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MINERALOGICAL EXAMINATION OF A COPPER ORE FROM THE R. M. CLARKE MINING COMPANY LIMITED, PARRY SOUND, ONTARIO

by

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MINERAL SCIENCES DIVISION

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SUMMARY

Mineralogical studies made on a copper ore from the R. M. Clarke Mining Company Limited, Parry Sound, Ontario, have shown that the principal ore minerals are bornite, chalcocite, magnetite and hematite. The bornite and chalcocite occur as small masses and grains in gangue, commonly intergrown with each other, and the magnetite and hematite occur as small masses and grains in gangue, and as locked grains in bornite and chalcocite.

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INTRODUCTION

A sample of a copper ore was received from A. Stemerowicz of the Mineral Processing Division, on February 10, 1966. Mr. Stemerowicz stated that the sample had been submitted to the Mines Branch by the R. M. Clarke Mining Company Limited, Parry Sound, Ontario. Mr. Stemerowicz asked that the sample be studied to identify the minerals in the sample and to investigate their textural relationships. The sample received consisted of a large hand specimen about four inches in diameter, and about 150 grams of a crushed head sample. The hand specimen was composed largely of quartz and amphibole, with scattered areas of mineralization. The head sample consisted of ore crushed to -10 mesh.

METHOD OF INVESTIGATION

The hand specimen was broken into a number of coarse fragments, from which some well-mineralized pieces were selected for polished sections. A -100+200 mesh fraction was screened from the head sample and separated into sink and float sub-fractions, by means of a heavy liquid with a specific gravity of 3.30. One polished section was prepared from the sink sub-fraction, while the float sub-fraction was run on the X-ray diffractometer to determine the principal gangue constituents. The minerals in the polished sections were identified by microscopical and X-ray diffraction studies.

RESULTS OF INVESTIGATION

General Character of the Ore

The ore consists of small masses and grains of copper-bearing and iron-bearing minerals in gangue, as well as a small amount of gold. The principal copper-bearing minerals are bornite and chalcocite, with trace amounts of digenite, covellite and chalcopyrite; the iron-bearing minerals are magnetite and hematite. The gangue consists of quartz, amphibole, mica, feldspar, chlorite, garnet and rutile.

Detailed Mineralogy

Bornite

Bornite occurs mainly as irregular masses and disseminated grains, varying in size from a few microns to about 6 millimeters. It is closely associated with other copper minerals, particularly chalcocite, with which it forms intimate intergrowths in some places (Figures 1, 3, 4, 5 and 7). It also contains veinlets and inclusions of chalcocite (Figures 2 and 5), inclusions of magnetite, gangue, rutile (Figures 5 and 9), hematite and chalcopyrite. These inclusions vary from a few microns to about 800 microns in diameter. In a few instances the bornite was found rimmed with digenite.

Chalcocite

Chalcocite is present largely as coarse to fine-grained intergrowths with bornite (Figures 1, 2 and 3), and occasionally as inclusions and veinlets in bornite (Figures 2 and 5). The chalcocite varies in size from about 5 microns to 2 millimeters. It contains inclusions of bornite, magnetite, rutile, hematite and gangue (Figures 7 and 9). These inclusions range from about 2 to 800 microns in size.

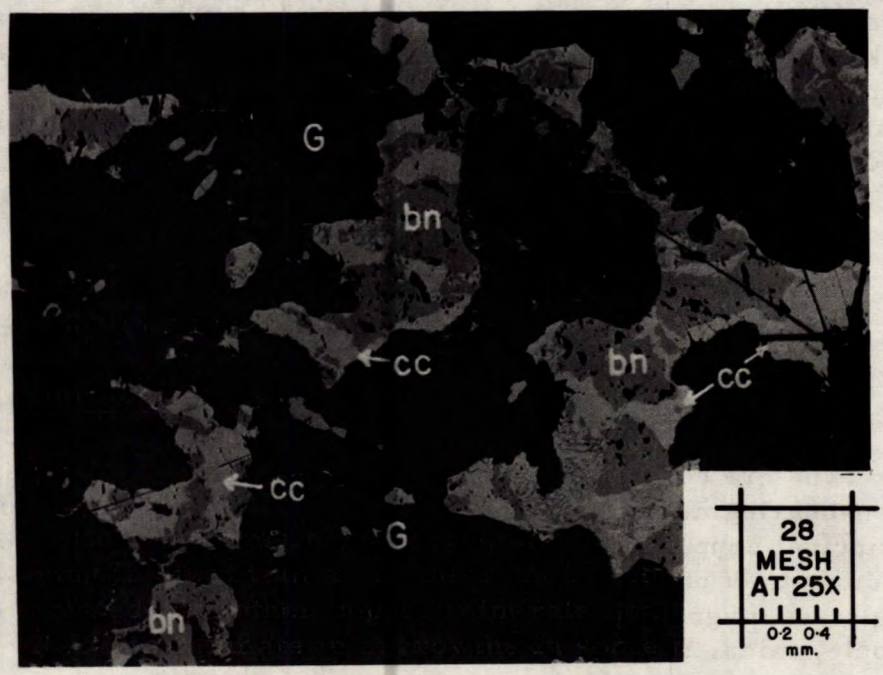

Figure 1. Photomicrograph of a polished section showing intergrowths of bornite (bn) and chalcocite (cc) in gangue (G).

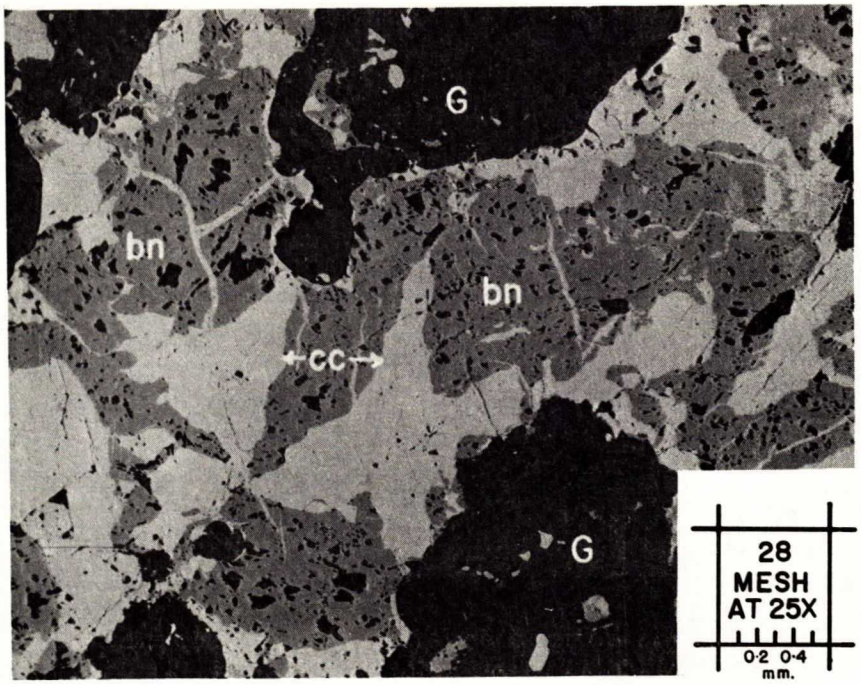

Figure 2. Photomicrograph of a polished section showing a coarse intergrowth of chalcocite (cc) and bornite (bn), with the bornite veined by chalcocite. The areas marked (G) represent gangue.

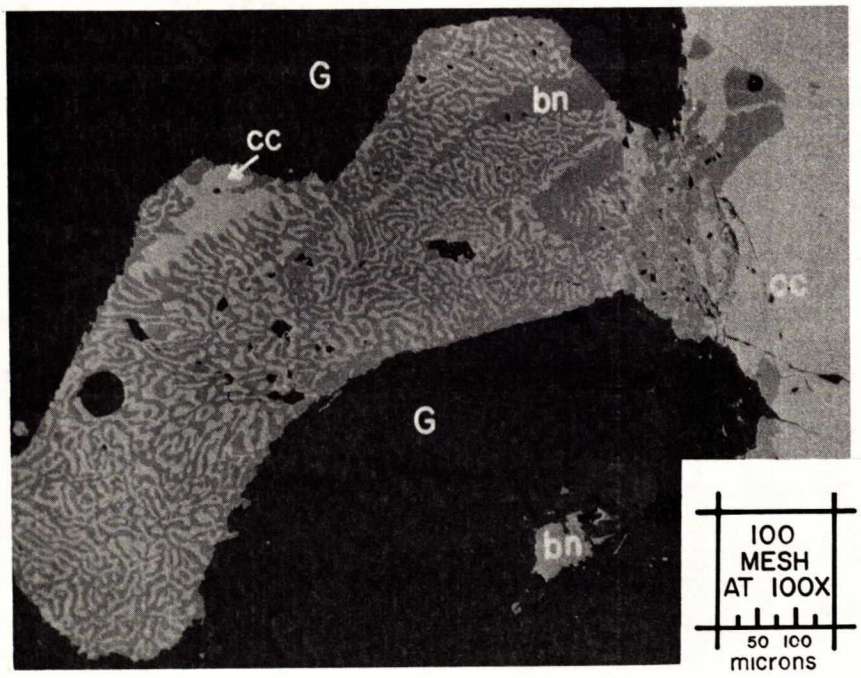

Figure 3. Photomicrograph of a polished section showing a fine-grained graphic intergrowth of chalcocite (cc) and bornite (bn) in gangue (G).

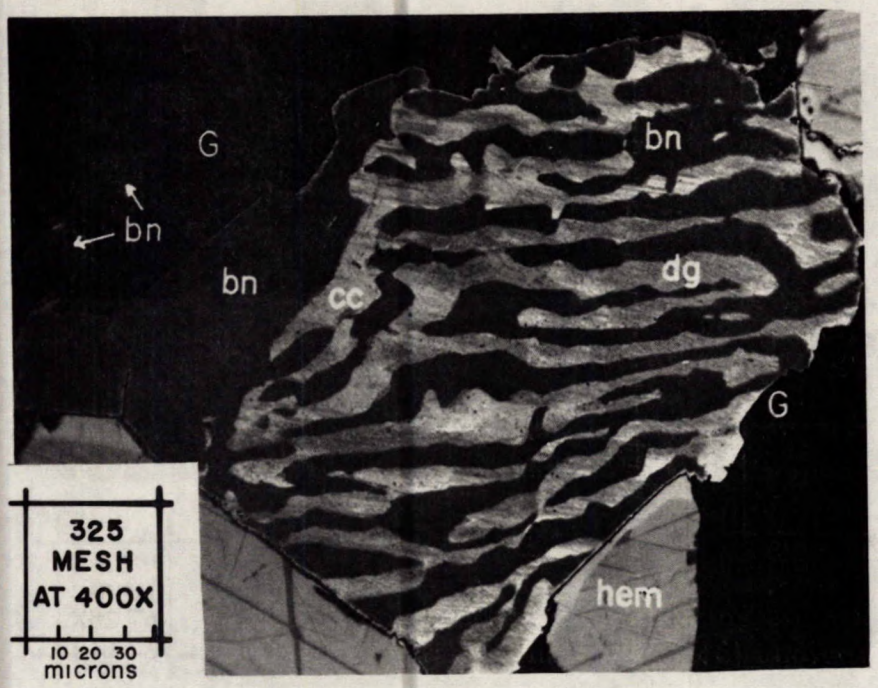

Figure 4. Photomicrograph (in oil immersion) of a polished section showing a graphic intergrowth of chalcocite (cc-white), bornite (bn-dark grey) and digenite (dg-light grey). A few inclusions of bornite in gangue (G), and hematite (hem) with inclusions of ilmenite (il) are also shown.

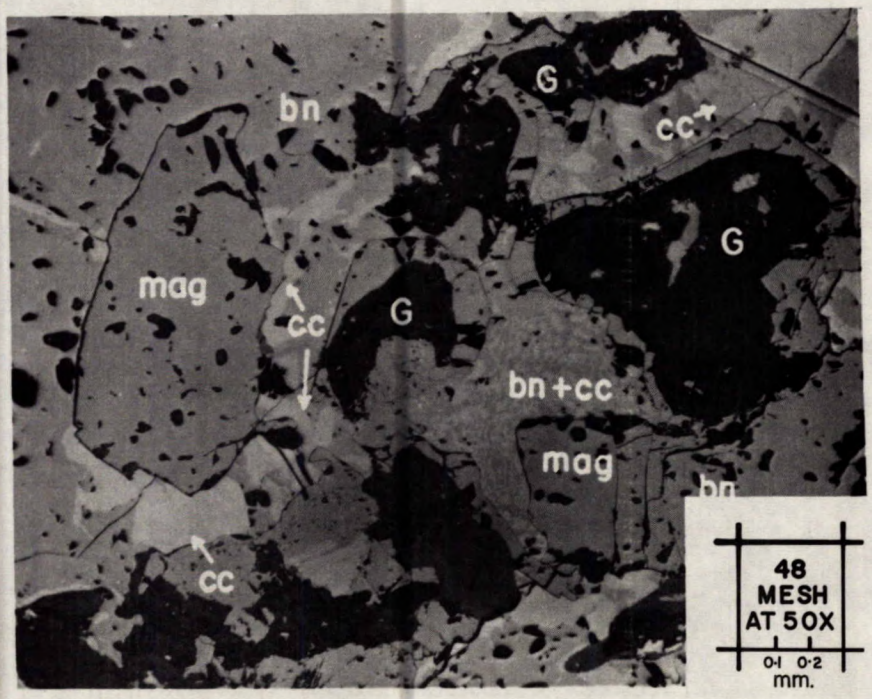

Figure 5. Photomicrograph of a polished section showing bornite (bn) in close association with magnetite (mag), chalcocite (cc) and gangue (G).

Digenite

Only a small quantity of digenite is present, and it occurs as thin rims about a few bornite grains in gangue and occasionally in a graphic intergrowth with chalcocite and bornite (Figure 4).

Covellite

A few grains of covellite were found in the polished section of the -100+200 mesh sink sub-fraction of the head sample. They occur as minute grains in bornite and chalcocite.

Chalcopyrite

A few grains of chalcopyrite were found. They occur as minute inclusions in bornite, and are only a few microns in diameter.

Native Gold

A few minute grains of native gold were found in the ore. They occur as inclusions, from 1 to 4 microns in size, in a pale yellowish-brown grain in chalcocite. The pale yellowish-brown grain, which is about 20 microns in size, could not be identified.

Magnetite

The magnetite was found largely as irregular grains of various size, ranging from about 5 to 800 microns. Some of it is closely associated with hematite in gangue (Figure 6), and some occurs as inclusions in bornite, chalcocite (Figure 5), and hematite. The magnetite, itself, contains inclusions of rutile (Figure 8), gangue, chalcocite and bornite. These inclusions in the magnetite vary from about 2 to 400 microns in size.

Hematite

Hematite occurs as coarse to fine grains in gangue, varying from about 5 microns to one millimeter in size (Figure 6). Some is associated with magnetite, and some occurs as inclusions in bornite, chalcocite (Figure 7) and magnetite. The hematite generally contains numerous narrow lamellae of ilmenite (Figure 7), as well as occasional inclusions of magnetite, gangue, bornite and chalcocite. The inclusions in the hematite vary from about 2 to 200 microns in size. In a few instances the hematite grains are partially rimmed by rutile-bearing magnetite (Figure 8).

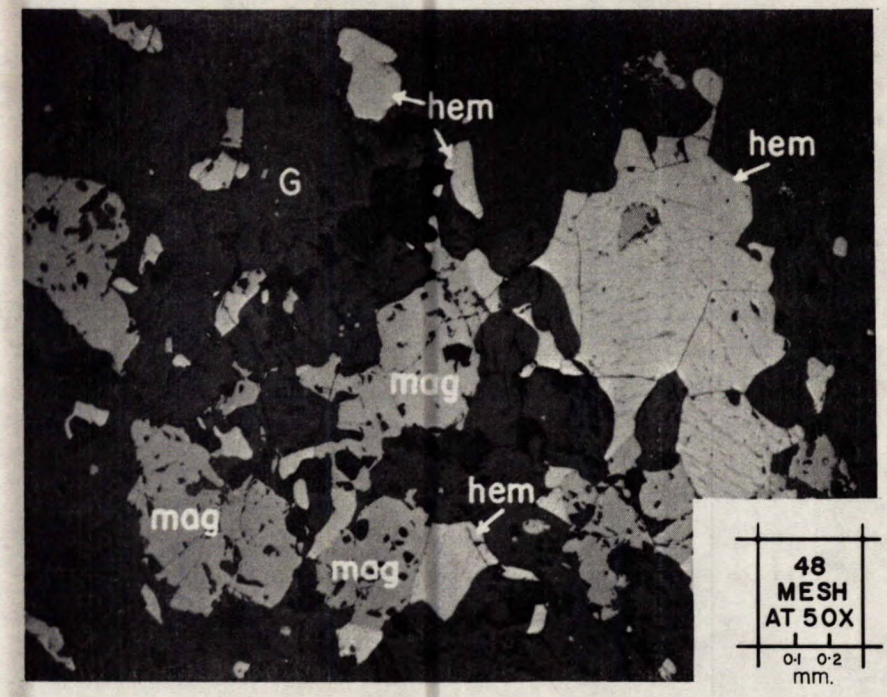

Figure 6. Photomicrograph of a polished section showing coarse to fine grains of magnetite (mag) and hematite (hem) in gangue (G).

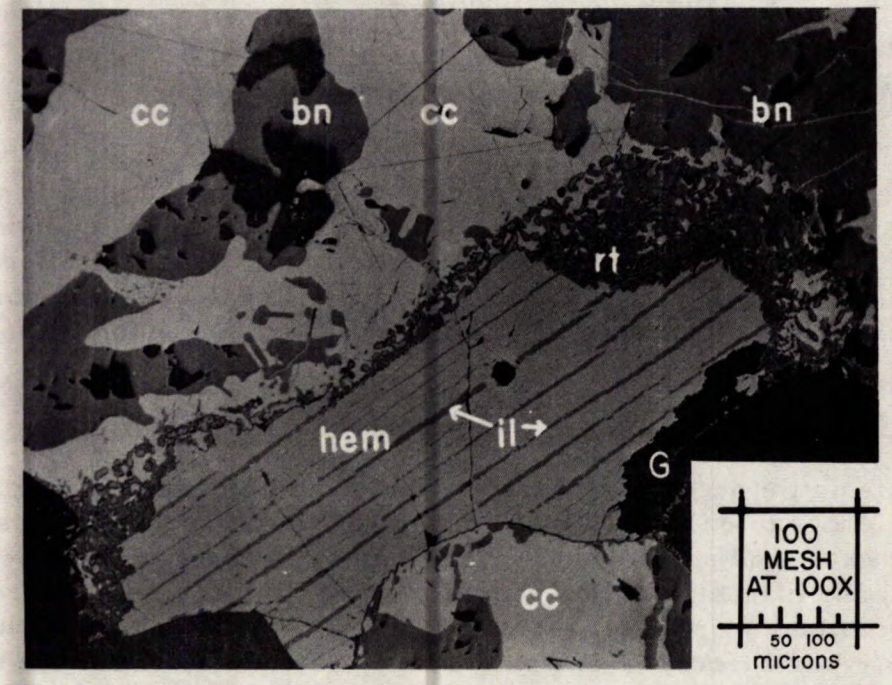

Figure 7. Photomicrograph (in oil immersion) of a polished section showing hematite (hem), containing ilmenite lamellae (il). The hematite is bordered by a rutile (rt)-chalcocite (cc) intergrowth. A few inclusions of bornite (bn) in chalcocite, and an area of gangue (G) is also shown.

Rutile

Numerous small grains of rutile are present in the ore. They occur as inclusions in magnetite (Figure 8), chalcocite and bornite (Figures 7 and 9), and in one instance were seen to intrude into the gangue. These grains range in size from about 2 to 50 microns. In a few places the rutile grains are clustered around the margins of hematite adjoining chalcocite and bornite (Figure 7).

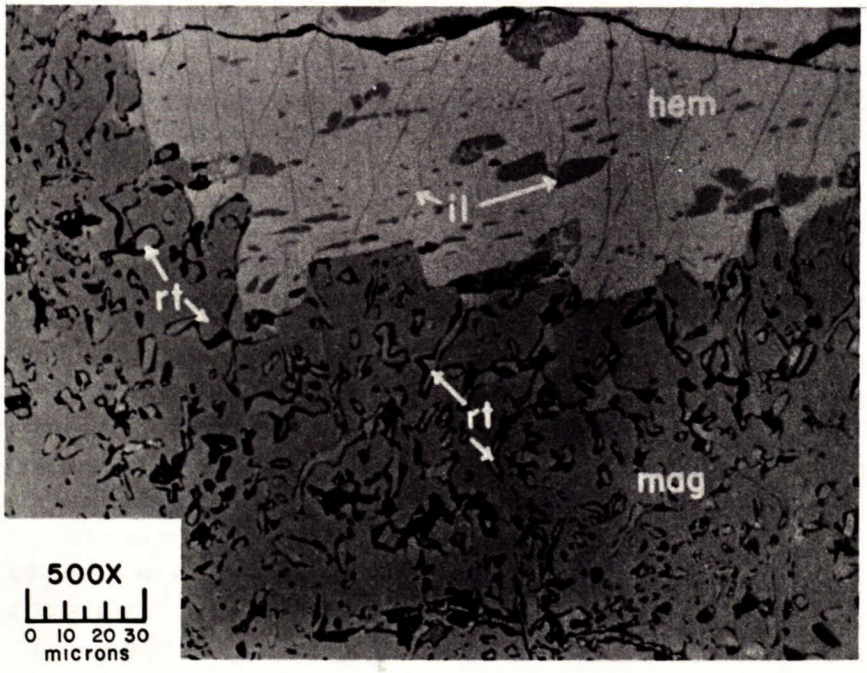

Figure 8. Photomicrograph (in oil immersion) of a polished section showing part of a rim of magnetite (mag) about hematite (hem). The magnetite is studded with inclusions of rutile (rt) and the hematite contains inclusions of ilmenite (il).

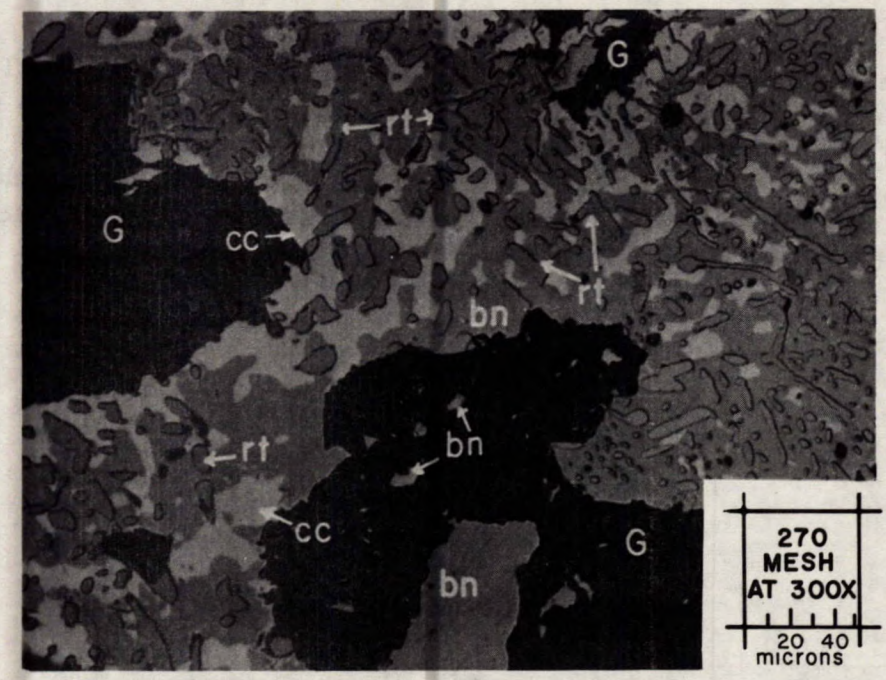

Figure 9. Photomicrograph (in oil immersion) of a polished section showing numerous inclusions of rutile (rt) in an intergrowth of bornite (bn) and chalcocite (cc). The gangue (G) contains a few inclusions of bornite.

CONCLUSIONS

A number of conclusions can be drawn from microscopical examination of the polished sections of the ore and mill products. The two principal copper-bearing minerals, bornite and chalcocite, are generally coarse-grained and should be readily liberated from the other minerals in the ore. It is to be expected that some of the bornite and chalcocite will persist as combined grains with each other down to a fine mesh size, due to the fine-grained intergrowth exhibited by these two minerals. Examination of the -100+200 mesh sink sub-fraction shows that the above conditions exist at this mesh size. In addition some of the bornite and chalcocite in this fraction still contain inclusions of rutile as might be expected, and a number of grains of bornite are partially bordered by digenite and chalcocite.

Due to the extremely small grain size of the native gold, it is expected that it will be almost impossible to liberate it by grinding.

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