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THE MAPLE LEAF MINE,
FRANKLIN MINING CAMP
BRITISH COLUMBIA

A mineralographic report with special reference to the occurrence of platinum in the ore. Produced in partial fulfilment of the course of Geology 409 at the University of British Columbia.

by

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INTRODUCTION

General Statement

In the spring of 1953 a mineralographic study was begun by the writer on a suite of specimens from several properties in the Franklin camp (49° 118° NE) which forms a part of the Greenwood mining division of the Yale district in south-central British Columbia. In all, about twenty hand specimens, twenty polished sections and five thin sections were studied, with most of the emphasis placed on the polished sections. Most of the specimens were from the Maple Leaf claim near the centre of the camp, while a few were from nearby properties: Averills group, Jessie and Mountain Lion. These were collected from the surface workings of the various claims.

Purpose of the Present Work

The purpose of the present work was to prepare a mineralographic report on the ores of the Maple Leaf property, and specifically, to describe the occurrence of the platinum that has been reported in assays of the ore.

Unfortunately, no platinum-bearing mineral was discovered, but it is hoped that this paper will prove of some value should further study on this problem be undertaken.

Acknowledgements

The writer wishes to express his thanks to members of the Geology Department, University of British Columbia: to Dr. R.M. Thompson, under whose direction this work was conducted, for his generous assistance and

guidance; to Mr. J.P. Donnan for his help and direction in the polishing of sections; to Mr. J.J. McDougall for personal information on the mining properties; and to Mr. E.D. Dodson for guidance on laboratory technique.

DESCRIPTION OF THE MAPLE LEAF MINE

The great majority of ore specimens are from the Maple Leaf and the Jessie mines which are located in the same body of shonkinite-pyroxenite, or "Black Lead" that occurs in a series of irregular outcrops in the northern half of the Franklin quadrangle.

Thomlison states[1] that "The mineral bearing gangue on the Maple Leaf claim is mainly pyroxenite with some inclusions of augite-syenite in the hanging wall side of the lode, and the copper minerals, principally chalcopyrite, occur in bunches and veinlets and as disseminated specks throughout the pyroxenite and syenite."

Drysdale wrote, in 1915, that "the development work that has been done on the various claims is not extensive and consists of numerous prospect pits and short tunnels."[2] To the knowledge of the writer no further work of importance has been since that date.

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1. Quoted in Minister of Mines Report, 1918.

2. G.S.C. Memoir 56 (1915) p.173.

MINERALOGRAPHY

Megascopic

The hand specimens, numbering about twenty, and selected as representative samples of the ore are, in general, rather small in size: the largest not over nine cubic inches in volume and the smallest slightly less than one cubic inch. Most of the specimens are considerably weathered with the production of colored stains and, in some cases, extreme friability.

The minerals visible in the hand specimens are chalcopyrite, sphalerite, galena, pyrite, malachite and quartz. The brilliant lustre and well developed cleavage of the sphalerite is often not apparent, and in such cases the mineral appears as a dull gray substance, giving the impression of another mineral. Galena is, in many specimens, extremely friable, but is easily identified. Pyrite, however, is only visible as minute crystals in massive chalcopyrite, and then only in some specimens. Malachite coats or fills fractures in the chalcopyrite.

Microscopic

Twenty polished sections were cut from the hand specimens. Some difficulty in preparation was encountered to the extreme friability of the sulphide minerals. In case of massive chalcopyrite, the hand specimens were often so small that the entire piece was used for the polished section.

The primary ore minerals present, in order of decreasing abundance are: chalcopyrite, sphalerite, galena, magnetite, pyrite and arsenopyrite.

The secondary ore minerals are malachite, and anglesite or cerussite.

The chief gangue mineral is quartz, and there is a small amount of a white carbonate, probably calcite.

Two unknown ore minerals were found in the suite, each in small amounts.

Chalcopyrite ($CuFeS_2$)

Chalcopyrite is closely associated with the other sulphides in the ore. At times it appears with a seriate distribution in the sphalerite producing a mottled texture that somewhat suggests exsolution. However, as explained later in the section on pargenesis, this texture may be due to replacement.

In sections where it is the dominant mineral (sections 30, 36, 5) it is seen to have suffered considerable fracturing. These fractures, not large but visible to the naked eye, have subsequently been filled by malachite and a white carbonate.

As the platinum mineral was thought most likely to be associated with the chalcopyrite, the latter was given more study than the other ore minerals. Oil immersion under high power was carried out on chalcopyrite, in several sections where it occurs in abundance, with the purpose of trying to see if there was any unknown platinum mineral. Chalcopyrite was recognized in polished sections by its yellow color, softness, black streak and isotropism.

Sphalerite (ZnS)

Sphalerite was identified by its medium-gray color, resin-colored internal reflection, softness and light-colored streak.

The internal reflection is often not obvious, and it is often necessary to study many grains before it is obtained.

Sphalerite is widespread, and generally associated with the other sulphides.

Galena (PbS)

Galena was identified by its white color, well developed cubic cleavage, softness, and positive etch-reactions with HCl, HNO_3, and $FeCl_3$.

Galena is much replaced by secondary minerals. Covellite is often found replacing it along cleavage planes and grain boundaries (fig.1). Often there is a transition outward from the galena, through a rim of covellite to anglesite (or cerussite). In some cases (as in section 6) it appears that covellite or the secondary lead mineral, alone, has replaced the galena.

Magnetite ($FeO \cdot Fe_2O_3$)

Magnetite is apparently not abundant in the ore, being found in only two sections (5 and 7). In section 5 it occurs as a few euhedral crystals (oct~~o~~ahedrons?) averaging 100 microns in size in the pyrite (fig.4), and as irregular masses in the chalcopyrite.

Magnetite was recognized by its strong magnetism, its hardness, and its negativity to etch-solutions.

Pyrite (FeS_2)

Pyrite, like magnetite, is very limited in amount, and, like magnetite, was found in only two sections (5 and 1). In section 1 it occurs in rather angular grains in chalcopyrite that suggests brecciation rather than replacement, though the latter may have also taken place. In section 5 it occurs intergrown with arsenopyrite in euhedral crystals ranging in size from 150 microns to 3 cm. The pyrite and arsenopyrite have been fractured with subsequent filling by gangue and later sulphides.

Pyrite was recognized by its hardness, pitted polish, light brass yellow color and isotropism.

Secondary Lead Mineral

In some sections (such as 6 and 9) a mineral believed to be anglesite ($PbSO_4$) or cerussite ($PbCO_3$) has been found replacing galena along grain boundaries. The replacement has in many cases gone to completion, with only pseudomorphs after galena remaining.

A thin section was prepared from a polished section where it occurred in abundance (9) in an attempt to positively identify this mineral, but it was apparently lost in polishing because it was not visible in the thin section.

Arsenopyrite (FeAsS)

Arsenopyrite was found in only one section (5) where is occurs intergrown with pyrite and as grains in chalcopyrite. The grains range in size from 60 microns, or so, to approximately one millimeter. A few of the grains show a characteristic rhombic cross-section.

The distinctive properties of arsenopyrite are its hardness, anisotropism (polarization colors green and orange-brown), and its general negativity to etch-solutions.

Covellite (CuS)

Covellite is found in many places in small amounts. There are suggestions (fig. 1 is an example) that it has replaced galena in preference to other minerals. It is generally associated with galena, and when found alone it is believed to have totally replaced this mineral. The blue appearance and the fire-red polarization color were the properties that identified this mineral.

Hematite (Fe_2O_3)?

A small amount of a mineral believed to be hematite was found in one section (5). It occurs in a carbonate vein (?) that cuts the chalcopyrite. It is medium-gray in color, is hard, has apparently a fibrous habit, a red streak and it appears to react negatively with all common etch-reagents. It seems to be isotropic, but this is believed due to its fine grain.

Unknown "A"

In one section (25) an intergrowth of chalcopyrite and an unknown mineral was found. The intergrowth was observed in a few scattered irregular grains none of which apparently exceeds 200 microns in largest dimension. The material was x-rayed and chalcopyrite was definitely identified as one of the minerals. It apparently lies along crystallographic planes and as irregular blebs in the unknown mineral. The other mineral was not identified by x-ray due to a vague pattern on the film. The properties of this mineral appear to be:

Color: Pinkish brown

Hardness: C

Anisotropism: Apparently nil, but possible.

Etch-tests:

$HgCl_2$	(-)	
KOH	(-)	
KCN	(+)	quickly stains dark brown
$FeCl_3$	(-)	
HCl	(+)	quickly stains black
HNO_3	(-)	

Unknown "B"

In two sections (2,20) very small amounts of a light brown ore mineral has been found associated with the chalcopyrite. Its properties appear to be:

Color: Light brown

Hardness: C

Anisotropism: Strong-polarization colors resin, blue, coppery pink, light green.

Etch-tests:

$HgCl_2$	(-)	
KOH	(-)	
KCN	(+)	quickly stains black
$FeCl_3$	(?)	possibly light brown stain
HCl	(-)	
HNO_3	(+)	quickly stains orange brown

Platinum Mineral

The platinum-bearing mineral was not recognized in the suite, though several different lines of approach were used in an attempt to locate and identify it.

1) As has already been mentioned an oil immersion study was carried out on much of the chalcopyrite with no success.

2) Specimens of relatively pure chalcopyrite were ground (200 mesh) and superpanned and a first and second tip obtained. A spectrographic analysis was made by Dr. Thompson, and a weak platinum line identi-

fied. Unfortunately, due to a mistake by the writer, the two tips were mixed before the analysis was made and the occurrence of the platinum was not narrowed down to either tip.

3) Some of the superpanner product was divided into two fractions: magnetic and non-magnetic. These were set in separate bakelite shells and studied under the reflecting microscope. No mineral thought possibly to be platinum-bearing was seen.

4) In a study of thin sections a mineral believed possibly to be chromite was observed. However, as no chromite was identified in the polished sections and no chromium line noted on the spectrographic plate, this occurrence of platinum was not regarded further.

In 1918 Wm. Thomlinson, working for the Munitions Resource Commission, had samples of sulphide ore assayed, and the platinum content was reported to be 0.15 and 0.17 ounces a ton. He writes that the results appeared to him to indicate "that the platinum content of the ore was roughly proportionate to the amount of primary copper minerals, especially chalcopyrite, showing in the ore."[3]

It is the writer's opinion that the probable occurrence of the platinum-bearing mineral is in the form of sperrylite ($PtAs_2$) in associa-

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3. Quoted in Minister of Mines Report, 1918.

tion with the chalcopyrite. This occurrence is common enough to warrant such a belief. With this in mind, it is suggested that if further study is done on this suite, it be concentrated on specimens such as section 5 where there is not only abundant chalcopyrite but ar~~e~~senopyrite as well.

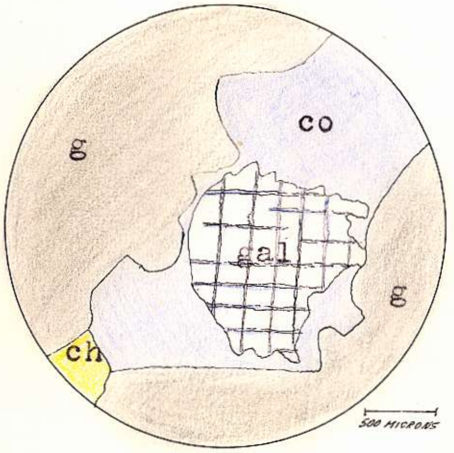

Fig. 1 (Section 40)
Covellite replacing galena along cleavage planes and grain boundaries.

g - gangue gal - galena
co - covellite ch - chalcopyrite

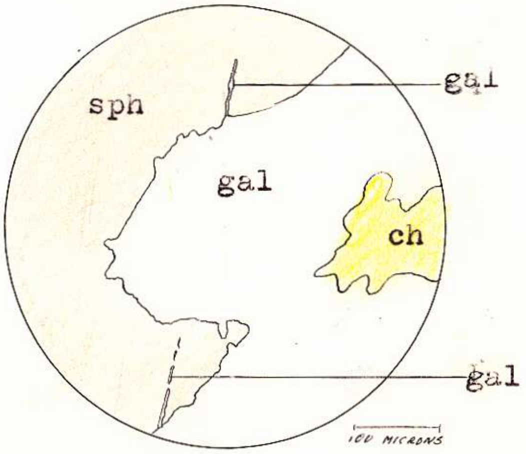

Fig. 2 (Section 40)
Galena replacing sphalerite along cleavage planes.

sph - sphalerite

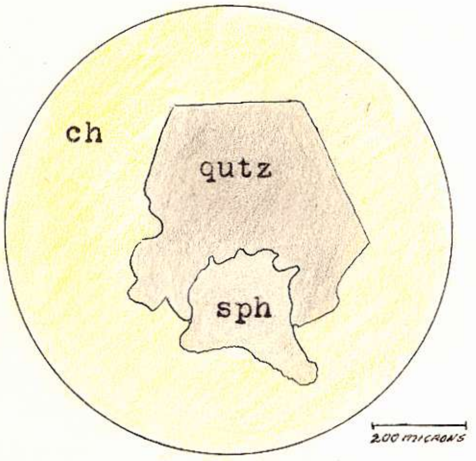

Fig. 3 (Section 5)
Sphalerite replacing quartz crystal

qutz - quartz

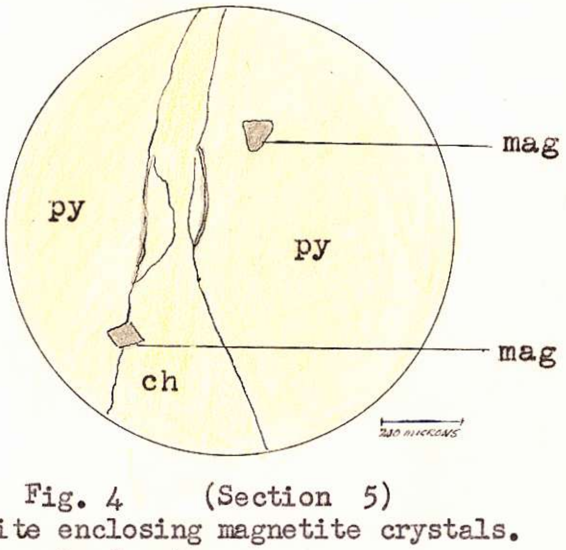

Fig. 4 (Section 5)
Pyrite enclosing magnetite crystals.
Gangue in fractures.

py - pyrite mag - magnetite

PARAGENISIS

Apparently the first mineral to form was either quartz, arsenopyrite, or magnetite but the orders of these is not known. All three are found surrounded by pyrite as if the latter has crystallized about them. The quartz is believed to be continuous because it has been found veining chalcopyrite.

The pyrite and arsenopyrite have suffered fracturing with the introduction of gangue minerals. The grains of pyrite seen in section 1 may represent breccia fragments which have been surrounded by chalcopyrite or, perhaps, replaced by chalcopyrite. There may have been both fissure filling and replacement.

The relation between chalcopyrite and aphalerite is not too clear. A mutual boundary texture, noted between the two in many places, implies replacement of one by the other or simultaneous deposition. Blebs of chalcopyrite in sphalerite are common,and these may represent exsolution but are not indicative because they lack orientation. Perhaps there has been some overlapping in deposition between the two.

Galena is believed to be later than sphalerite; in Figure 2 it is shown apparently replacing the latter along cleavage planes.

Covellite, malachite, and the unknown lead mineral are secondary products of the primary minerals. They are probably to be found in only the enriched and oxidized portion of the ore deposit.

A suggested paragenetic sequence in summary form is as follows:

1) Quartz, followed by magnetite, arsenopyrite, and pyrite in that order, with the quartz continuing.

2) Sphalerite and/or chalcopyrite followed by galena.

3) Supergène enrichment producing covellite.

4) Oxidation of the ore with the production of malachite and the secondary lead mineral.

Temperature Type of Deposit

The mineral assemblage suggests a mesothermal deposit (temp. 350°-500°C) that has undergone some supergène sulphide enrichment.

No textures indicative of temperature of formation were noted other than the intergrowth between chalcopyrite and unknown "A". If the unknown mineral had been identified a more specific temperature determination could have been made.