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MINERALOGICAL STUDY OF A GOLD ORE FROM McINTYRE PORCUPINE MINES LTD., SCHUMACHER, ONT.

by

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EXTRACTION METALLURGY DIVISION

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SUMMARY

A sample of auriferous quartz ore was received from McIntyre Porcupine Mines Ltd. for mineralogical investigation and preliminary gold recovery test work. A microscopic study showed that the main metallic minerals present in the lump specimens are an antimony-rich member of the tetrahedrite-tennantite series of minerals, and chalcopyrite. Smaller amounts of pyrite, hessite and gold are also present. The gold appears to be alloyed with silver and occurs mainly in metallic minerals, but a small proportion of the gold occurs in gangue mineral. The gold grains vary in size from a micron or less to a maximum of about 100 - 150 mesh.

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INTRODUCTION

An 8 lb sample of lump specimens of ore from McIntyre Porcupine Mines Ltd., our reference No. 12/60-9, was submitted to the Mineralogical Section by Mr. R. Ennis, Industrial Liaison Officer, Extraction Metallurgy Division. It was requested that a mineralogical examination be made to identify the metallic mineral constituents and to determine the mode of occurrence of the gold-bearing minerals. The sample, which was labelled "Tennantite, 2656-7 Stope, No. 15 Vein", had been brought from the mine by Mr. Ennis at the request of Mr. P.B. McCrodan, Mine Manager. Copies of two mineralogical reports, based on studies of similar ore samples carried out by American Cyanamid Company and by Falconbridge Nickel Mines Ltd., were also obtained by Mr. Ennis.

This report is based mainly on the study of eight polished sections using an ore microscope. Mineral identifications were made by the X-ray diffraction method.

MINERALOGY

A preliminary examination of the hand specimens with a low-power binocular microscope showed that the sample consists mainly of white quartz with scattered masses, up to 1/2 - 3/4 inch in size, of a grey metallic mineral and chalcopyrite. The metallic minerals comprise approximately 10% of the volume of the sample.

Under the ore microscope the following metallic minerals were observed: tetrahedrite-tennantite $(Cu, Fe, Zn, Ag)_{12} (Sb, As)_4 S_{13}$, chalcopyrite $CuFeS_2$, pyrite FeS_2, hessite Ag_2Te, and gold. The tetrahedrite-tennantite appears to be the most abundant metallic mineral present. Its identity was established by X-ray diffraction and the cubic cell edge as determined from a powder diffraction pattern is 10.322 Å as compared to 10.21 Å for nearly pure tennantite and 10.35 Å for nearly pure tetrahedrite. A semi-quantitative spectrographic analysis of a sample gouged from a polished section gave the following results: Cu > 20%, Sb 5%, As 2%, Zn 4%, Fe 1%. The relative proportions of Sb and As further confirm that the mineral composition is closer to that of tetrahedrite than tennantite.

Chalcopyrite is also a major metallic mineral constituent of the sample and occurs alone or closely associated with the other metallic minerals. Pyrite is present in smaller amounts in the form of euhedral to subhedral grains.

Hessite occurs sparingly as small irregular blebs, and shows anomalous anisotropism under the ore microscope. Some grains are elongated and some are lens-shaped. The hessite occurs in tetrahedrite, and less commonly in pyrite, as free grains or associated with other metallic minerals. Grains smaller than one micron in diameter were observed and the maximum grain size noted was about 150 mesh.

Gold is present in amounts approximating those of hessite. It occurs as irregular blebs, stringers, or fissure-filling material and shows several types of mineral association. It occurs (a) in tetrahedrite, as discrete grains (Figure 1), attached to or enclosed by hessite (Figures 2, 3), or attached to chalcopyrite; (b) in pyrite as blebs or veinlets (Figure 4); (c) in sericite-dolomite gangue. The size of the gold grains varies from a micron or less to a maximum observed size of about 100 - 150 mesh. The gold exhibits a range in colour from yellow to almost white and at times this variation is noted within a single area. The colour of the gold is believed to result from its composition : the lighter coloured varieties probably contain higher proportions of alloyed silver. The silver content of the grains was not determined due to the difficulty of sampling the small grains.

Minor amounts of non-metallic minerals, other than quartz, occur in the specimens. Brown to green sericite is present as well as gypsum and dolomite.

CONCLUSIONS AND DISCUSSION

The gold in this ore is enclosed, for the most part, in metallic minerals (tetrahedrite, pyrite, hessite) and it may therefore be feasible to effect a preliminary concentration of the gold by concentrating the metallic minerals by a gravity or flotation method. Since the gold occurs in fine grains down to a micron or less in size, however, the ultimate recovery of the gold values will be influenced by the degree of liberation of the gold by grinding as well as by the extent to which the enclosing metallic minerals are attacked by the leaching solution.

The ore sample examined in this investigation is apparently similar to that reported on by Falconbridge Nickel Mines Ltd. and the metallic mineral constituents identified are identical, with one exception. The mineral identified as the silver telluride, hessite, in the present study was tentatively identified as the gold-silver telluride, sylvanite, in the Falconbridge study. The occurrence of hessite may be of metallurgical significance in that some hessite is affected by potassium cyanide solution* whereas sylvanite remains unaltered.

* U.S. Geological Survey Bulletin 914, Microscopic Determination of the Ore Minerals, by M.N. Short.

PHOTOMICROGRAPHS

A 200-mesh screen opening is outlined on each photomicrograph

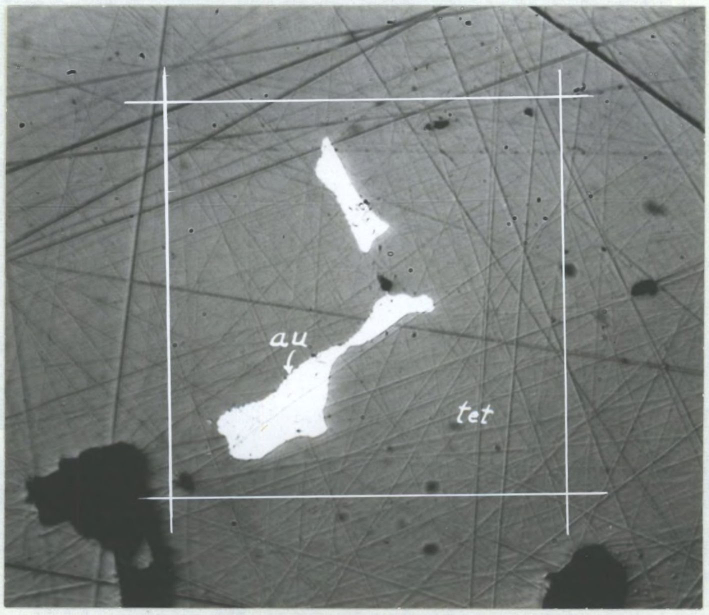

Figure 1. Grains of gold (au) in tetrahedrite (tet). X700

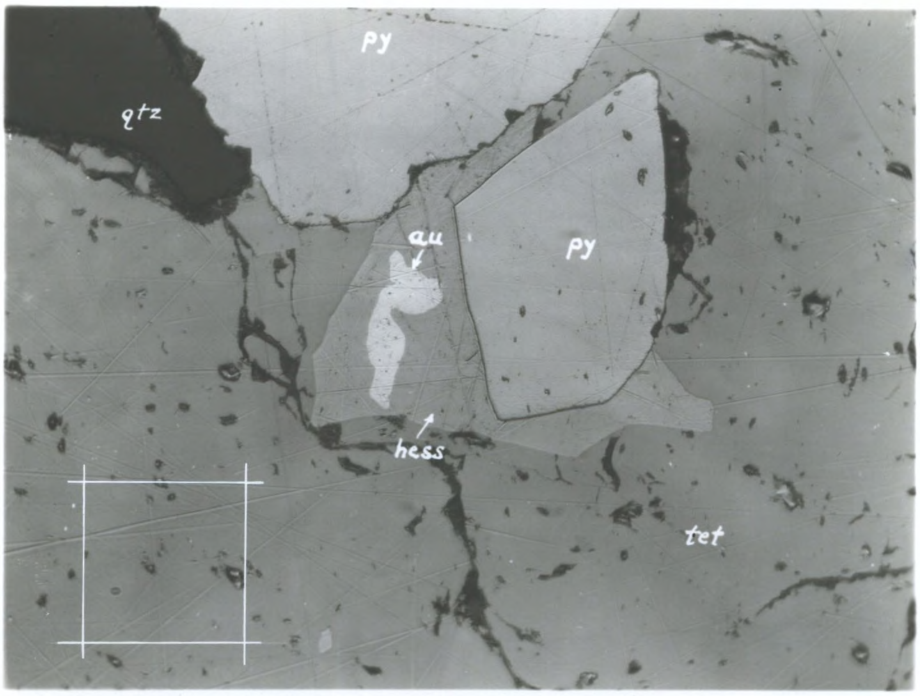

Figure 2. Tetrahedrite (tet) containing hessite (hess) adjacent to subhedral grains of pyrite (py). Gold (au) is enclosed by hessite. Quartz (qtz) is also present. X285

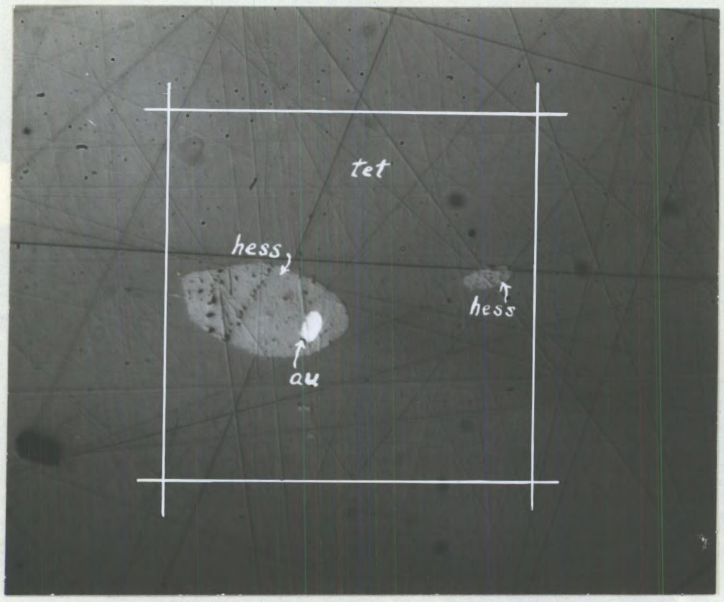

Figure 3. A four-micron grain of gold (au) enclosed by hessite (hess) occurring in tetrahedrite (tet). X650.

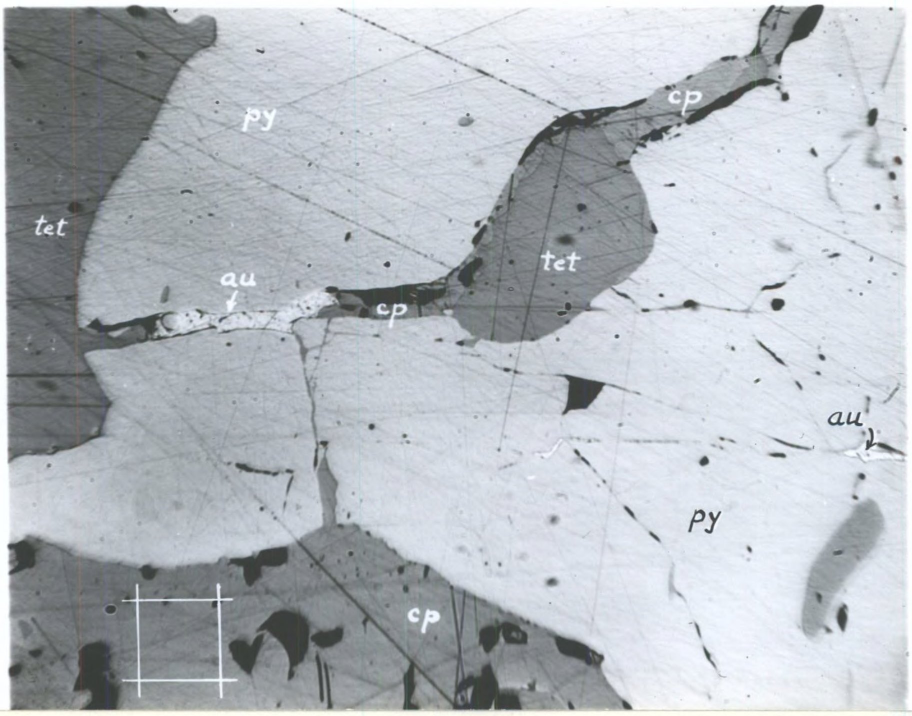

Figure 4. Gold (au), chalcopyrite (cp), and tetrahedrite (tet) filling a fissure in pyrite (py). Small blebs of gold also occur in the pyrite. X140.