CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 68-75

MINERALOGICAL INVESTIGATION OF A SAMPLE OF A MOLYBDENUM-BISMUTH ORE FROM ANGLO AMERICAN MINES LIMITED, QUEBEC

by

D. R. OWENS

MINERAL SCIENCES DIVISION

NOTE: THIS REPORT RELATES ESSENTIALLY TO THE SAMPLES AS RECEIVED. THE REPORT AND ANY CORRESPONDENCE CONNECTED THEREWITH SHALL NOT BE USED IN FULL OR IN PART AS PUBLICITY OR ADVERTISING MATTER.

COPY NO. 19

NOVEMBER 13, 1968

Mines Branch Investigation Report IR 68-75

MINERALOGICAL INVESTIGATION OF A SAMPLE OF A MOLYBDENUM-BISMUTH ORE FROM ANGLO AMERICAN MINES LIMITED, QUEBEC

by

D. R. Owens*

- - -

SUMMARY OF RESULTS

A mineralogical study of a sample of a molybdenum-bismuth ore from Anglo American Mines Limited, in the Abitibi Mining District of Quebec has shown that the ore has a low ratio of ore minerals to gangue. The only molybdenum-bearing mineral present is molybdenite, which occurs as fairly coarse flakes in gangue. Bismuth is represented in the ore by both native bismuth and bismuthinite, with the latter greatly predominating. The bismuthinite occurs as inclusions in gangue and in molybdenite, while all of the native bismuth that was seen occurs as small inclusions in the bismuthinite. Although a small amount of talc was found in the sample, none was positively identified in direct association with the molybdenite. Other minerals identified in the sample include magnetite, hematite, ilmenite, goethite, rutile, sphalerite, pyrite, chalcopyrite, pyrrhotite, quartz, biotite, muscovite, chlorite, amphibole, pyroxene, feldspar, apatite, fluorite and a carbonate mineral.

---

*Technical Officer, Mineralogy Section, Mineral Sciences Division, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

INTRODUCTION

A sample of molybdenum-bismuth ore was received from Mr. G. Mathieu of the Mineral Processing Division on September 23, 1968. Mr. Mathieu requested that the sample be examined mineralogically to identify the molybdenum- and bismuth-bearing minerals and their textural relationships, and to report on the occurrence of any talc. The ore was reported to be from a deposit five miles north of Cadillac, in the Abitibi Mining District of Quebec, and had originally been submitted to the Mines Branch by Mr. L. Provost, Mill Superintendent, Anglo American Mines Limited, P. O. Box 100, Cadillac, Quebec.

SAMPLE

The sample, as received, consisted of a number of hand specimens, all smaller than two inches in size, and about 30 grams of head sample, crushed to minus 35 mesh. The hand specimens were composed mainly of quartz and mica and contained only a small amount of ore mineralization. An exception to this was one small hand specimen composed almost entirely of molybdenite.

METHOD OF INVESTIGATION

The hand specimens were examined under binocular microscope, and those showing the highest proportion of ore mineralization were selected for polished sections. A total of four polished sections were prepared from these, and examined under the ore microscope to identify the metallic minerals and their textural relationships. In addition, the 35 to 65, and 65

to 250 -mesh fractions were screened from the head sample and separated by means of heavy liquids. One polished section was prepared from each of the sink products of the two screened fractions, and examined microscopically to permit a comparison of the ore minerals in the mill product with those in the hand specimens. The float products were run on the X-ray diffractometer to identify the principal gangue minerals.

RESULTS OF INVESTIGATION

General Mineralogy of the Ore

It should be noted that comparison of the ore minerals in the hand specimens with those in the head sample shows that the hand specimens do not appear to be representative of the ore. This is illustrated by the fact that, while only a few grains of magnetite were found in the hand specimens, it is the principal metallic mineral in the head sample. Based on the examination of the head sample, the metallic minerals in the ore consist mainly of magnetite, lesser molybdenite and bismuthinite, and from small amounts to a few grains each of native bismuth, pyrite, pyrrhotite, hematite, ilmenite, goethite, chalcopyrite, sphalerite and rutile. The presence of goethite, pyrrhotite, rutile and sphalerite was restricted to the head sample, none being observed in the hand samples. The gangue minerals in the ore consist mainly of quartz, less muscovite and biotite, and small amounts of talc, amphibole, pyroxene, chlorite, fluorite, apatite, feldspar and carbonate.

Detailed Mineralogy

Molybdenum- and Bismuth-Bearing Minerals

The molybdenite in the ore occurs largely as individual grains and sheaf-like aggregates in gangue (Figure 1). The grains and aggregates generally range in size from about 50 microns to about one millimetre, although one large aggregate of molybdenite from which a polished section

Figure 1. Photomicrograph of a polished section showing individual crystals and sheaf-like aggregates of molybdenite grains (light grey) in gangue (black). The largest aggregate to the right of the photograph contains inclusions of bismuthinite (white). (see also Figure 3).

was prepared measured one centimetre in size. (The word "size" as used in this report refers to the greatest dimension of the mineral grain being described. In a few places molybdenite also occurs combined with bismuthinite in gangue (Figure 2). The molybdenite grains contain fairly numerous inclusions of bismuthinite (Figures 2 and 3), as well as a few inclusions of gangue and chalcopyrite. These inclusions range in size from about 4 to 250 microns. A few veinlets of gangue, 10 to 20 microns wide, also penetrate the molybdenite.

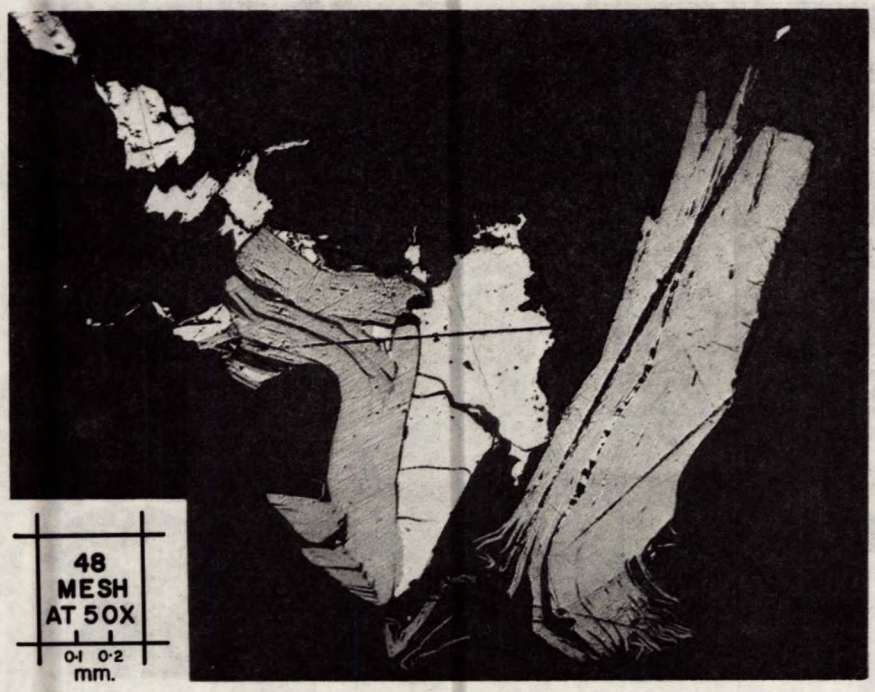

Figure 2. Photomicrograph of a polished section showing individual and combined grains of bismuthinite (white) and molybdenite (light grey) in gangue (dark grey).

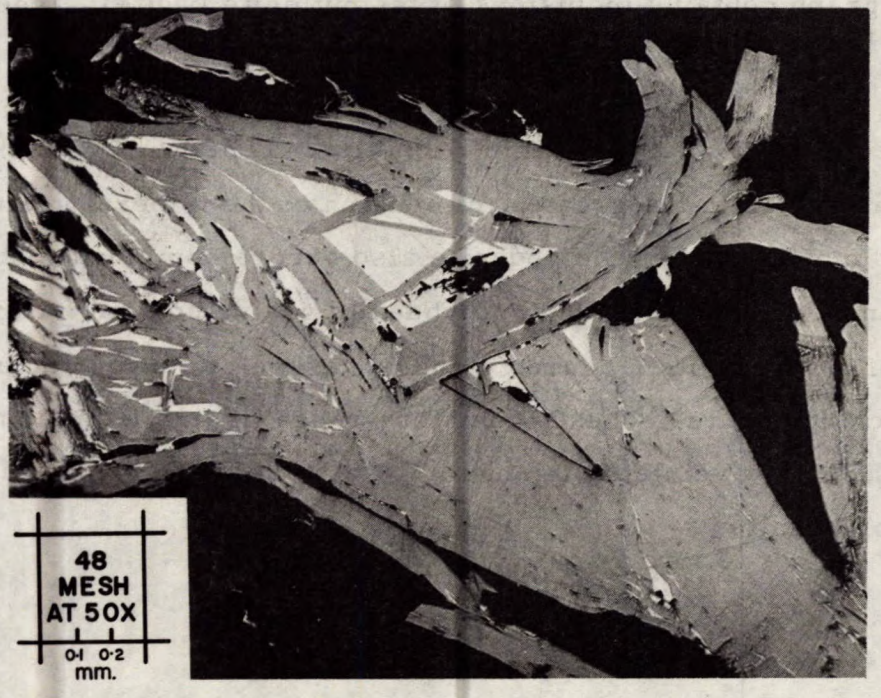

Figure 3. Photomicrograph of a polished section of an area from Figure 1 at a higher magnification, which shows the inclusions of bismuthinite (white) in molybdenite (light grey). The dark grey areas are gangue.

The bismuthinite in the sample occurs largely as elongate inclusions in molybdenite (Figures 1 and 3) and as disseminated grains in gangue (Figure 4). The bismuthinite inclusions in molybdenite vary from about 4 to 250 microns in size, while the grains in gangue vary from about 15 to 900 microns. In addition, a few grains occur combined with molybdenite in gangue (Figure 2). The only inclusions found in the bismuthinite are of native bismuth. This is also the only occurrence of native bismuth that was seen in the examination of the sample. The grains of native bismuth vary in size from 2 to 50 microns. The grains of bismuthinite that contain inclusions of native bismuth occur largely in the molybdenite, although a few grains are also present in the gangue or adhering to grains of molybdenite (Figure 5).

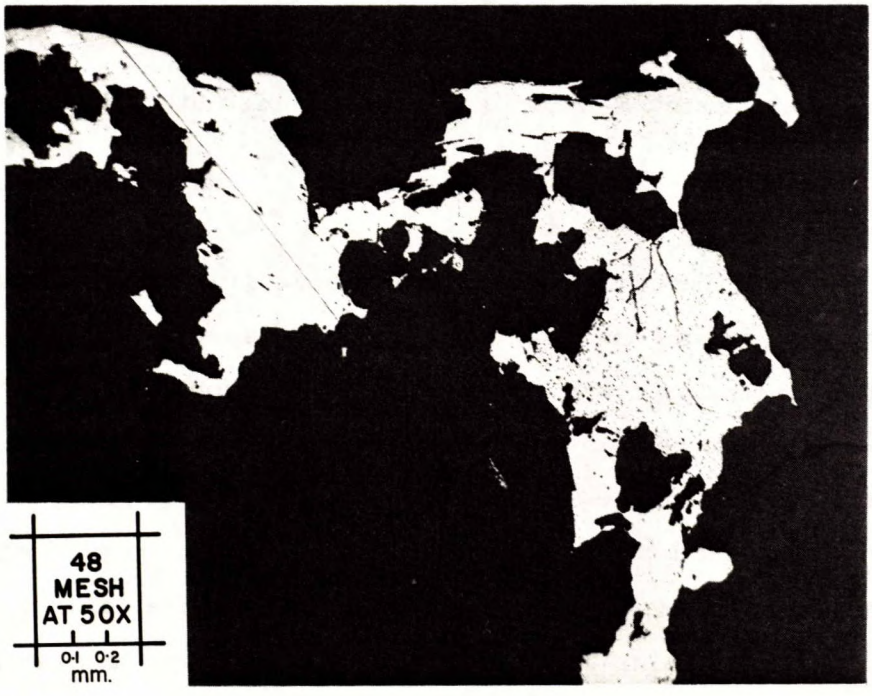

Figure 4. Photomicrograph of a polished section showing grains of bismuthinite (white) disseminated in gangue (dark grey).

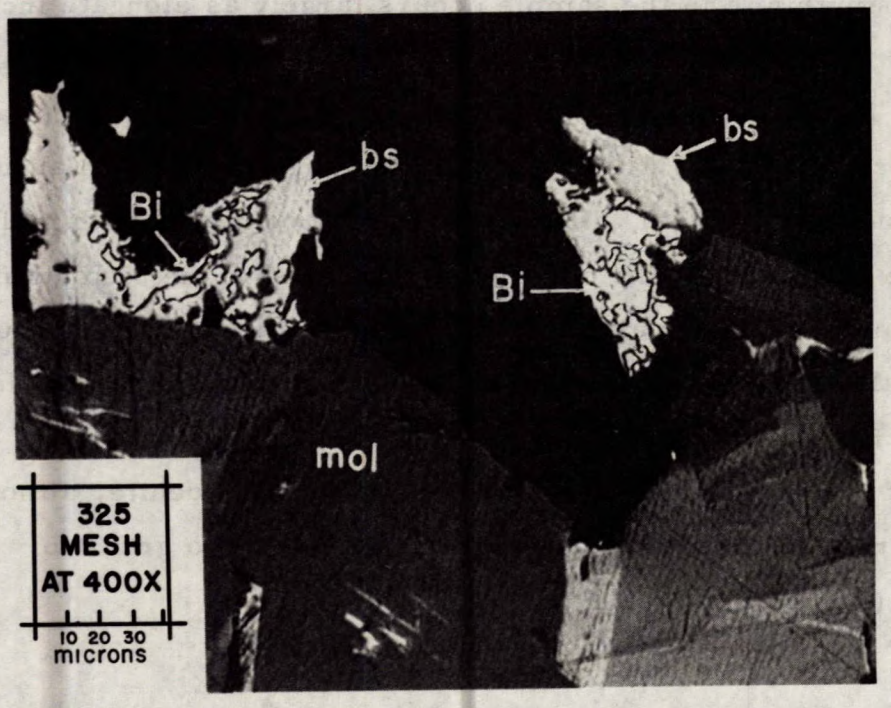

Figure 5. Photomicrograph (in oil immersion) of a polished section showing two grains of bismuthinite (bs) adhering to molybdenite (mol) in gangue (black). The bismuthinite grains contain a number of small inclusions of native bismuth (Bi).

Other Ore Minerals

Although magnetite is the principal metallic mineral in the head sample, only a few grains are present in the hand specimens, where they occur in gangue and range from about 20 to 300 microns in size. Some of these grains are partly replaced by hematite. Although a few free grains of hematite are present in the head sample, all the hematite in the hand specimens was combined with magnetite. Similarly, the ilmenite in the sample occurs as rare grains in gangue, which are of the same size as the magnetite. A few grains each of pyrite and chalcopyrite were found in the hand specimens; they occur as inclusions in gangue, and vary from about 10 to 900 and 15 to 170 microns in size, respectively. In addition, a few grains of chalcopyrite, about 20 microns in size, were observed in the molybdenite.

As mentioned before, small amounts of rutile, sphalerite, goethitite and pyrrhotite were found only in the head sample. They consist of free grains, except for pyrrhotite, which occurs only as inclusions in some of the pyrite grains.

Gangue Minerals

The gangue consists essentially of quartz. Also present are smaller quantities of muscovite and biotite, and less talc, chlorite, amphibole and pyroxene. Only traces of feldspar, apatite, fluorite and carbonate were found. The presence of talc in the the ore was established by X-ray diffractometer analysis of the float products of the head sample. Microscopic examination of grain mounts of the float products showed that some of the talc is combined with chlorite. The gangue minerals which occur as inclusions in, or in direct association with the molybdenite, are largely quartz, and lesser mica and amphibole. No talc was positively identified as being in intimate relationship with the molybdenite.

CONCLUSIONS

The conclusions drawn from the mineralogical examination are as follows: Firstly, while most of the molybdenite is quite coarse-grained and should be largely liberated, it is expected that it will retain some of the very small elongate inclusions of bismuthinite. Secondly, the native bismuth is quite fine-grained, and will be largely retained with the bismuthinite. Thirdly, although the talc is not closely associated with the molybdenite, its presence in the ore can nevertheless be expected to cause some difficulties in beneficiation.

DRO:vm