MT. NANSEN MINES LTD.

MINERALOGICAL INVESTIGATION

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Mines Branch Investigation Report IR 68-52

MINERALOGICAL INVESTIGATION OF A SAMPLE OF SILVER-GOLD ORE FROM MOUNT NANSEN MINES LIMITED, YUKON TERRITORY

by

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SUMMARY OF RESULTS

Mineralogical studies of a sample of a silver-gold ore from Mount Nansen Mines Limited in the Yukon Territory, show that the ore consists of siliceous rock and breccia, which contains masses and disseminated grains of a wide variety of ore minerals. The gold is present in the form of electrum as inclusions in a number of the ore minerals, and the silver as a constituent of freibergite, and to a much lesser degree of miargyrite and electrum. Other minerals identified in the ore include bournonite, boulangerite, galena, sphalerite, pyrite, arsenopyrite, chalcopyrite, quartz, dolomite, muscovite and amphibole.

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INTRODUCTION

A sample of a silver-gold ore was received from Mr. T. Berry of the Mineral Processing Division on May 17, 1968. The sample was reported to be from the Heustis zone of the Mount Nansen Mines Limited deposit in the Yukon Territory, and was submitted to the Mines Branch by Mr. B. S. Imrie, Exploration Manager, Mount Nansen Mines Limited, 420-475 Howe Street, Vancouver 1, B.C.. Mr. Berry requested that the sample be examined to identify the minerals, particularly the gold-bearing ones, and to determine their textural relationships.

This mineralogical study succeeds an earlier one of a composite sample of ore from this same deposit. (Investigation Report IR 68-33).

SAMPLE

The sample, as received, consisted of five hand specimens, each about two to five pounds in weight. The hand specimens consisted mainly of siliceous rock and breccia, which contained masses and disseminated grains of sulphides. Mr. Berry stated that this sample was not representative of the Heustis zone of the orebody but that the hand specimens had been selected for their extensive mineralization.

METHOD OF INVESTIGATION

The large hand specimens were broken into smaller pieces with a hammer, from which chips of both massive sulphides and gangue with disseminated sulphides were selected for polished sections. A total of 23 polished sections were prepared and examined under the ore microscope to identify the metallic minerals and to determine their textural relationships. In addition, 5 thin sections were prepared from the small pieces and examined petrographically to identify the gangue minerals. The minerals in the ore were identified by both microscopical and X-ray diffraction studies.

RESULTS OF INVESTIGATION

General Mineralogy of the Ore

The ore consists essentially of masses and disseminations of metallic minerals in gangue. The metallic minerals are mainly sphalerite, pyrite and galena, lesser amounts of arsenopyrite and bournonite, and minute amounts of boulangerite, chalcopyrite, freibergite, electrum and miargyrite. The gangue minerals are quartz, some dolomite, and traces of muscovite and amphibole.

Detailed Mineralogy

Silver- and Gold-Bearing Minerals

The silver is present as a constituent of freibergite $[(Cu, Ag, Fe)_{12} Sb_4S_{13}]$, and to a smaller extent of miargyrite ($Ag_2Sb_2S_4$) and electrum (Au_3Ag).

The freibergite occurs largely as inclusions in sphalerite (Figure 1) and gangue, and to a lesser degree as inclusions in bournonite, arsenopyrite and galena. These inclusions are mainly from 10 to 200 microns in size, although a few up to 750 microns in size are present in the gangue. (The word "size" as used in this report refers to the greatest dimension of the mineral grain being described.) In addition, freibergite is sometimes combined with galena in sphalerite (Figure 1) and in a few places is intergrown with galena and arsenopyrite (Figure 2), or with bournonite and galena (Figure 3). The freibergite contains relatively few inclusions. These consist chiefly of chalcopyrite and galena, and occasionally of bournonite, electrum, sphalerite and miargyrite. These inclusions are from 10 to 150 microns in size.

Only a small amount of miargyrite is present in the ore. It occurs as inclusions in gangue, bournonite, pyrite (Figure 4), galena and sphalerite and varies from about 5 to 300 microns in size.

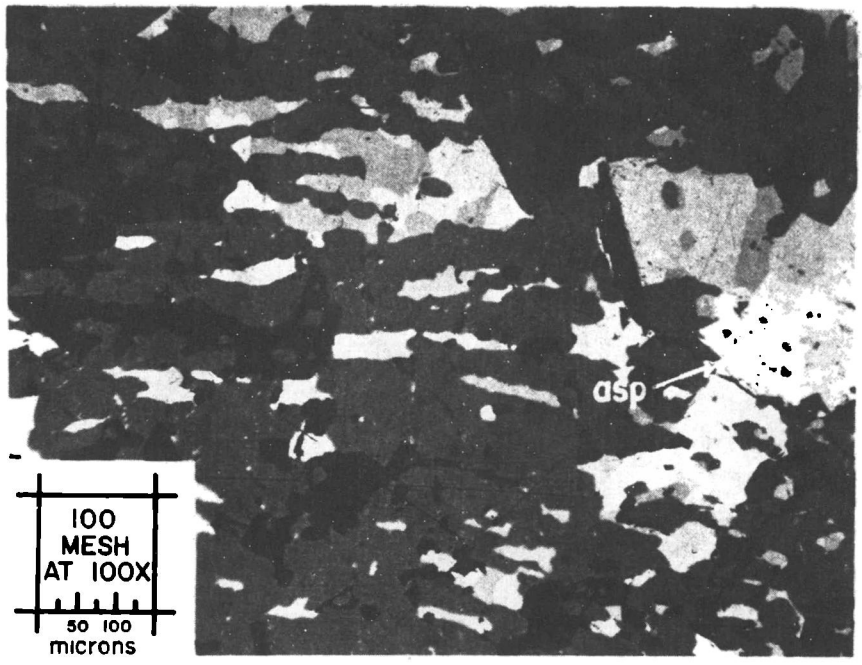

Figure 1. Photomicrograph (in oil immersion) of a polished section showing an area of sphalerite (dark grey) which contains numerous inclusions of gangue (black); individual and combined grains of freibergite (medium grey) and galena (greyish white) and two larger grains of arsenopyrite (asp).

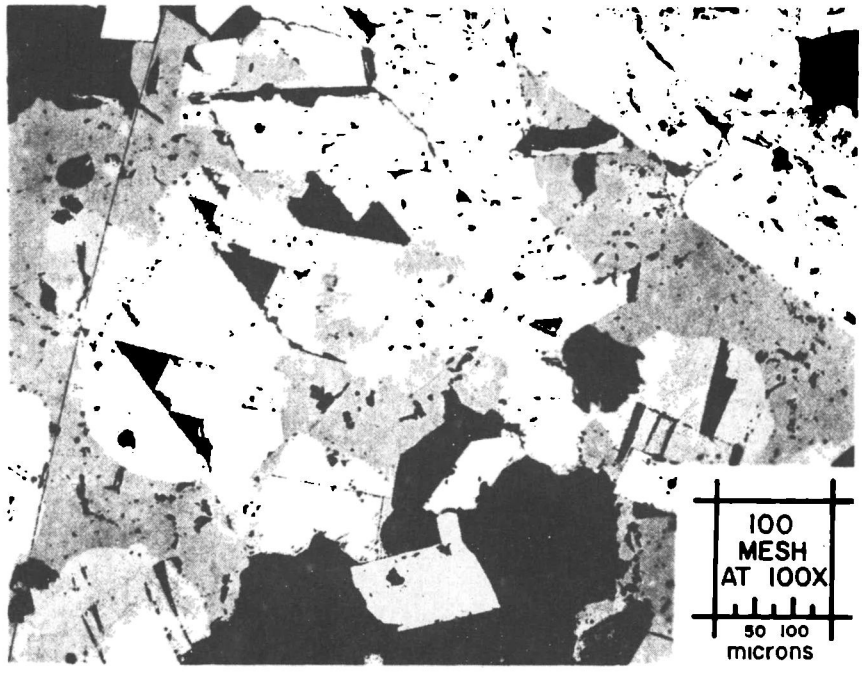

Figure 2. Photomicrograph of a polished section showing an intergrowth of arsenopyrite (white), galena (light grey) and freibergite (medium grey). The small black areas are polishing pits and the larger ones are gangue.

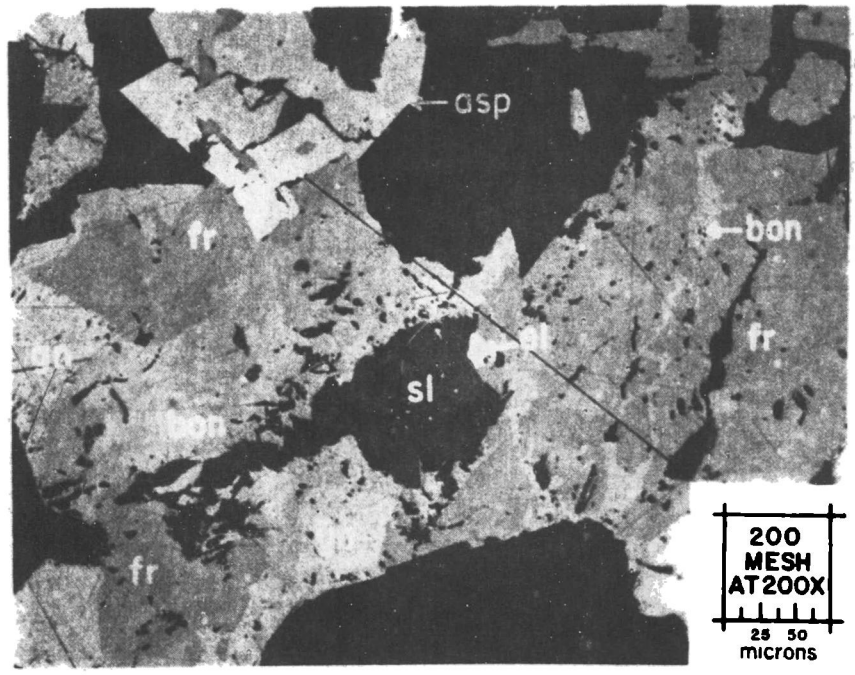

Figure 3. Photomicrograph (in oil immersion) of a polished section showing an intergrowth of freibergite (fr), bournonite (bon) and galena (gn). The freibergite contains an inclusion of electrum (el) along the contact with a grain of sphalerite (sl), and contains an irregular veinlet of bournonite. The grains of arsenopyrite (asp) in the upper left part of the photograph contain a few small inclusions of freibergite. The black areas are gangue.

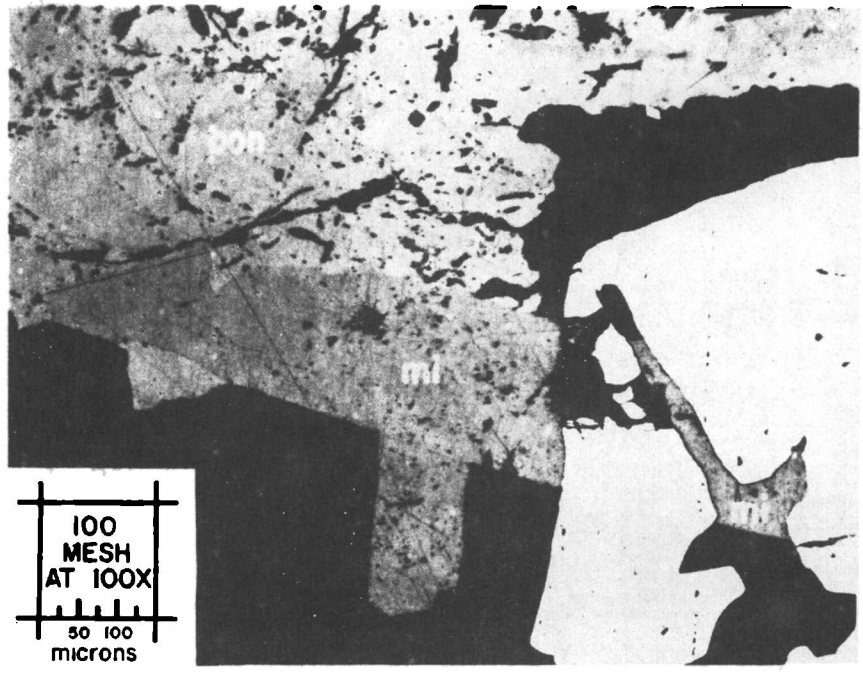

Figure 4. Photomicrograph (in oil immersion) of a polished section showing miargyrite (mi) in pyrite (white), gangue (black) and bournonite (bon).

A total of 33 grains of electrum were found during the examination of the ore; of these, 9 occur as inclusions in arsenopyrite (Figures 5 and 6), 15 as inclusions in pyrite (Figure 7) and 7 as inclusions in galena (Figures 5, 6 and 7). In addition, one grain of electrum was found in bournonite (Figure 8) and one in freibergite (Figure 3). The grains of electrum vary in size from 2 to about 180 microns. Two of the largest grains contain inclusions of galena (Figures 6 and 8). Microanalysis* of a few of the grains of electrum by means of the electron-probe microanalyser, showed that the gold:silver ratio is about 4:1.

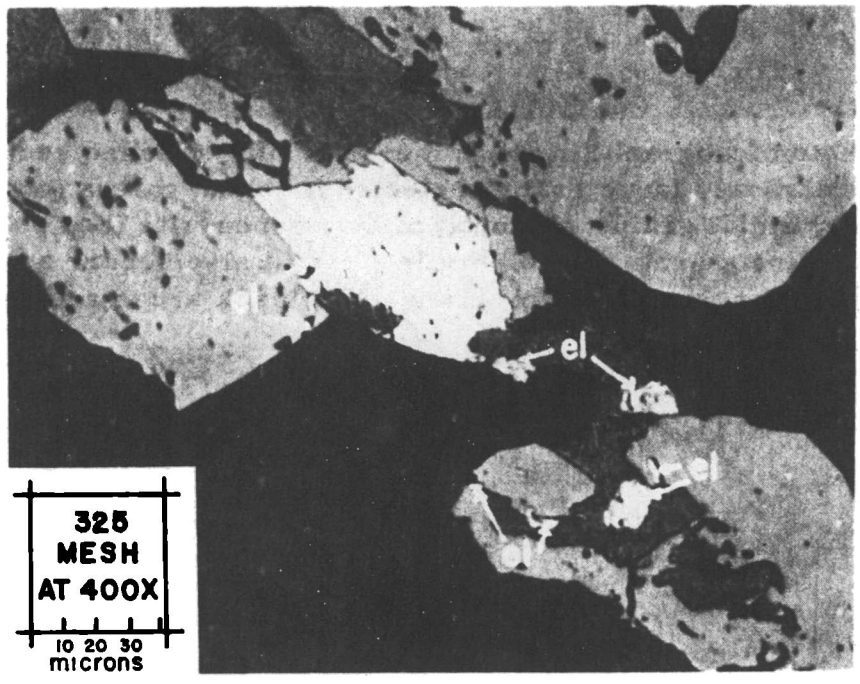

Figure 5. Photomicrograph (in oil immersion) of a polished section showing inclusions of electrum (el) in arsenopyrite (greyish white) and in galena (dark grey). The black areas are gangue.

* Microanalysis performed by D. C. Harris, Mineralogy Section, Mineral Sciences Division.

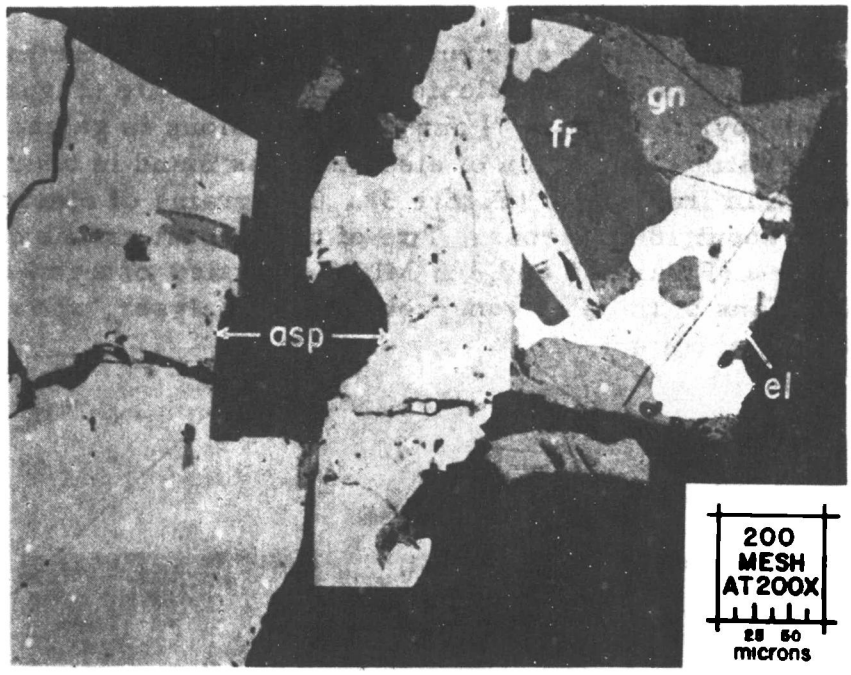

Figure 6. Photomicrograph (in oil immersion) of a polished section showing a relatively large grain of electrum (el) in galena (gn) and a few very small grains of electrum in arsenopyrite (asp). The galena contains a grain of freibergite (fr) and also occurs as an inclusion in the largest electrum grain. The black areas are gangue.

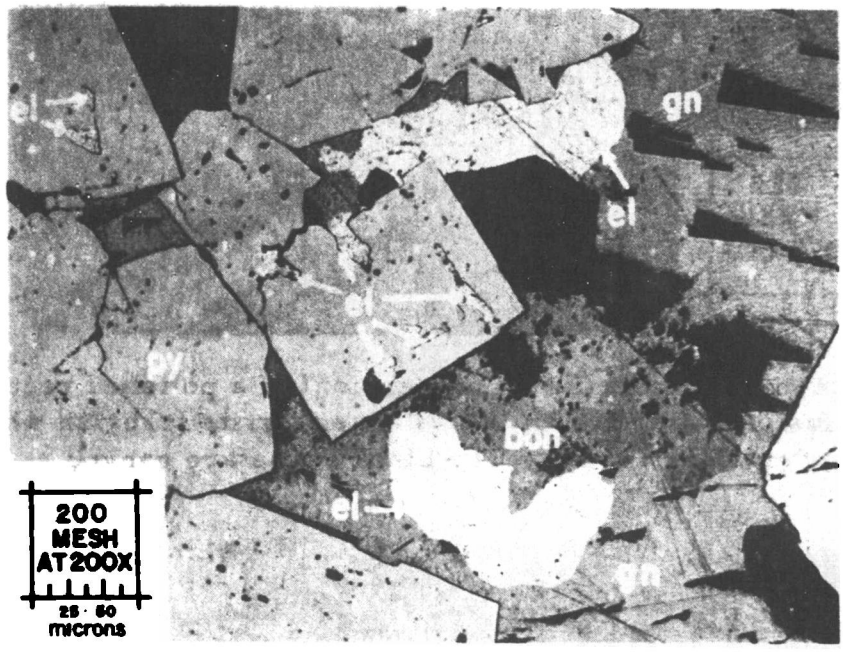

Figure 7. Photomicrograph (in oil immersion) of a polished section showing two large grains of electrum (el) in galena (gn) and a number of smaller grains of electrum in pyrite (py). A small area of bournonite (bon) is present in the galena in contact with one of the electrum grains. Most of the black areas are polishing pits.

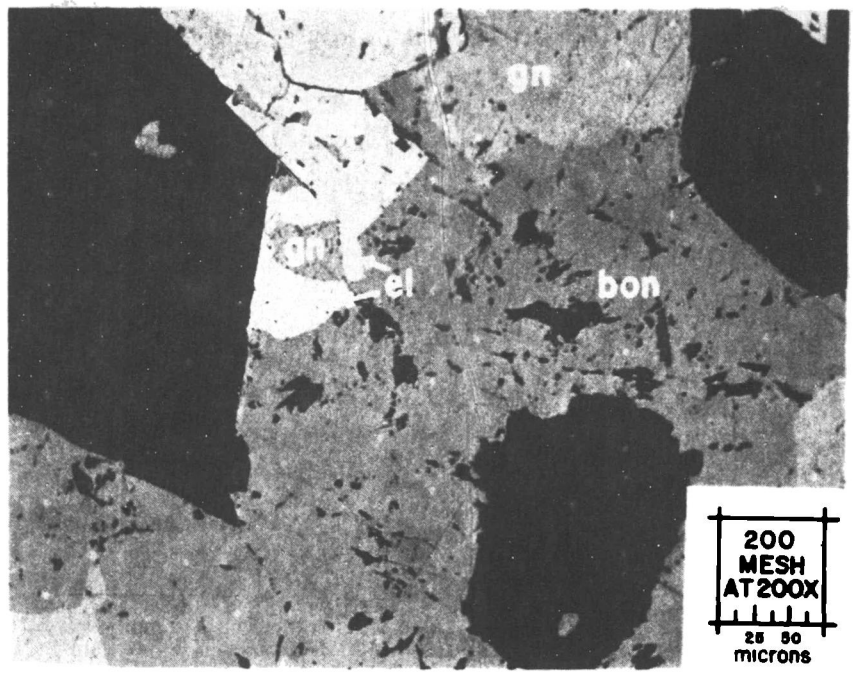

Figure 8. Photomicrograph of a polished section showing a grain of electrum (el) in bournonite (bon). The grain of electrum encloses an inclusion of galena (gn). Also shown are a few grains of arsenopyrite (asp) and galena. The three large black areas are gangue, while the very small black areas in the bournonite are polishing pits.

Lead-Bearing Minerals

The lead-bearing minerals in the ore are galena (PbS), bournonite (Pb, Cu, SbS_3) and boulangerite ($Pb_5Sb_4S_{11}$).

Galena is the most abundant lead-bearing mineral. It occurs largely as masses and disseminations in gangue, pyrite (Figure 9) and sphalerite. Some is also present as inclusions in arsenopyrite and freibergite, as intergrowths with arsenopyrite, freibergite, bournonite, pyrite and sphalerite (Figures 2, 3 and 10), and as combined grains with freibergite in sphalerite (Figure 1) and with either boulangerite or arsenopyrite in gangue. The masses and disseminated grains vary from 10 microns to about 8 millimetres in size. The intergrowths with pyrite and sphalerite are coarse-grained and form a granular ore (Figure 10). The galena contains inclusions of pyrite, sphalerite, arsenopyrite and gangue, and to a lesser extent freibergite, bournonite, electrum and miargyrite (Figures 5, 6 and 7). These inclusions range in size from 4 microns to about 1.5 millimetres.

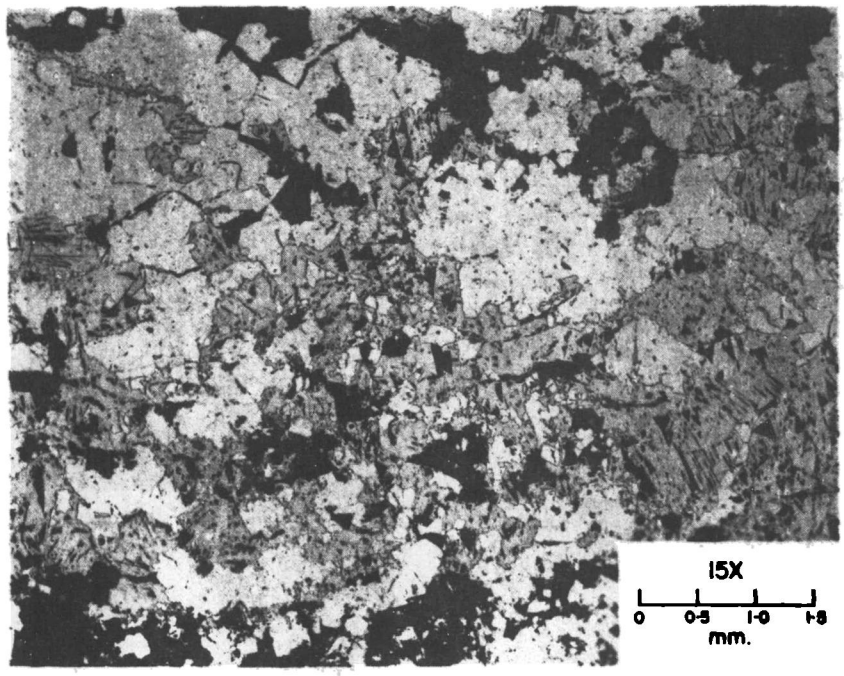

Figure 9. Photomicrograph of a polished section showing pyrite (white) containing inclusions of galena (light grey) and sphalerite (dark grey).

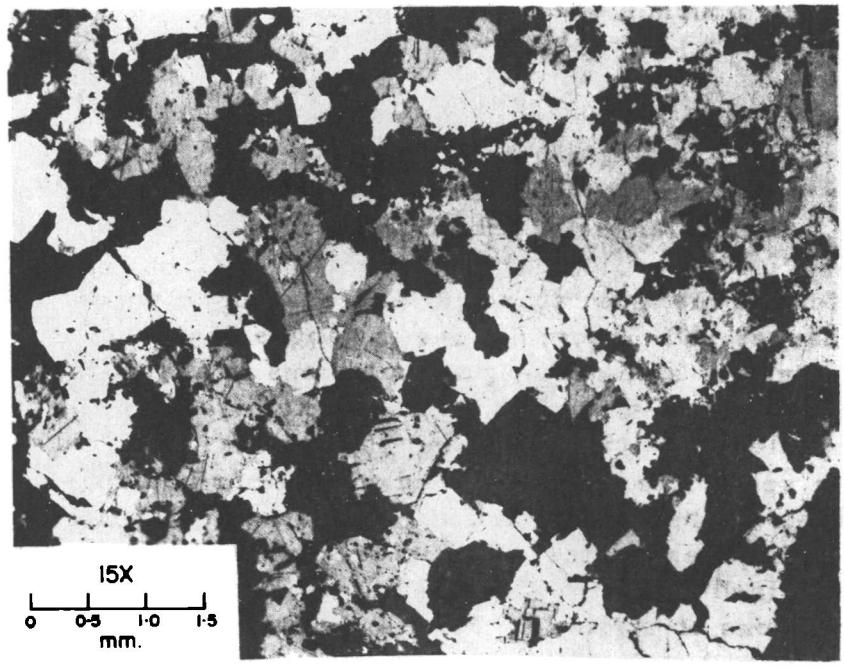

Figure 10. Photomicrograph of a polished section showing a coarse granular ore composed of pyrite (white), galena (medium grey) and sphalerite (dark grey).

Less bournonite than galena is present in the ore. It occurs largely as masses and irregular grains in gangue (Figure 11). A small amount also occurs as inclusions in galena, freibergite, and arsenopyrite, as intergrowths with freibergite and galena (Figure 3) and as combinations with either boulangerite or arsenopyrite in gangue. The masses and irregular grains of bournonite in gangue vary in size from 0.05 to about 6 millimetres, and the inclusions in the ore minerals from 10 to about 200 microns. The bournonite contains only a few inclusions. They are galena, gangue, pyrite, electrum, miargyrite and chalcopyrite, and they vary from about 10 to 500 microns in size (Figures 4, 8 and 11).

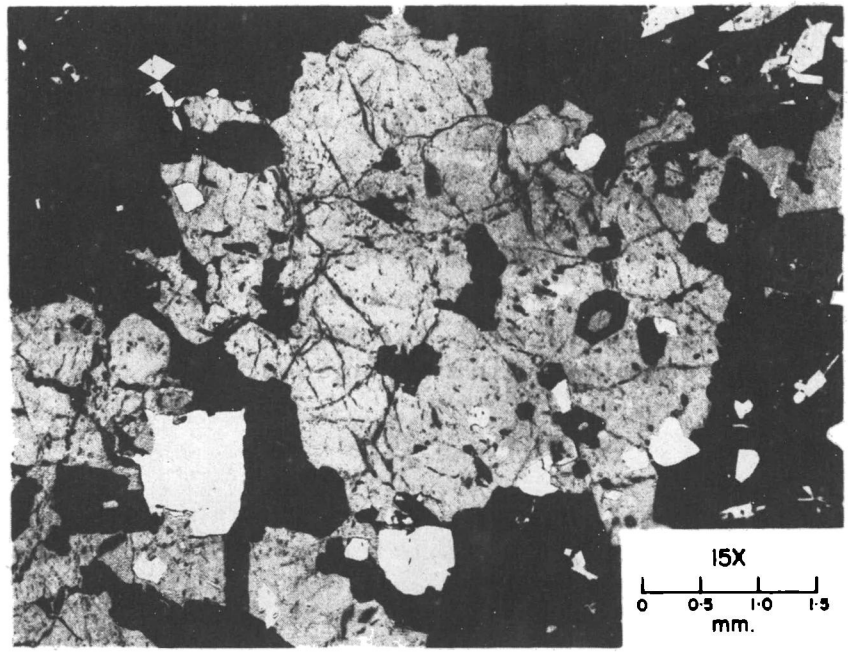

Figure 11. Photomicrograph of a polished section showing bournonite (greyish white) in gangue (black). The bournonite contains inclusions of gangue and pyrite (white). Also shown are two grains of sphalerite (dark grey).

Only a very small amount of boulangerite was found in the ore. It occurs largely as individual and sheaf-like clusters of elongate grains in gangue (Figure 12), but some is present as combined grains with galena, sphalerite and bournonite in gangue. The individual grains and clusters of grains vary from a few microns to about 2 millimetres in size, but most are smaller than 300 microns. The boulangerite contains very few inclusions. These are gangue, pyrite and arsenopyrite, and they vary from 10 to about 180 microns in size.

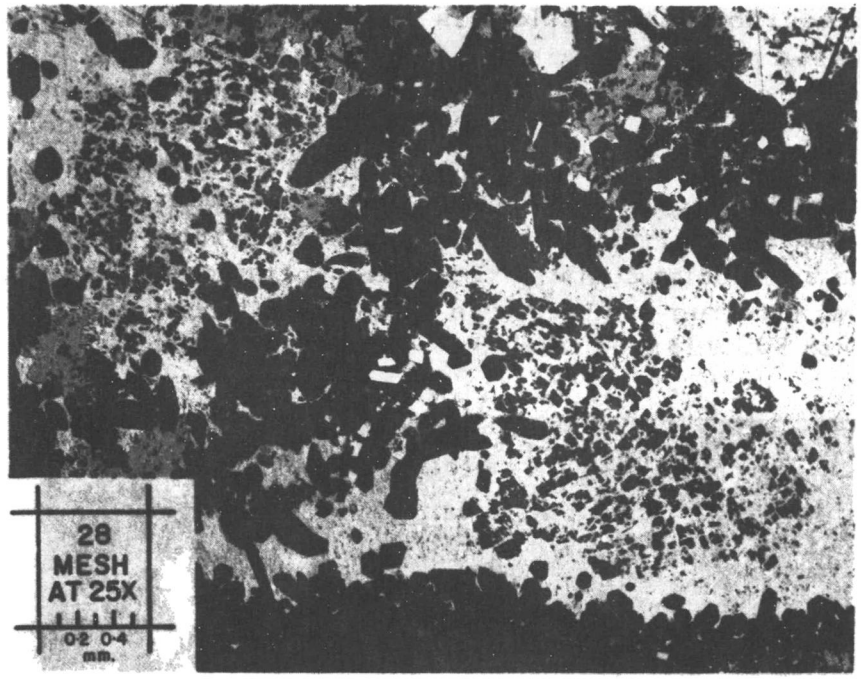

Figure 12. Photomicrograph of a polished section showing boulangerite (white) in gangue (black). A few grains of sphalerite (dark grey) are combined with the boulangerite.

Other Ore Minerals

The other ore minerals are sphalerite (ZnS), pyrite (FeS_2) arsenopyrite (FeAsS) and chalcopyrite ($CuFeS_2$).

The sphalerite is present largely in a massive form (Figure 13) and as small masses and irregular grains in gangue. It also occurs as inclusions in galena, pyrite and arsenopyrite (Figure 9), intergrowths with pyrite and galena (Figure 10), and combined grains with either arsenopyrite or boulangerite in gangue (Figure 12). The small masses and irregular grains of sphalerite vary from 10 microns to about 2 millimetres in size. The sphalerite contains inclusions of chalcopyrite, freibergite, galena, arsenopyrite, pyrite, gangue and miargyrite (Figure 1). These inclusions vary in size from a few microns in the smaller grains of sphalerite to about 3 millimetres in massive sphalerite. The sphalerite is cut by veinlets of gangue up to 350 microns in width (Figure 13).

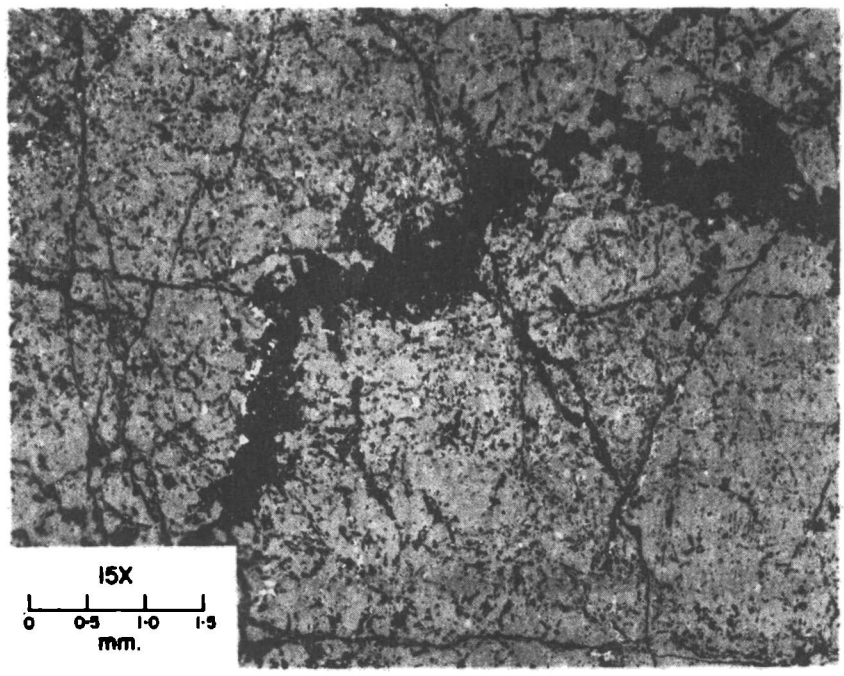

Figure 13. Photomicrograph of a polished section showing massive sphalerite (medium grey), which is cut by a veinlet of gangue (dark grey) and contains a number of small inclusions of the other sulphides (white).

The pyrite occurs largely as masses and coarse grains in gangue, galena and sphalerite. Some also occurs as intergrowths with galena and sphalerite (Figure 10) and as combined grains with arsenopyrite in gangue. In addition, trace amounts of pyrite occurs as inclusions in boulangerite and bournonite (Figure 11). The masses and grains of pyrite in gangue, galena and sphalerite are from about 50 microns to one centimetre in size, while the pyrite inclusions in boulangerite and bournonite vary from about 20 microns to 0.8 millimetres. The pyrite contains inclusions of gangue, galena, electrum, miargyrite, sphalerite and arsenopyrite (Figures 4, 7 and 9), and these inclusions range from a few microns to about 2 millimetres in size.

Less arsenopyrite than pyrite occurs in the ore, and is generally present as smaller grains. It occurs mainly as individual grains and aggregates of grains disseminated in gangue. Some arsenopyrite occurs as inclusions in sphalerite (Figure 1), pyrite, galena and boulangerite, as combined grains with either pyrite or bournonite in gangue, and as intergrowths with galena and freibergite (Figure 2). The individual grains and aggregates of arsenopyrite grains in gangue vary from 20 microns to about 1.2 millimetres in size, while the arsenopyrite inclusions in the ore minerals are from 10 to about 350 microns in size. The arsenopyrite contains inclusions of electrum, freibergite, pyrite, galena and sphalerite (Figures 3, 5 and 6) and these range from 2 to about 250 microns in size.

Only a small amount of chalcopyrite is present in the ore. It occurs primarily as small belbs in sphalerite, which range from 2 to 25 microns in size. A few larger grains of chalcopyrite also occur in the sphalerite as well as in gangue and freibergite.

Gangue Minerals

The gangue is composed mainly of quartz, with lesser dolomite, and a small quantity of muscovite and amphibole.

CONCLUSIONS

The conclusions drawn from the mineralogical investigation are:

1. The gold is present in the form of electrum, generally fine-grained, and it is expected that very fine grinding would be required to liberate it.
2. The silver occurs predominantly as a constituent of freibergite, with a small amount in the form of electrum and miargyrite. The grains of freibergite have a varying size, but many of them are comparatively large. Most of the miargyrite grains on the other hand are quite small and it is expected that fine grinding would be required to liberate them.

ACKNOWLEDGEMENT

The author wishes to express his gratitude to Dr. D. C. Harris of the Mineralogy Section, Mineral Sciences Division for his analysis of the electrum.

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