anomalies are scattered elsewhere in the project area.

The principal anomalies were rather thoroughly investigated by trenching and drilling. The amount of mineralization disclosed by this work was generally in proportion to the size and intensity of the anomaly. It is concluded that the geochemical survey was successful in that it established the location of the better mineralized areas. It is also concluded that further investigation of minor geochemical anomalies or non-anomalous areas is not warrented in view of results of trenching and drilling.

Respectfully submitted,

Gordon R. Hilchey, P. Eng.,
Exploration Manager.

April 30, 1968.