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MINERALOGY OF A SLAG FROM COBALT REFINERY LIMITED

by

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MINERAL SCIENCES DIVISION

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W. Petruk*

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SUMMARY OF RESULTS

Examination of a slag from Cobalt Refinery Limited shows that it consists of a fine grained black material and contains a number of metallic pellets that range from about 1 micron to several millimeters in diameter. The black material is composed of melilite, magnetite and pyroxene, and the metallic pellets are composed of a niccolite-type compound, native silver, chalcocite, safflorite, bornite, ZnS, and galena. These pellets contain Ag 15.94%, Co 13.38%, Ni 7.30%, Fe 6.20%, As 36.77%, Sb 1.45%, Cu 6.72%, Zn 2.77%, Pb 1.07% and S 6.49%.

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INTRODUCTION

Several hand specimens of a slag from Cobalt Refinery Limited were received from T.F. Berry of the Mineral Processing Division in April, 1964. Mr. Berry stated that the specimens were submitted to the Mines Branch by Mr. J.N. Cram, Prof. Eng., Vice President and General Manager, Cobalt Refinery Limited, Cobalt, Ontario, and requested that the constitutents be identified.

METHOD OF INVESTIGATION

Some of the hand specimens were broken with a hammer and metallic pellets were hand picked. Polished and thin sections were then prepared from the pellets and hand specimens, and the constituents were identified by means of microscopical and X-ray diffraction studies. The pellets were also analysed chemically.

RESULTS OF INVESTIGATION

The slag consists of a black, fine grained, strongly magnetic material and contains a number of metallic pellets. The black material is composed of melilite, magnetite and pyroxene. The melilite occurs chiefly as prismatic crystals (see Figure 1), and the magnetite occurs as euhedral to anhedral grains in the melilite (see Figure 2). Pyroxene was detected only by X-ray diffraction studies of the slag.

The metallic pellets range from one micron (see Figure 3) to several millimeters in diameter, and have a specific gravity of about 7.7. Their chemical composition is given in Table 1.

TABLE 1

Chemical Composition of Metallic Pellets in a Slag from Cobalt Refinery Ltd.

Element	Weight per cent
Co	13.38
Ni	7.30
Fe	6.20
As	36.77
Sb	1.45
Cu	6.72

continued

TABLE 1 concluded

Element	Weight per cent
Zn	2.77
Pb	1.07
Ag	15.94
S	6.49
Insoluble	1.31
Total	99.40

Chemical analysis by staff of the Analytical Chemistry Subdivision, Mineral Sciences Division, Internal Report MS-AC-64-913.

The metallic pellets are composed of a niccolite-type compound (Ni (Co?) As), native silver (Ag), chalcocite (Cu_2S), safflorite ($(Co,Fe)As_2$) bornite (Cu_5FeS_4), galena (PbS), and probably ZnS. The niccolite-type compound is the main constituent of the pellets; it is intergrown with irregular grains of native silver, chalcocite (see Figure 4) and safflorite (see Figure 5). This compound, however, is different from normal niccolite in that it contains a high amount of cobalt, and its X-ray diffraction pattern and optical properties differ slightly. The approximate chemical composition of the niccolite-type compound plus minor safflorite was estimated from the values reported in Table 1 by allocating the silver, copper, lead, zinc, iron, sulphur and insoluble to native silver, chalcocite, galena, ZnS, FeS and a silicate; and the cobalt, nickel, arsenic and antimony to niccolite-type compound plus minor safflorite. The approximate chemical composition of the niccolite-type compound plus minor safflorite is Co 22.7%, Ni 12.4%, As 62.4%, and Sb 2.5%.

The chalcocite and bornite are present as masses within the pellets. In a few places the chalcocite contains bornite lamellae, and in other places it is intergrown with grey material (see Figure 6). This grey material was found only as such small intergrowths that it cannot be positively identified. However, since significant amounts of zinc were reported in the chemical analysis of the metallic pellets it is suggested that the grey material is ZnS.

Galena was detected by X-ray diffraction studies of the pellets but was not found in polished sections.

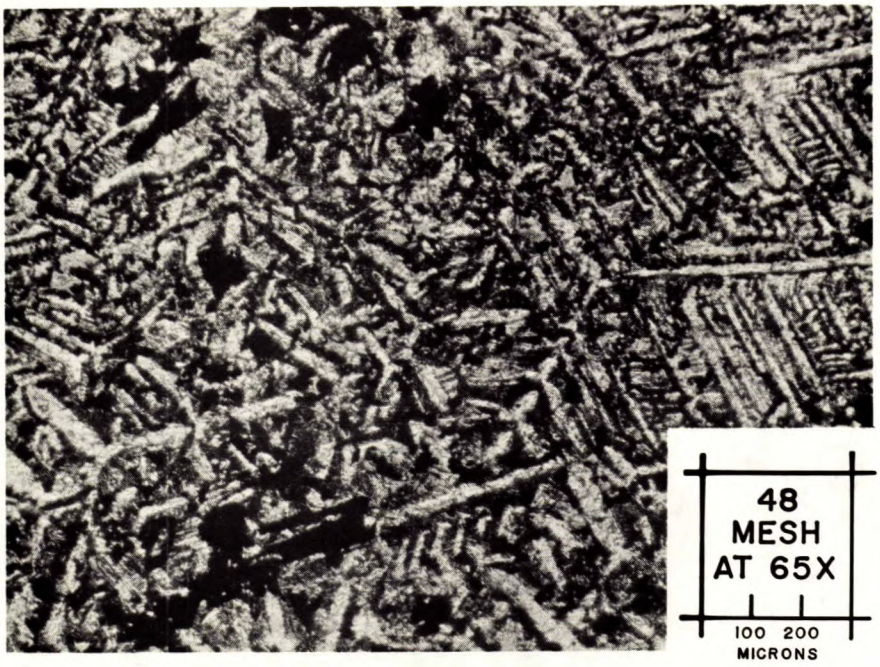

Figure 1. Photomicrograph of a thin section of the slag. It shows prismatic crystals of melilite (white to grey) and irregular areas of magnetite (black).

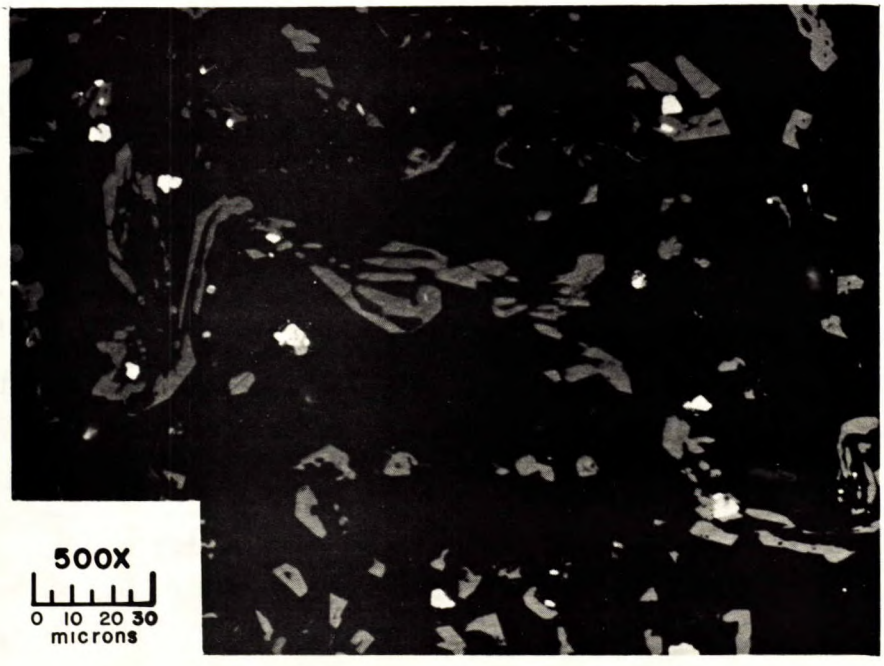

Figure 2. Photomicrograph of a polished section of the slag. It shows magnetite grains (grey) in the melilite (black). The white spots represent metallic pellets.

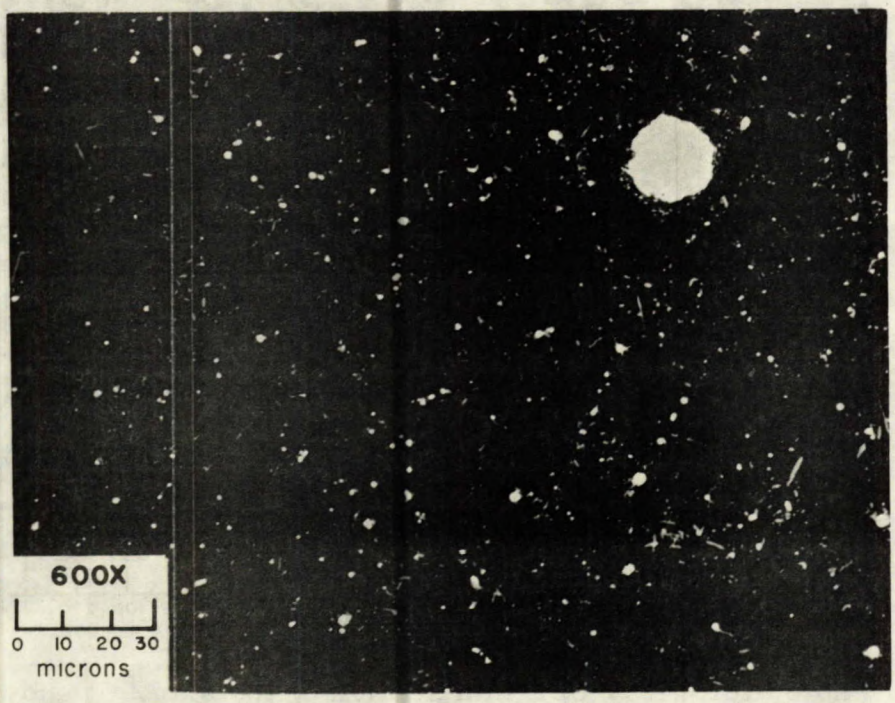

Figure 3. Photomicrograph of a polished section showing minute metallic pellets (white dots) in the slag (black). The grey dots represent magnetite.

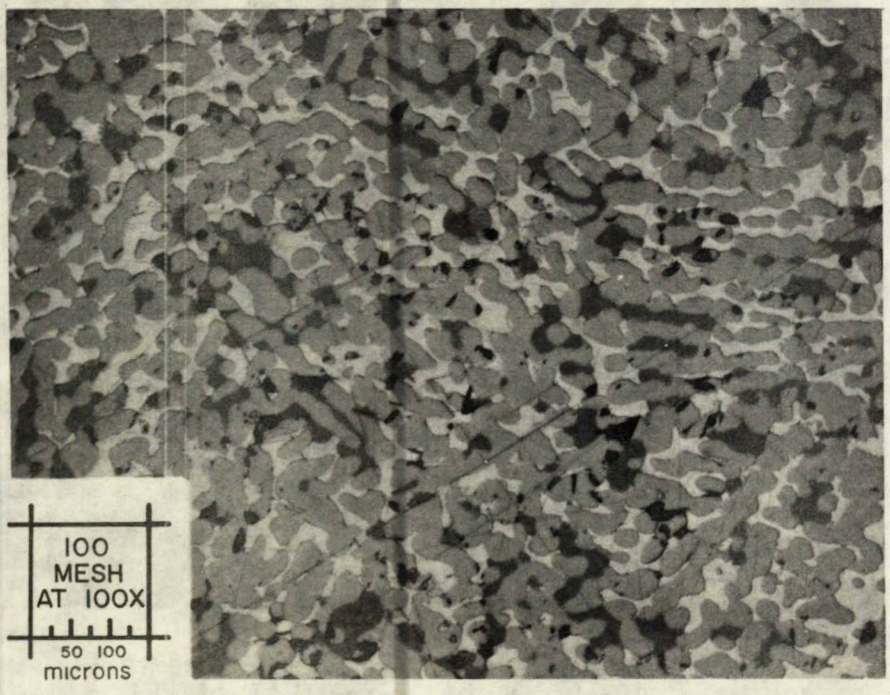

Figure 4. Photomicrograph of a polished section of a large metallic pellet. It shows the niccolite-type compound (light grey), native silver (white), and chalcocite (dark grey).

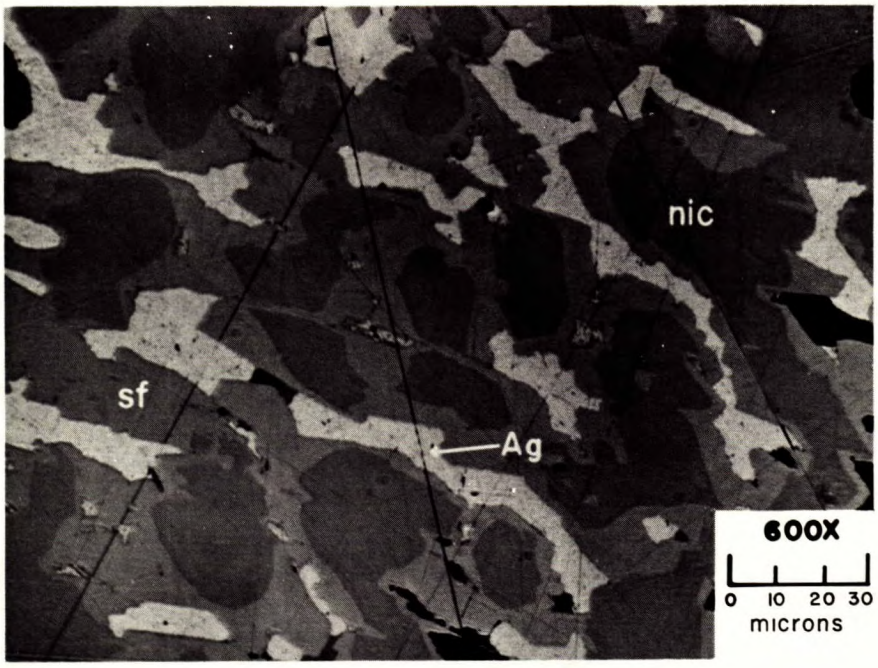

Figure 5. Photomicrograph of a polished section of a large metallic pellet. It shows the niccolite-type compound (nic), safflorite (sf), and native silver (Ag).

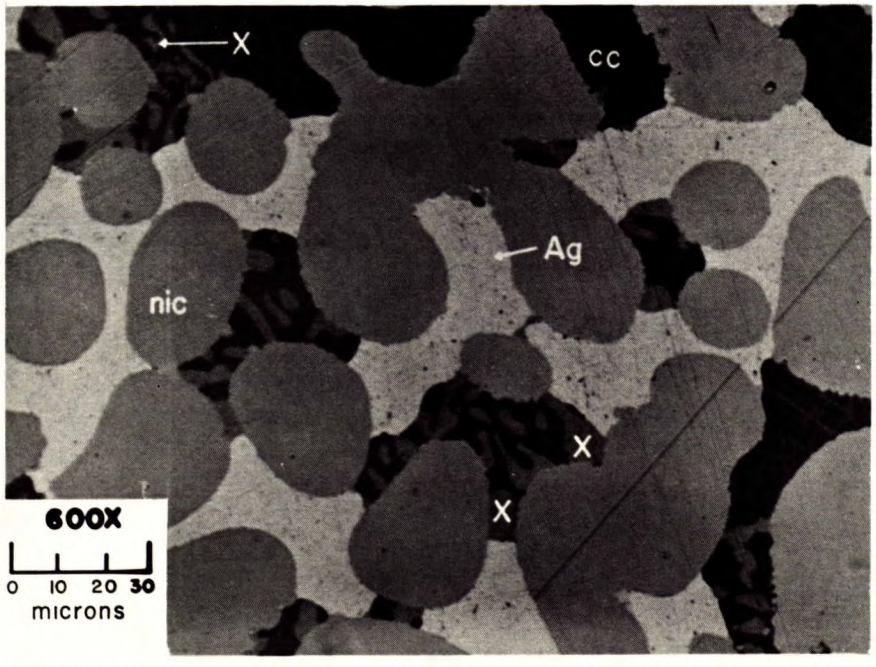

Figure 6. Photomicrograph of a polished section of a metallic pellet. It shows the niccolite-type compound (nic), native silver (Ag), chalcocite (cc), and the grey material (X) that is considered to be ZnS.

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