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MINERALOGICAL INVESTIGATION OF BASE METAL ORE FROM THE CHAPUT MINE LUMBY, B. C., FOR ALBERTA GYPSUM LIMITED

by

D. R. OWENS

MINERAL SCIENCES DIVISION

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MINERALOGICAL INVESTIGATION OF A SAMPLE OF BASE METAL ORE FROM THE CHAPUT MINE LUMBY, B.C., ON BEHALF OF ALBERTA GYPSUM LIMITED

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D. R. Owens*

SUMMARY OF RESULTS

Mineralogical studies on ore from the Chaput Mine show that it consistslargely of siliceous and carbonaceous gangue in which are disseminated small masses and grains of sulphides. The principal lead-bearing mineral present is galena; also present are minute amounts of bournonite(?) and anglesite. Copper is represented almost entirely by argentiferous tetrahedrite and chalcopyrite, with the former the dominant of the two, and by traces of covellite. Sphalerite is the only significant zinc-bearing mineral in the sample; electron microprobe analysis shows it to be cadmium-bearing. The argentiferous tetrahedrite, as well as being a major copper-bearing mineral, is also the chief silver-bearing mineral. In addition, silver occurs as a constituent of the few grains of native gold that were observed. Other minerals identified in the sample include pyrite, pyrrhotite, marcasite, arsenopyrite, rutile, goethite, quartz, calcite, mica, chlorite, feldspar and epidote.

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INTRODUCTION

A sample of a base metal ore from the Chaput Mine near Lumby, British Columbia, was received from Mr. D. Raicevic of the Mineral Processing Division on May 25, 1971. Mr. Raicevic requested that the sample be examined to identify the minerals present and to determine their grain sizes and textural relationships. The ore had originally been submitted to the Mines Branch by Mr. A. Van Raalte, President and Managing Director, Alberta Gypsum Limited, 2431 Udell Road, N. W. Calgary, Alberta.

SAMPLE

The sample, consisted of sixteen 1 to 4-inch hand specimens and of about 100 grams of minus ten-mesh head sample. The hand specimens were composed largely of quartz, in which were dispersed small masses and grains of sulphides. The sample was reported to contain 1.53 per cent lead, 1.53 per cent zinc, 0.22 per cent copper, and 20.3 ounces of silver and 0.006 ounces of gold per ton.

METHOD OF INVESTIGATION

The hand specimens were examined under the binocular microscope, and those showing significant amounts of mineralization were used in preparing polished sections. A number of thin sections were also prepared from less mineralized specimens. The polished sections were examined microscopically under the ore microscope to identify the metallic minerals and to determine their grain sizes and textural relationships;

the thin sections were examined petrographically to identify the gangue minerals. In addition, the head sample was screened and the 35 to 65-, 65 to 150-, and 150 to 270-mesh sizes were removed and separated into float and sink products by means of heavy liquids. Polished sections were prepared from the sink products and examined microscopically to permit a comparison of the concentrated ore minerals with those in the hand specimens. The minerals in the ore were identified by the combined methods of microscopy, X-ray diffraction analysis, and electron microprobe analysis.

ACKNOWLEDGEMENTS

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RESULTS OF INVESTIGATION

General Mineralogy of the Ore

Before discussing the mineralogy of the sample, it must be stated that most of the hand specimens that were received contained only sparse mineralization which, in turn, was dominated by the presence of pyrite. The occurrence of the economically significant minerals was more or less confined to three of the smallest of the sixteen hand specimens. Therefore, the assessment of the textural relationships and the grain sizes of these minerals was based on minimal evidence. An illustration of this can be seen in the occurrence of the sphalerite. In the head sample, it is more prevalent than tetrahedrite, galena, or chalcopyrite but, in the hand specimens, the reverse is true.

The microscopical examination of the sink products, deemed more representative of the ore minerals than the hand specimens, indicated that the principal ore mineral* present is pyrite, with smaller amounts of sphalerite, argentiferous tetrahedrite, galena, and chalcopyrite. The head sample also contains from minor to trace amounts of pyrrhotite, marcasite, anglesite, bournonite(?), covellite, goethite, arsenopyrite, and rutile. Trace amounts of goethite and covellite were observed only in the sink products in which each has partially replaced a few grains of pyrite and chalcopyrite, respectively.

Detailed Mineralogy of the Ore Minerals

Lead-bearing Minerals

The three lead-bearing minerals in the sample are galena, anglesite ($PbSO_4$), and a mineral tentatively identified as bournonite(?) ($PbCuSbS_3$). Of the three, galena is by far the most abundant and only minute amounts of bournonite(?) and anglesite are present.

A large proportion of the galena in the hand specimens is quite coarse-grained. Two 15-millimetre specimens, consist almost entirely of galena (Figure 1). Most of the remaining galena occurs as inclusions in argentiferous tetrahedrite and sphalerite and, to a lesser degree, in pyrite and gangue. These inclusions vary in size** from 5 to about 450 microns. Galena also occurs in association with granular fine-grained disseminations of pyrite, sphalerite and argentiferous tetrahedrite in gangue (Figure 3).

The two small hand specimens of galena, mentioned above, are heavily fractured, and many of the fractures are filled with anglesite. The principal contaminant in the galena is bournonite(?). Almost every

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*The term "ore mineral" as used in this report, does not necessarily have an economic connotation.

**The word "size" as used in this report, refers to the greatest dimension of the mineral grain being described.

area of the galena that was examined microscopically shows these small acicular- to irregular-shaped inclusions (Figure 2) which rarely exceed 10 microns in size. Other minerals forming inclusions in the galena include pyrite, sphalerite, argentiferous tetrahedrite, chalcopyrite, arsenopyrite and gangue. These inclusions are from 10 to 800 microns in size, although a few large areas of argentiferous tetrahedrite, up to about four millimetres, occur in the masses of galena (Figure 1).

The identification of the minute inclusions in the galena (Figure 2) as bournonite(?) is tentative. The grains are too small to extract for identification by X-ray powder diffraction, however, they are large enough for a qualitative analysis, using electron microprobe methods. This together with their optical properties and their occurrence shows that they are probably bournonite(?).

Zinc-bearing Minerals

The only significant zinc-bearing mineral present is sphalerite. Although tetrahedrite often contains some zinc, the amount involved is quite small. The number of sphalerite occurrences in the hand specimens are minimal. However, in the sections of the head sample, it is the most prevelant of the significant ore minerals.

The sphalerite in the hand specimens is present mainly as a few small masses and grains in gangue and in galena. These small masses and grains range in size from about 10 microns to 3 millimetres. Some sphalerite also occurs as inclusions in tetrahedrite and in pyrite. These range in size from 20 to 200 microns. In a few instances, sphalerite occurs in association with granular fine-grained disseminations of pyrite, galena, and argentiferous tetrahedrite (Figure 3).

The sphalerite contains few inclusions. These consist of galena, pyrite, arsenopyrite, argentiferous tetrahedrite, chalcopyrite, and gangue. These inclusions range in size from 5 to 550 microns, with the majority between 20 and 150 microns.

Electron microprobe analysis of the sphalerite shows that the iron content is between three and five per cent, and that the cadmium content is about 0.8 per cent.

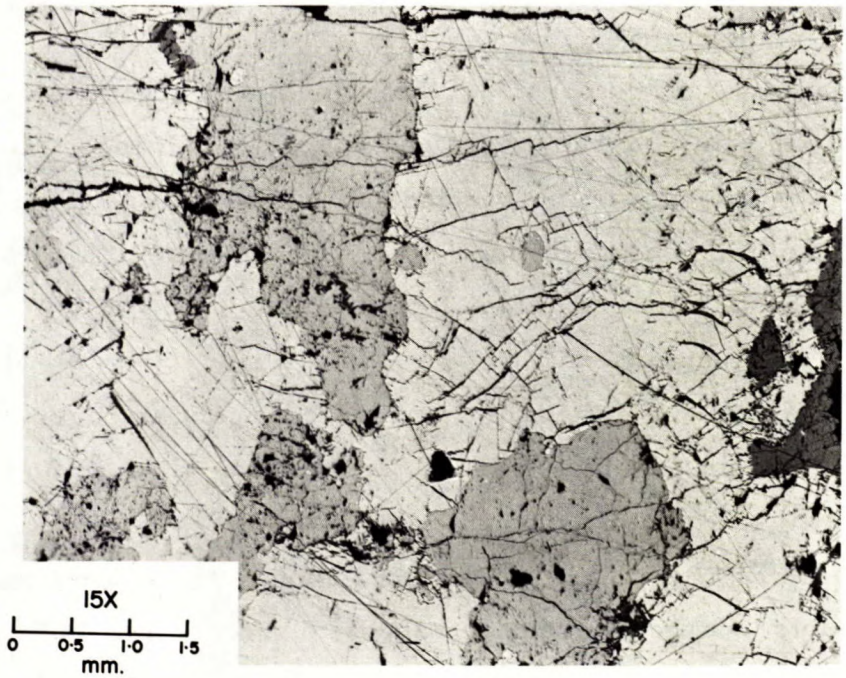

Figure 1. - Photomicrograph of a polished section showing part of one of the hand specimens of galena (greyish white). The galena contains quite large inclusions of argentiferous tetrahedrite (medium grey) and a few smaller ones of sphalerite (dark grey). The galena is heavily fractured, and many of the fractures are filled with anglesite (black).

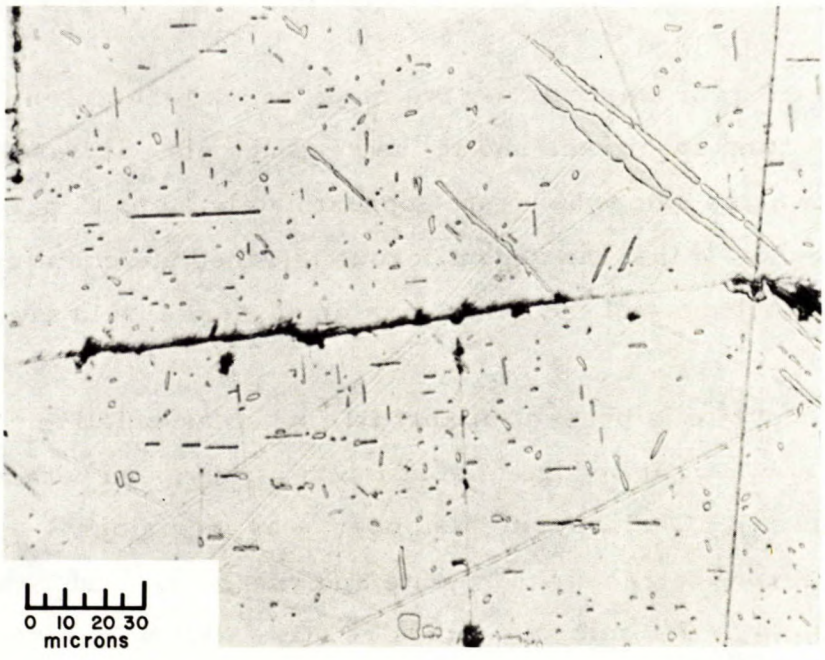

Figure 2. - Photomicrograph at a higher magnification, of the galena in Figure 1, shows the small inclusions of bournonite(?) which occurs in nearly all of the galena. The bournonite(?) is slightly darker than the galena and is marked by relief due to etching with hydrochloric acid.

Copper-bearing Minerals

The copper-bearing minerals in the sample are argentiferous tetrahedrite, chalcopyrite, bournonite(?) and covellite. Of these the argentiferous tetrahedrite is the most abundant, with somewhat smaller amounts of chalcopyrite. The occurence of the bournonite(?), also a lead-bearing mineral, has already been discussed, and the trace amounts of covellite present, are insignificant.

The argentiferous tetrahedrite is present largely as coarse to fine-grained inclusions in galena (Figure 1) and gangue. The argentiferous tetrahedrite varies in size from a few microns to about four millimetres. Most grains, however, are from about 40 to 200 microns in size. Small amounts of argentiferous tetrahedrite, from 10 to 150 microns in size, are present as inclusions in pyrite, chalcopyrite and sphalerite. In addition, the argentiferous tetrahedrite occurs in association with granular, fine-grained pyrite, galena, sphalerite (Figure 3), and chalcopyrite (Figure 4). Inclusions in the argentiferous tetrahedrite are few and scattered, and in some places it is entirely devoid of other minerals. Where present, the inclusions consist of galena, sphalerite, pyrite, chalcopyrite, and gangue and range from 10 to 300 microns in size.

Electron microprobe studies were made on both the argentiferous tetrahedrite in the hand specimens and in the head sample. It was found that the silver content varies somewhat from approximately 10 to 15 percent. The analysis also showed that the argentiferous tetrahedrite contains some iron and zinc and that most of the grains examined were low in arsenic and high in antimony.

The chalcopyrite is present mainly in a loose association with grains of pyrite in gangue, where it occurs almost interstitially, and with argentiferous tetrahedrite (Figure 4). Chalcopyrite also occurs as inclusions in galena, argentiferous tetrahedrite, pyrite and sphalerite. The chalcopyrite ranges in size from 4 to 750 microns. It is relatively free from inclusions and, when present, they consist mainly of a few small grains of pyrite and argentiferous tetrahedrite.

Silver and Gold-bearing Minerals

The principal silver-bearing mineral in the sample is the argentiferous tetrahedrite. Its occurrence and silver content has already been discussed above.

Silver is also present as a minor constituent of the few grains of native gold in the sample. In each instance, these grains occur at the contact between galena and argentiferous tetrahedrite. The grains are very small and are all less than 10 microns in size. Their identification by electron microprobe analysis shows that they consist essentially of gold and that they contain some silver. The small size of these grains made it impossible to determine the exact amounts of each element present.

Other Ore Minerals

The other ore minerals present are pyrite, pyrrhotite, marcasite, arsenopyrite, and rutile.

Pyrite is the most prevalent ore mineral in both the hand specimens and the head sample. Many of its occurrences have already been mentioned in the discussion of the mineralogy of the significant ore minerals. The most common occurrence of the pyrite is as grains and small masses in gangue. These range in size from a few microns to more than two centimetres. As mentioned before, pyrite also is present as inclusions in the other ore minerals, the grain sizes of which has already been given. The pyrite contains inclusions of argentiferous tetrahedrite, galena, sphalerite, chalcopyrite, pyrrhotite and gangue. These inclusions range from 10 to 450 microns in size. The number of inclusions in the pyrite is low because many areas of the pyrite are entirely free from contaminants.

Pyrrhotite, marcasite, arsenopyrite and rutile are present in very small amounts. The pyrrhotite occurs as a few coarse grains in gangue and as a number of small inclusions in pyrite; the marcasite replaces some of the pyrrhotite grains in gangue; some arsenopyrite occurs as small inclusions in the ore minerals; and the rutile occurs as very small disseminations in gangue.

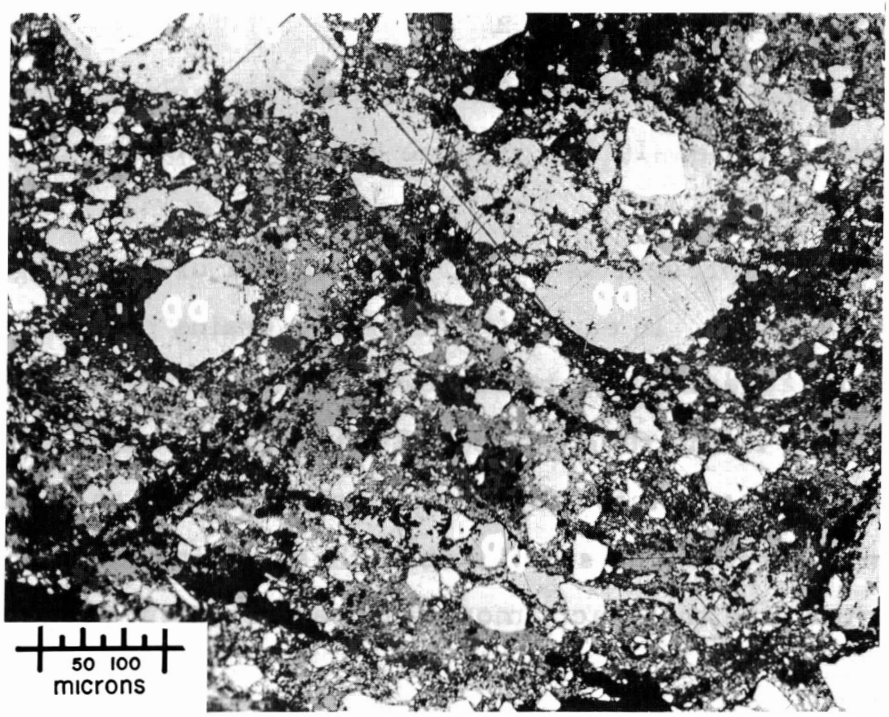

Figure 1. - Photomicrograph (in oil immersion) of a polished section showing grains of galena (ga) and pyrite (white) associated with argentiferous tetrahedrite (medium grey), some sphalerite (dark grey), and gangue (black).

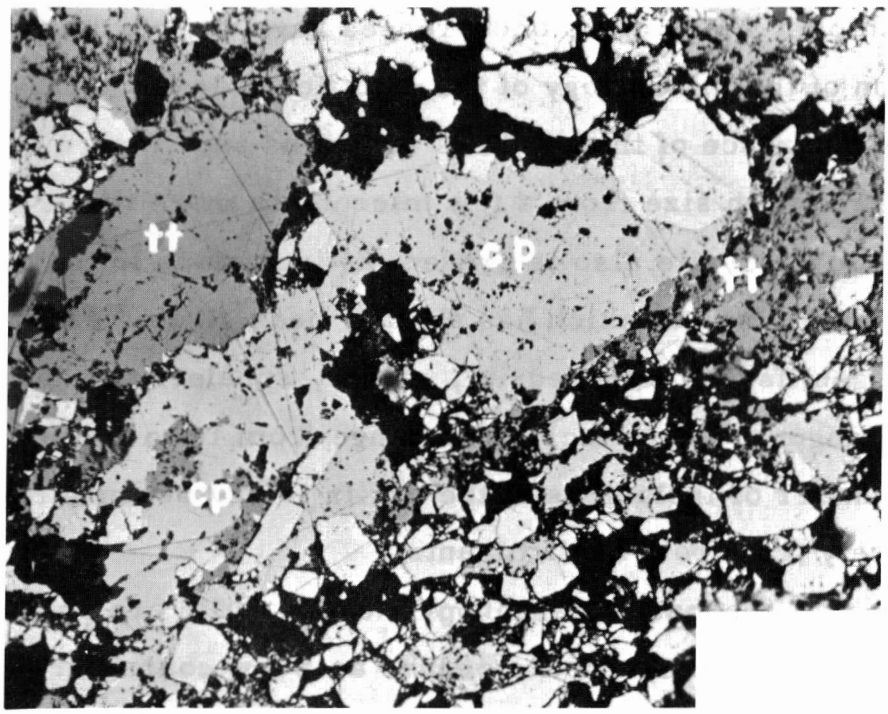

Figure 2. - Photomicrograph (in oil immersion) of a polished section showing associated chalcopyrite (cp), argentiferous tetrahedrite, (tt) and pyrite (white). The black areas are mainly polishing pits.

Mineralogy of the Gangue Minerals

The gangue minerals identified in the sample are quartz, calcite, chlorite, muscovite, feldspar, and epidote; quartz is the most prevalent. The examination of thin sections prepared from the hand specimens show that the quartz is present as both coarse- and fine-grained compact aggregates. The muscovite, feldspar, and epidote are disseminated throughout the quartz aggregates, and the chlorite occurs mainly in the metamorphic shear-zones. Calcite veinlets of various widths cut the quartz aggregates.

CONCLUSIONS

An assessment of the liberation and textural characteristics of the ore is inhibited, to some extent, by the sparse mineralization of the hand specimens. However, the following statements can be made.

The galena appears to be mainly coarse-grained and most of it should be easy to liberate from the other ore minerals. However, any lead concentrate will contain some copper and antimony due mainly to the minute inclusions of bournonite(?) ($PbCuSbS_3$), and due somewhat to the small inclusions of chalcopyrite and of argentiferous tetrahedrite.

The small amount of sphalerite in the hand specimens prevents any assessment of its liberation characteristics, even though most of what was observed was fairly coarse.

The copper is present almost entirely as argentiferous tetrahedrite and to a smaller extent as chalcopyrite. More of the former was observed than the latter. The argentiferous tetrahedrite is largely coarse-grained, but some of the chalcopyrite is quite fine-grained and may be dfficult to liberate.

The silver in the sample is present almost entirely as a constituent of the argentiferous tetrahedrite. The amount involved in the few grains of native gold is insignificant.

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