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MINES BRANCH INVESTIGATION REPORT IR 63-31

MINERALOGICAL INVESTIGATION OF ORE SPECIMENS FROM CHISEL LAKE MINE OF HUDSON BAY MINING AND SMELTING CO. LTD.

by

S. KAIMAN

EXTRACTION METALLURGY DIVISION

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SUMMARY

Microscopic study of four small specimen samples of richly mineralized ore showed that at least three silver-bearing minerals are present, namely hessite, argentiferous-tetrahedrite and pyrargyrite-proustite. They occur in grains which are usually less than 200 mesh in size and are intimately intergrown with other metallic minerals. In addition, it is believed that some silver probably is present in solid solution in gold and also in tennantite.

Gold occurs as fine inclusions in hessite, chalcopyrite or sphalerite. The largest grain of gold observed was between 150 and 200 mesh in size.

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INTRODUCTION

In a letter dated November 28, 1962, from Mr. J.N. Kirkbride, Assistant Research Superintendent of Hudson Bay Mining and Smelting Co. Ltd., Flin Flon, Manitoba, it was reported that since the introduction of a zinc-lead ore into the milling circuit the silver recovery from cyanidation of the flotation tailings had been adversely affected. It was requested that a mineralogical study of several ore samples be made to identify the contained silver- and gold-bearing minerals and to determine the nature of their occurrence.

The Extraction Metallurgy Division undertook to carry out the investigation. Accordingly, four small specimen samples and two lead concentrate samples from the Chisel Lake mine of Hudson Bay Mining and Smelting Co. Ltd., were submitted to the Mineralogy Section and were assigned our Reference No. 12/62-7. (The Chisel Lake mine is situated five miles south-west of Snow Lake, Manitoba).

MINERALOGY

A reconnaissance examination of the submitted samples was made first under a low-power microscope. Brief descriptions of the samples are given in the table on page 2. The analyses in the second column of the table were supplied by the Company.

The two samples of lead concentrate were not studied further. Detailed microscopic examinations were made of polished sections of the four specimen samples. The following are brief descriptions of the mineral occurrences in these samples. All mineral identifications were confirmed by X-ray diffraction analysis.

Sample CH-478

The metallic minerals occur in fine masses which are usually irregular in shape and appear to have been introduced into openings in the dolomite gangue. For the most part they consist of intergrowths of several minerals. The largest area of metallic minerals measures about 1 $^1/_2$ mm x 4 $^1/_2$ mm.

Description of Submitted Samples

Sample Designation	Analyses	Type of Sample	Mineralogical Composition
D.D. Hole No. CH-478 at 22.9 feet	Au 1.76 oz/ton Ag 6.64 oz/ton Pb 0.3 %	One specimen of split 7/8" core, approximately 1" in length	1/4" vein of dolomite in calcite. Vein contains small masses of galena and pyrite.
D.D. Hole No. CH-480 at 3 feet	Au 0.51 oz/ton Ag 30.29 oz/ton Pb 12.7 %	Two small specimens of split 7/8" core	Massive pyrite and silvery metallic minerals in coarse amphibole gangue.
High Lead Sample	---	One specimen approximately 3"x1 3/4"x1"	Coarse crystalline galena and pyrite in fine-grained amphibole-calcite gangue.
Sample from higher copper low lead section of mine	Au 0.57 oz/ton Ag 10.67 oz/ton Cu 12.0 % Pb 0.2 %	Two specimens each about 1 1/2"x1 1/2"x2"	Both specimens are almost entirely mineralized with chalcopyrite, sphalerite and minor amounts of pyrrhotite.
Lead Concentrate +325 mesh	Au 1.39 oz/ton Ag 44.05 oz/ton Cu 0.43 % Zn 10.0 % Pb 55.1 %	75 grams of concentrate	Mainly galena. Small proportions of non-opaque gangue minerals and minor amounts of pyrrhotite, pyrite, chalcopyrite, sphalerite, etc.
Lead Concentrate -325 mesh	Au 1.29 oz/ton Ag 58.86 oz/ton Cu 1.72 % Zn 2.7 % Pb 60.7 %	75 grams of concentrate	Similar to +325 mesh sample.

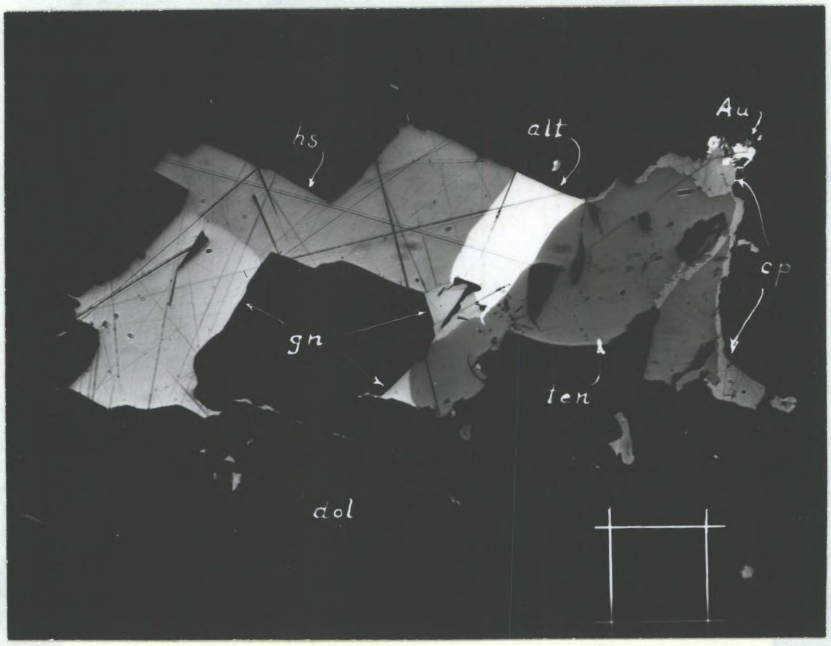

Figure 1. Intergrowth of metallic minerals in dolomite (dol) includes galena (gn), hessite (hs), altaite (alt), tennantite (ten), chalcopyrite (cp) and native gold (Au). Sample CH-478. X170

Pyrite FeS_2 (1)*, tennantite $(CuFe)_{12}As_4S_{13}$, bournonite $PbCuSbS_3$ and galena PbS are the most abundant minerals present. Pyrite often contains intergrown tennantite, galena or arsenopyrite FeAsS. Bournonite is usually associated with tennantite or galena. Galena often occurs free in gangue or is intergrown with tennantite, chalcopyrite $CuFeS_2$ or other sulphide minerals.

Arsenopyrite occurs as euhedral to subhedral grains, up to about 35 mesh in size. Chalcopyrite occurs free in gangue or is intergrown with other metallic minerals.

Minor amounts of altaite PbTe, hessite Ag_2Te and gold are present in the form of very fine grains. Altaite is usually intergrown with tennantite, galena, hessite (Figure 2) or bournonite. Hessite occurs in grains which are usually less than 200 mesh in size and is associated with tennantite and galena (Figure 1), and at times it contains fine inclusions of gold or altaite (Figure 2). Most of the gold occurs as very fine grains in hessite. The gold is light yellow in colour, which indicates the presence of alloyed silver. The largest grain of gold in the sections studied is approximately 30 microns in size (< 325 mesh).

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*Numbers in brackets refer to references listed on last page.

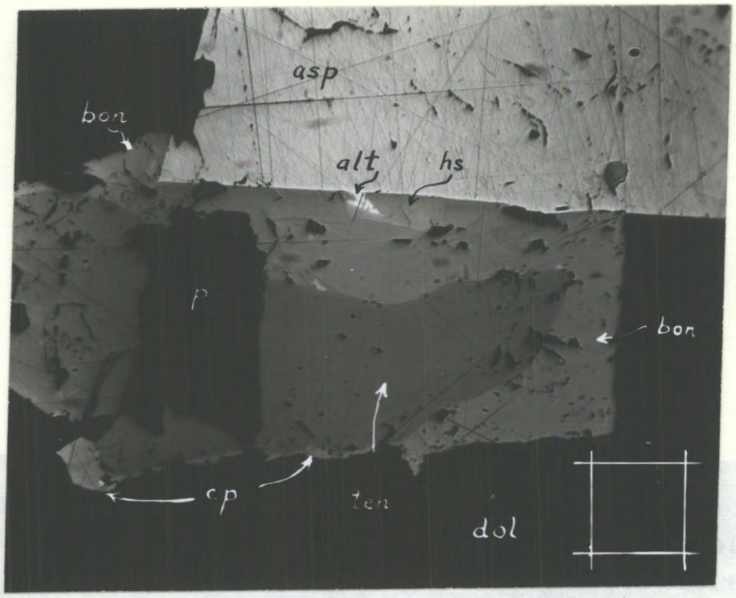

Figure 2. Intergrowth of metallic minerals adjacent to a crystal of arsenopyrite (asp) includes altaite (alt), hessite (hs), bournonite (bon), tennantite (ten) and chalcopyrite (cp). Dark areas are dolomite (dol) and a pit (p). Sample CH-478. X161.

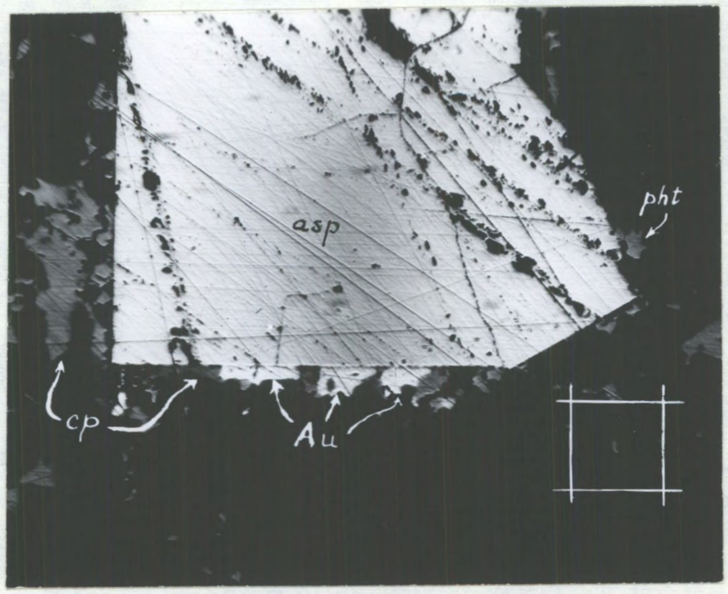

Figure 3. Gold (Au) and chalcopyrite (cp) partially coating a crystal of arsenopyrite (asp). Fine grains of pyrrhotite (pht) are also present in the section. High copper sample. X161.

Sample CH-480

The sample consists of coarse masses of intergrown metallic minerals. Galena, geocronite* $Pb_5(Sb,As)_2S_8$ and pyrite are most abundant. Minor proportions of bournonite, arsenopyrite and tennantite are usually intergrown with galena or geocronite. Trace amounts of native arsenic and chalcopyrite are present, usually associated with tennantite. In addition, irregular fine grains of hessite, usually less than 200 mesh in size, occur in galena or geocronite, or less commonly are associated with bournonite and tennantite. Very fine grains of gold are occasionally present within hessite. The largest observed grain of gold is approximately 10 microns in size.

High Lead Sample

Galena is the main metallic mineral. Intergrown with the galena are occasional coarse masses of pyrite and, less commonly, pyrrhotite. Small proportions of other metallic minerals are also present in the galena, including numerous fine, prismatic grains of boulangerite $Pb_5Sb_4S_{11}$, anhedral grains of argentiferous tetrahedrite**$(Cu, Fe, Ag)_{12}Sb_4S_{13}$ which are less than 200 mesh in size, and coarser grains of sphalerite.

An X-ray spectrometric analysis of a sample of galena taken from this specimen showed that it contains 0.04 per cent Ag.

High Copper, Low Lead Sample

The sample is composed mainly of intergrown sphalerite, chalcopyrite and pyrrhotite. Arsenopyrite is present in minor amounts in the form of coarse euhedral grains. In one small area of the two polished sections examined there occurs a fine-grained intergrowth of a member of the pyrargyrite-proustite series $Ag_3(Sb,As)S_3$ with pyrrhotite and chalcopyrite in spalerite.

Gold occurs as fine particles and is associated with chalcopyrite as fracture-filling in arsenopyrite and as a discontinuous capping on arsenopyrite (Figure 3). Gold also occurs as irregular fine inclusions in chalcopyrite and in sphalerite. The largest area of gold in the sections studied is approximately 150-200 mesh in size. The light yellow colour of the gold indicates that it probably contains alloyed silver.

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* Geocronite and jordanite $Pb_{14}As_7S_{24}$ give very similar X-ray powder patterns (2). The identification is based on a spectrographic analysis which showed that the present mineral contains a much higher proportion of Sb than of As.

**Because of the fine grained nature of the tetrahedrite it was not possible to obtain a sample for silver analysis. That it is the silver-bearing variety of tetrahedrite (freibergite) was however indicated by the size of the unit cell edge.

CONCLUSIONS

Four small samples of richly mineralized ore were investigated microscopically. Fifteen metallic minerals were identified, thirteen of these being sulphide minerals and two being telluride minerals. Two varieties of tetrahedrite-tennantite were distinguished.

Hessite, a telluride of silver, is believed to account for a major proportion of the silver in the two drill core samples. A mineral of the pyrargyrite-proustite series is the only silver mineral identified in the high copper sample. Argentiferous tetrahedrite (freibergite) occurs in the high lead sample. In addition to these minerals, tennantite, which is present in the two drill core samples, may also be silver-bearing. Tennantite usually contains silver in amounts less than 6 per cent but as much as 14 per cent Ag has been reported (1). Also, some silver may occur in solid solution in the galena. The presence of only 0.04 per cent Ag in the freibergite-bearing galena indicates rather that the contained silver occurs in the inclusions of freibergite. The colour of the gold as seen in polished section suggests that it contains some alloyed silver. However, this possibility was not confirmed by analysis of the gold.

In addition to the gold present as the native element (or gold-silver alloy) a small proportion may be present in hessite, in substitution for silver.

The refractoriness of the ore may be due, in part, to the fine grained nature of the argentiferous minerals and, in part, to the relative insolubility of one or more of these minerals in mill cyanide solution.

ACKNOWLEDGMENTS

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REFERENCES

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2. L.G. Berry and R.M. Thompson, "X-ray Powder Data for Ore Minerals: The Peacock Atlas", The Geological Society of America, Memoir 85 (1962) p. 131.