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MINERALOGICAL INVESTIGATION OF A LEAD-ZINC-SILVER ORE FROM THE REEVES-MacDONALD MINES LIMITED, REMAC, B. C.

by

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MINERAL SCIENCES DIVISION

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SUMMARY OF RESULTS

Mineralogical studies made on a sample of lead-zinc-silver ore from Reeves-MacDonald Mines Limited, Annex Mine deposit, located near Remac, British Columbia show that the ore consists primarily of carbonate minerals with sulphide inclusions and of some massive sulphides. Zinc is present in the ore as sphalerite, lead occurs as galena, and the silver as argyrodite (?) Other minerals identified in the ore include pyrite, magnetite, pyrrhotite, dolomite, mica, calcite, and quartz.

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INTRODUCTION

A sample of a lead-zinc-silver ore from a deposit near Remac, British Columbia was received from Mr. A. Wall of the Mineral Processing Division on November 3, 1970. Mr. Wall stated that the ore had originally been submitted by Mr. L.M. Kinney, Vice-President of Mining, Reeves-MacDonald Mines, Ltd., Mr. Wall requested that the sample be examined mineralogically to identify its constituent minerals and to determine their grain sizes and textural relationships.

SAMPLES

The samples, as received, consisted of 20 small hand specimens, each about one inch in size; about 100 grams of composite head sample crushed to minus ten mesh; 5 cleaner Pb concentrates numbered 3 to 7, inclusive; and 8 each of cyclosized lead and zinc concentrates sized at -150 mesh, 150 to 200 mesh, 200 to 250 mesh, 40.6 microns, 30.9 microns, 22.5 microns, 15.5 microns, and 11.9 microns. The small hand samples were composed largely of carbonate minerals, with small inclusions of sulphides, and a few small pieces that were mainly massive sulphides.

METHOD OF INVESTIGATION

Eight polished sections were prepared from the small hand specimens, and examined under the ore microscope to identify the ore minerals, and to determine their grain sizes and textural relationships. In addition, the 48 to 325-mesh fraction was screened from the head sample and separated into sink and float products by means of heavy liquids. The sink product was

further separated magnetically on the Franz Isodynamic separator. The float products were run on the X-ray diffractometer by Mr. E. J. Murray of the Crystallography Group to identify the principal gangue minerals. The heavier fractions of the gravity separation and the magnetic fractions were used to prepare polished sections which were examined to determine the liberation of the ore minerals. Polished sections of the five cleaner Pb concentrates, the eight cyclosized lead concentrates, and the eight cyclosized zinc concentrates were prepared and examined microscopically to identify the ore minerals and to evaluate their liberation.

The minerals in the ore were identified by microscopy, X-ray diffraction methods, and electron-probe microanalysis. The electron probe analyses were made by D. R. Owens of the mineralogy Section.

RESULTS OF INVESTIGATION

General Mineralogy of the Ore

The minerals identified in the ore are sphalerite, pyrite, galena, argyrodyite (?), magnetite, pyrrhotite, dolomite, mica, calcite and quartz. The most abundant ore minerals* are sphalerite, pyrite and galena, with only traces of magnetite and pyrrhotite. Argyrodyite was the only silver-bearing mineral found in the ore. The ore minerals occur in a wide variety of associations and are intimately intergrown, as shown in the following section of the report.

Detailed Mineralogy

Sphalerite ZnS

The sphalerite in the ore occurs mainly in a massive form (Figure 1), Few areas of the sphalerite are free from inclusions, and most of it is riddled with grains of the other minerals in the ore (Figure 2). These grains consist mainly of galena, pyrite, gangue and the silver-bearing mineral, and they

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

occur over a wide size* range, varying from 2 microns to about one cm. The sphalerite also occurs as inclusions in gangue and pyrite over a wide size range, varying from a few microns to over one mm. The electron microprobe analysis of the sphalerite gave the following results.

Cd = ~ 0.57 Wt.%; Fe = ~ 1.06 Wt.%

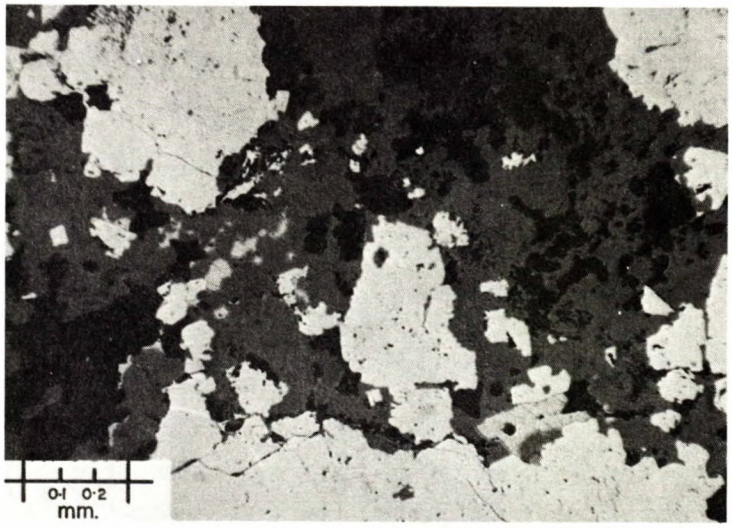

Figure 1. 50X. Photomicrograph of polished section showing massive sphalerite (dark grey) with inclusions of pyrite (white), galena (light grey) and gangue (black).

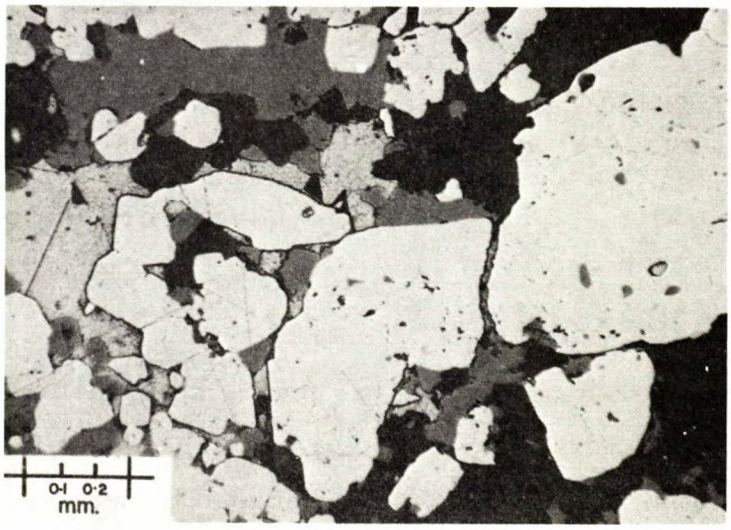

Figure 2. 50X. Photomicrograph of a polished section showing sphalerite (dark grey), pyrite (white), galena (light grey) and gangue (black).

*Size as used in this report refers to the longest dimension of a grain.

Galena

The galena is present largely as inclusions in, or associated with, sphalerite (Figure 2) and to a lesser extent occurs as inclusions in pyrite and gangue (Figure 3). The grain size of the galena varies from small inclusions of a few microns up to grains to ~ 600 microns, but most grains are in the 25 to 50-micron range (Figure 3). The galena, itself, contains only a few inclusions of other minerals and the amount is deemed insignificant.

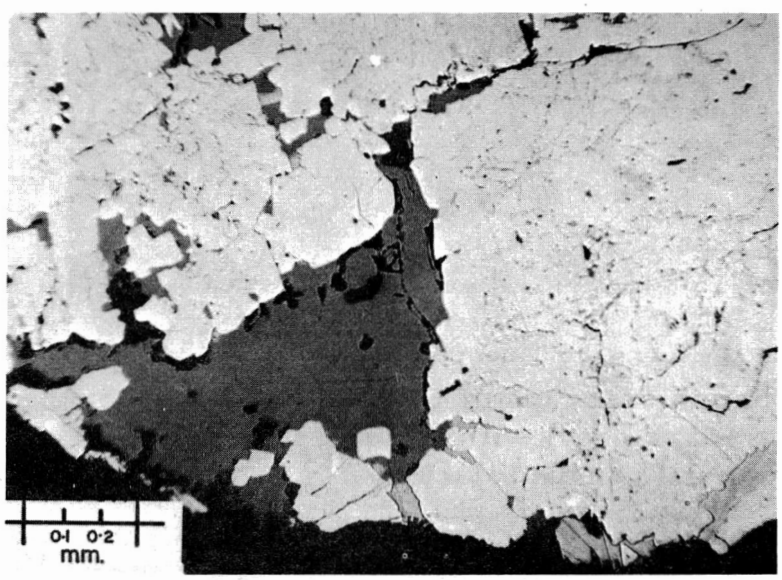

Figure 3. 50X. Photomicrograph of a polished section showing veinlets of galena (light grey) in pyrite (white). The sphalerite is dark grey and the gangue and mounting medium are black.

Argyrodyite $Ag_8(Ge)S_6$

The only silver-bearing mineral occurring in the ore is believed to be argyrodyite (Ag_8GeS_6), shown in Figure 4. This identification is only tentative, as substantiation was impossible because the grains were too small for X-ray diffraction analysis, and they decomposed under the electron beam during attempts at electron probe microanalysis. However, it was definitely established by electron microprobe studies that the mineral is a silver-germanium sulphide.

The occurrence of the argyrodyite(?) consists of a number of very small grains, about 30 microns or less in size, present mainly as inclusions in sphalerite and as grains adhering to sphalerite and rarely to galena.

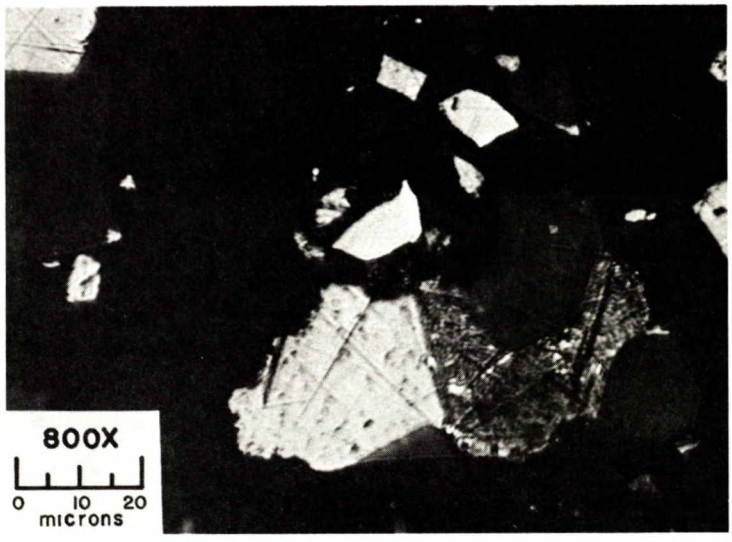

Figure 4. Photomicrograph of a polished section showing argyrodyite? (medium grey) with sphalerite (dark grey) and galena (white), the mounting medium is black.

Pyrite

Pyrite is the principal metallic mineral in the ore. It occurs as individual masses and clusters of grains disseminated throughout the ore. It varies from a few microns to ~ 1 cm in size, but most of the grains are in the 200 to 500-micron range (Figures 1, 2, and 3).

The pyrite is mainly free of inclusions but a few grains do have inclusions of sphalerite varying in size from a few microns to over one mm. Galena is also found as inclusions in the pyrite, often as veins up to ~ 2 mm long and ~ 100 microns wide.

Magnetite and Pyrrhotite

Only a few grains of magnetite and pyrrhotite were found in the head sample concentrate; they may be contaminants because no traces of these minerals were found in the polished hand specimens.

Gangue Minerals

As mentioned above, the ore consists mainly of gangue. The principal gangue mineral is dolomite with smaller amounts of mica and calcite. A minute amount of quartz is also present.

Mineralogy of the Concentrates

Zinc Concentrate

Examination of the polished sections of the zinc concentrate showed that the sphalerite consists mainly of free grains, even in the coarsest fraction (+150) (Figures 5, 6, 7, and 8). Relatively few grains of the sphalerite are contaminated by galena, pyrite or gangue. The concentrate, however, does contain many free grains of these minerals.

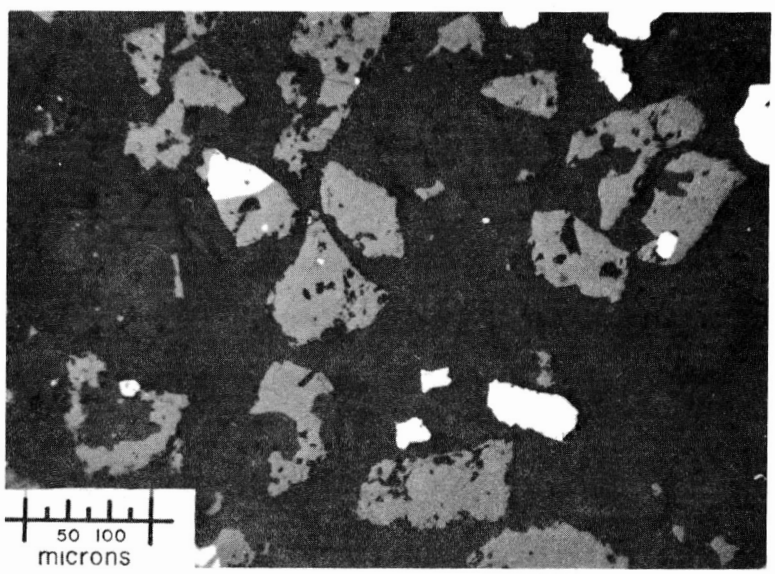

Figure 5. 100X. Photomicrograph of a polished section of the plus 150-mesh zinc concentrate showing sphalerite (grey), pyrite (white) and gangue (dark grey) in the black mounting and medium.

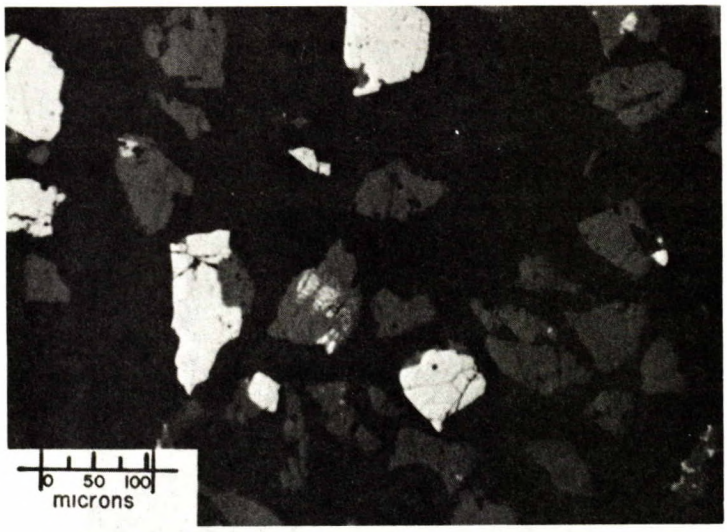

Figure 6. 150X. Photomicrograph of a polished section of the plus 250-mesh zinc concentrate.

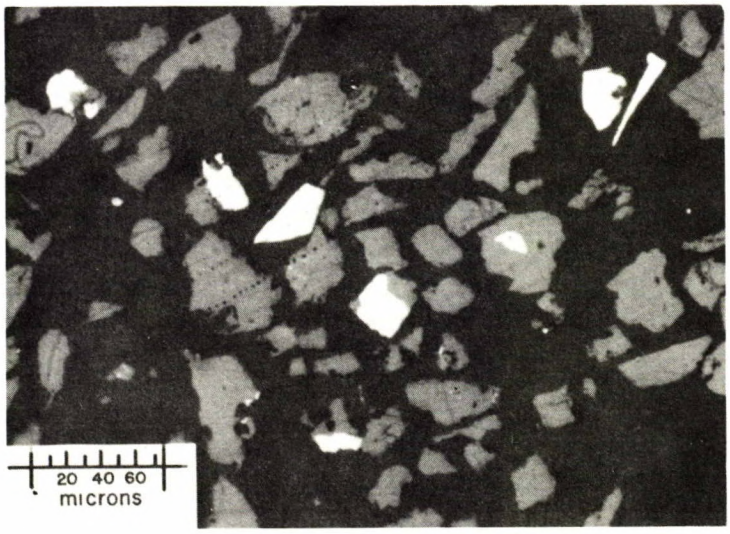

Figure 7. 250X. Photomicrograph of a polished section of the plus 30.7-micron zinc concentrate.

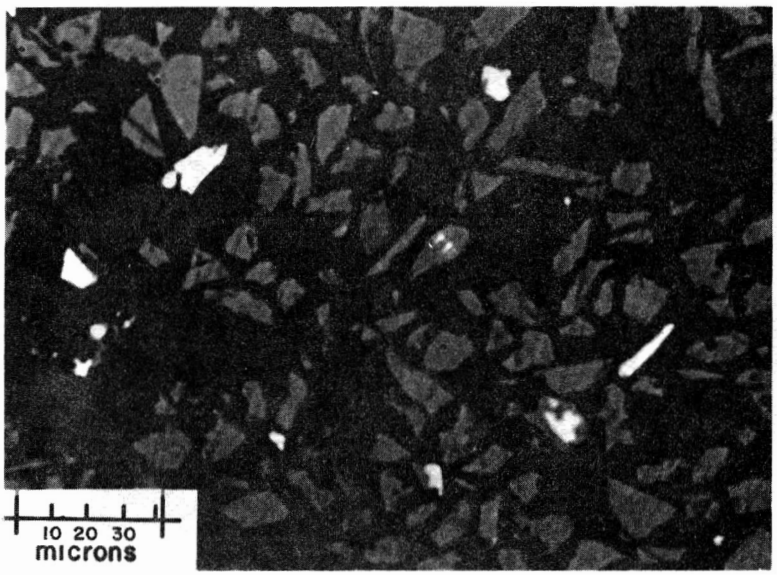

Figure 8. 400X. Photomicrograph of a polished section of the plus 15.5-micron zinc concentrate.

Lead Concentrate

Examination of polished sections of the lead concentrate show the galena content to be about evenly distributed between free grains and small inclusions in sphalerite and, to a lesser extent, in pyrite (Figures 9, 10, 11, and 12). Small inclusions of galena, many less than 10 microns in size, were found in otherwise free grains of sphalerite and pyrite. The presence of sphalerite and pyrite in the lead concentrate may be due to these inclusions of galena.

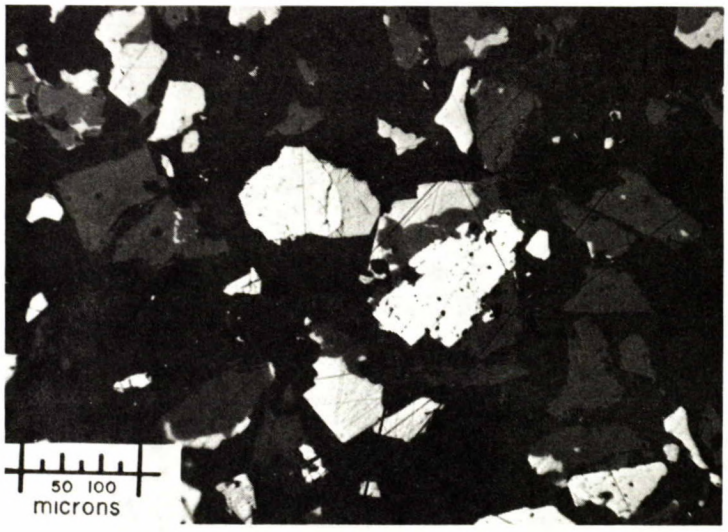

Figure 9. 100X. Photomicrograph of a polished section of the plus 150-mesh lead concentrate showing galena (light grey), pyrite (white) and sphalerite (dark grey). The black areas are the mounting medium and gangue.

Figure 10. 150X. Photomicrograph of a polished section of the plus 150-mesh lead concentrate.

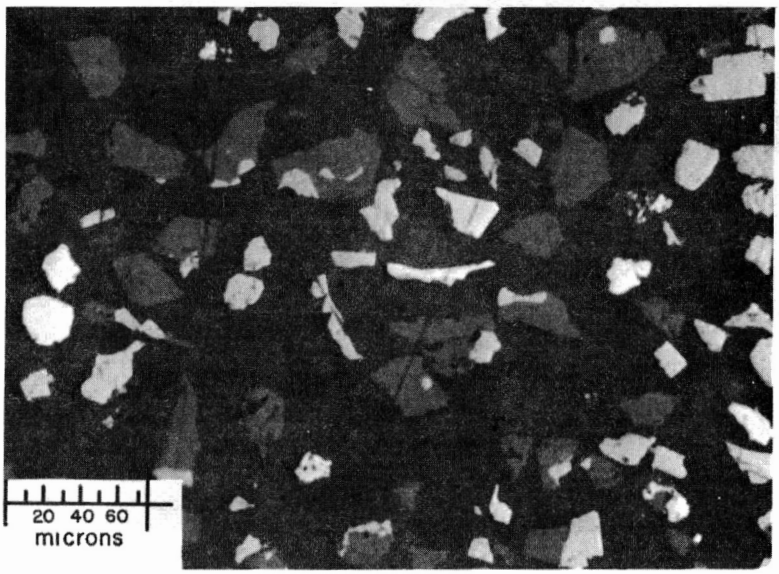

Figure 11. 250X. Photomicrograph of a polished section of the plus 30.7-micron lead concentrate.

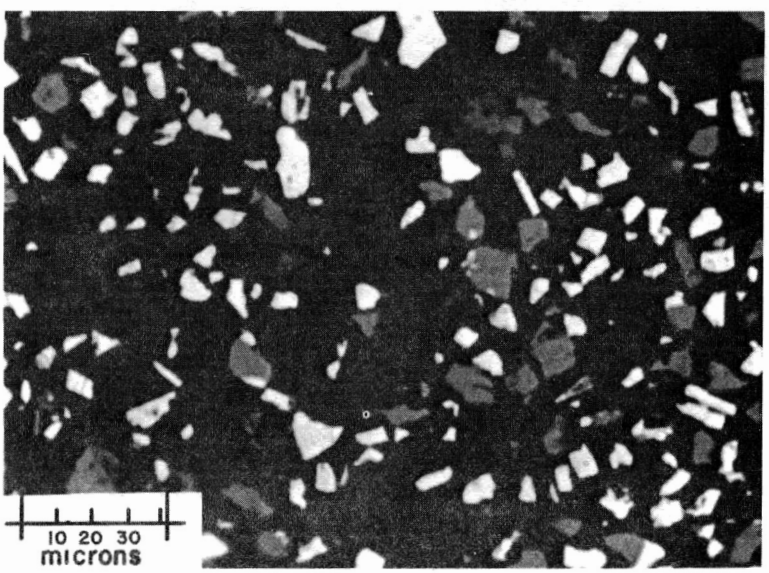

Figure 12. 400X. Photomicrograph of a polished section of the plus 15.5-micron lead concentrate.

Cleaner Lead Concentrate, Tests 3, 4, 5, 6, and 7

Tests 3, 4, 6, and 7. Examination of polished sections of these mill products shows that the galena and sphalerite are intergrown to a large degree (Figure 13). Although each product contains some free grains of galena, many free grains of pyrite and gangue are also present.

Test 5. Finer grinding of this mill product liberates more of the ore minerals, but it still contains many intergrown grains of galena and sphalerite (Figure 14). There are also many free grains of pyrite, sphalerite and gangue.

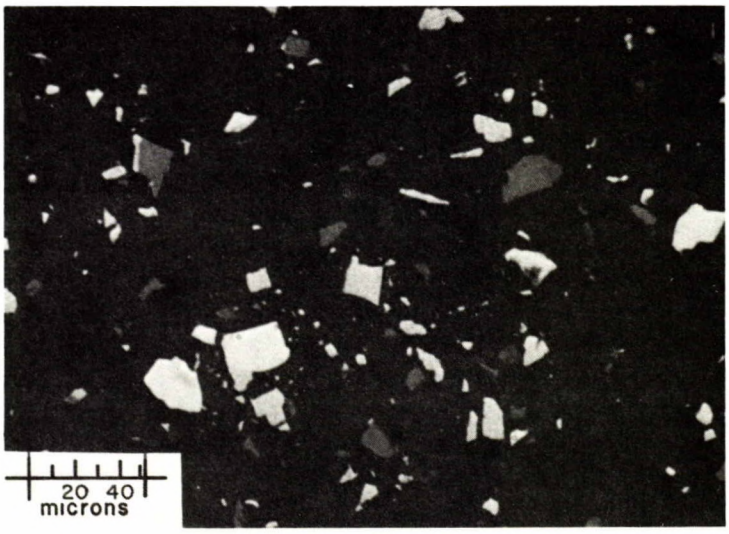

Figure 13. 300X. Photomicrograph of a polished section shows a typical field from the cleaner lead concentrate, Tests 3, 4, 6, and 7. Test Number 3 is shown. The pyrite is (white), the galena, (light grey), and the sphalerite (dark grey).

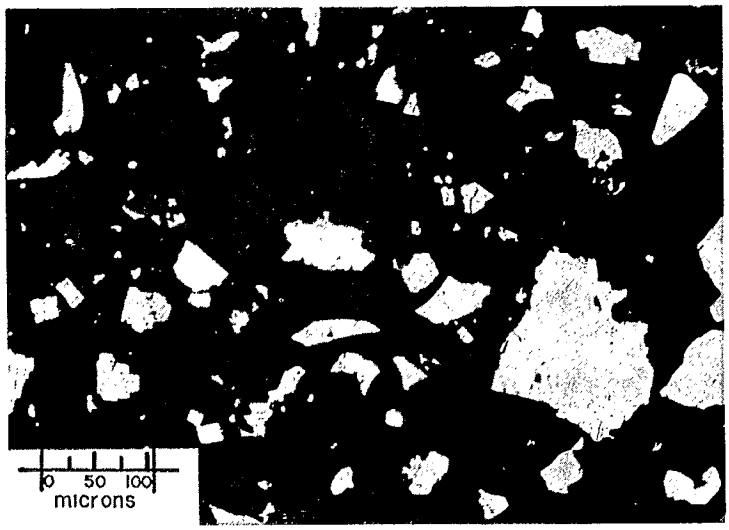

Figure 14. 150X. Photomicrograph of a polished section of the cleaner lead concentrate, Test 5, showing pyrite (white), galena (light grey) and sphalerite (dark grey).

CONCLUSIONS

From the mineralogical examination of the ore, a number of conclusions can be drawn. Firstly, although the sphalerite in the ore is relatively coarse-grained some of it is riddled with inclusions of pyrite, galena, and gangue that would be difficult to liberate. Secondly, the galena is medium to fine-grained, and this fine-grained galena is probably responsible for many of the mixed sphalerite-galena and pyrite-galena particles reporting in the lead concentrates. Thirdly, the silver-bearing mineral argyrodyite (?) is fine-grained and complete liberation would be difficult.

RGP/pg