

*No microscopic description.*  
*65-70*

A MINERALOGRAPHIC REPORT

of

THE ORES OF THE ATLIN RUFFNER MINE, ATLIN, B.C.

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by

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## SUMMARY

The specimens for this exercise were taken from the Atlin Ruffner Mine, northeast of Atlin, B. C.

The mine is located on Vaughan mountain which is composed of quartz-diorite and diorite, both of which are cut by mineralized basic dykes and barren aplite dykes.

Metallic minerals determined were galena, sphalerite, pyrite, marcasite, chalcopyrite, arseno pyrite, tetrahedrite, pyrargyrite, and pyrrhotite in order of decreasing abundance. The gangue minerals are quartz, calcite, ankerite and altered wall rock.

The deposit is mesothermal, probably near the higher end of this type.

INTRODUCTION

The following report is a result of a mineralographic study of specimens from the Atlin Ruffner Mine, Atlin, B.C. The study was carried out during part of the spring session of 1953 at the University of British Columbia as an exercise in mineralography.

The writer extends thanks to Dr. Thompson, Dr. Okulith, Mr. Donnan, and Mr. Dodson for their advice, criticism, and guidance.

LOCATION AND HISTORY <sup>1</sup>

The Atlin Ruffner Mine, previously known as the Atlin Silver-Lead Mines, is located on Vaughan Mountain, about 16 miles northeast of Atlin.

Development of this property was started in 1921 by Mr. J. M. Ruffner. Preliminary surveying, trenching, and mapping was carried out, and several tunnels driven to block out ore.

Between 1921 and 1926, the property was leased by the Federal Mining and Smelting Company, under the management of Mr. Ruffner, and from then until 1934 it was operated by Buffalo interests and managed by Mr. Ruffner. A total of 225 tons of ore was shipped between 1921 and 1926 which netted approximately \$100.00 per ton.

During the summers of 1951 and 1952 a sampling and diamond drilling program was undertaken.

1 B.C. Minister of Mines Reports, 1921-1932 & 1934  
G.S.C. Summary Report, 1925.

GENERAL GEOLOGY<sup>1</sup>

Vaughan mountain, elevation 6900 feet, is one of a series of peaks comprising a range running in a general northerly direction. The range is separated from other parallel ranges by Fourth of July Creek on the west, and Silver Creek on the east. The mountain is comprised of coarse quartz-diorite and fine-grained diorite.

Both the quartz-diorite and the diorite are cut by a series of parallel lamprophyre dykes and another series of smaller aplite dykes.

The basic dykes strike northeasterly and vary in width from a few inches to about 40 feet. Some of the dykes are mineralized, the mineralization being dependent upon the formation of faults and fissures. These faults also provided channels for percolating water which caused some secondary enrichment near the surface. At the lower level, parts of these dykes grade into a quartz porphyry.

The aplite dykes are narrow, barren, and later than the basic dykes. They probably represent the acid<sup>ic</sup> end phase of the quartz diorite.

- 1 -B.C. Minister of Mines Reports, 1921-1932 & 193~~3~~<sup>4</sup>  
 -G.S.C. Summary Report, 1925  
 -Okulitch, V. J. - Ore Deposits of the Eastern Side of the Coast Range Batholith (with special reference to Atlin District) - thesis for Master's degree in Applied Science, 1932.



The ore occurs mostly within the basic dykes. In general the veins are well defined, but there is some replacement of the dykes, and they vary in width from a few inches to five feet.

#### MICROSCOPIC RESULTS

Metallic minerals identified were galena, sphalerite, pyrite, marcasite, chalcopyrite, arsenopyrite, tetrahedrite, pyrargyrite, and pyrrhotite in order of decreasing abundance.

Gangue minerals consist of quartz, calcite, a light to dark brown carbonate, probably ankerite (B.C. Minister of Mines, 1930) and fragments of the wall rock, some of which have been altered to a dark green, soft mineral which may be serpentine.

#### PYRRHOTITE

Pyrrhotite was possibly the first mineral deposited, although there is no microscopic evidence of this. The only reason for this supposition is that pyrrhotite is the highest temperature mineral present.

Only three grains were found in all the sections. These are in #11 section and occur in the galena as regularly shaped bodies with fairly smooth boundaries, the largest of which was 110 x 50 microns. The grains were identified by their hardness, color, strong anisotropism, and etch tests.

### ARSENOPYRITE

Arsenopyrite was the first metallic mineral to be deposited (with the possible exception of pyrrhotite). It commonly occurs as characteristic rhomb-shaped and triangular crystals from 10 microns to  $\frac{1}{2}$  m.m. in size.

Hardness, shape, anisotropism, color and etch tests readily identified it.

Galena and sphalerite commonly replace it, (Fig. 1) as does chalcopyrite to a lesser extent.

### MARCASITE AND PYRITE

These two minerals commonly occur together as intimate intergrowths of coarse grained aggregates, some of the grains being fairly well crystalized. Their time of deposition is nearly contemporaneous, but the marcasite began slightly earlier. A certain amount of overlapping exists between them and the previously deposited arsenopyrite.

The hardness, color, shape, polish, etch tests, isotropism of the pyrite, and anisotropism of the marcasite made these minerals easily identifiable.

Replacement of pyrite by galena, sphalerite (Fig. 2) chalcopyrite, and marcasite is not uncommon. Marcasite is occasionally replaced by galena.

### SPHALERITE

The color, hardness, isotropism, and internal reflect-



ion of sphalerite made its identification possible. The reddish internal reflection indicates that it is the <sup>iron</sup> ~~non~~-rich variety (Uytenbogaardt).

<sup>S</sup>phalerite occurs mostly as irregularly-shaped, continuous masses, but is also present as minute blebs in the chalcopyrite which are up to 5 microns across. These blebs are probably formed by unmixing of a solid solution of the two minerals.

Sphalerite was deposited after pyrite and before galena. Some replacement by galena is evident (Fig. 1).

#### CHALCOPYRITE

Chalcopyrite was identified by its color, hardness, brittleness, weak anisotropism, and etch tests.

It occurs as irregular masses up to 4 or 5 m.m. across, and as smooth-bordered, fairly well-rounded bodies up to 300 microns, but averaging approximately 20 microns, which occur in the galena. These rounded bodies in the galena suggest simultaneous deposition, but most of the chalcopyrite was deposited before the galena.

Chalcopyrite is also present as an ex<sup>S</sup>olution product in the sphalerite, occurring as fine inclusions 5 to 10 microns in size, some of which are elongated and often orientated.

#### GALENA

Galena is the most abundant mineral present. Color,

hardness, etch tests, excellent cubic cleavage and typical triangular pits along cleavage planes (Figs. 4 and 5) readily identified it.

#### TETRAHEDRITE

Tetrahedrite was identified by its color, hardness, isotropism and etch tests. It commonly occurs in the galena as minute blebs 5 to 15 microns in size but it also is present as irregular, larger bodies in the galena up to approximately 20 x 50 microns. Larger masses up to one half m.m. are rarely seen which may contain minute blebs of chalcopyrite. Most of the tetrahedrite was apparently deposited from solid solution with the galena, but some has been deposited simultaneously with the galena, and rarely, with the chalcopyrite. A small amount, occurring with pyrargyrite in a tiny fissure which cuts the galena, has been deposited later (Fig. 3). Some replacement by pyrargyrite is evident (Fig. 3).

#### PYRARGYRITE

Color, strong anisotropism, deep red internal reflection, and etch tests aided in the identification of pyrargyrite. It commonly occurs along cleavage planes of the galena as lath-shaped bodies up to 20 microns wide (Figs. 1, 3, and 4). In some cases it occurs as irregular masses up to 100 x 200 microns in size where it has replaced the galena (Figs. 1 and 5). The pyrargyrite has been deposited later than the galena and tetrahedrite in most cases, but a few inclusions about 5 microns in size in the galena might indicate some precipitat<sup>ion</sup> from

solid solution.

#### UNKNOWN MINERAL

Several fairly well rounded bodies, the largest of which is 100 x 150 microns occur in the galena, in association with pyrargyrite and <sup>f</sup>Tetrahedrite. (Fig. 5) One grain occurs in the pyrargyrite, and another is bounded on one side by <sup>f</sup>Tetrahedrite, but these boundaries are all smooth and regular, as they are with the galena, so it is difficult to place its time of deposition. One of the larger grains contained small blebs of chalcopyrite (Fig. 5) and another contained fine inclusions of Tetrahedrite which suggests solid solution, or simultaneous deposition with these minerals.

The mineral is a light brownish grey with a definite mauve tinge. It takes a good polish, hardness B+ to C-, is isotropic, has no apparent cleavage, twinning, internal reflection, or texture under crossed nicols. The etch tests are as follows: Hg Cl<sub>2</sub> (+) - stains light brown to blue; KOH, (+) - darkens and leaves rough surface; HCl, (-); KCN, (+) - darkens and leaves rough surface; HNO<sub>3</sub> (-) - faint suggestion of etch cleavage; Aqua Regia (+) - stains bluish black.

Dr. Thompson, after some difficulty securing a sample, X-rayed the mineral, but it gave an unknown pattern.

PARAGENESIS

Some inter-relation of times of deposition of the individual minerals has been discussed under microscopic results.

Quartz was deposited following the initial fracturing of the country rock, and beautiful, clean crystals were formed, some of which are greater than 1 m.m. in diameter.

Pyrrhotite was possibly the first metallic mineral to be deposited, but there is no evidence for this. Arsenopyrite was then deposited with marcasite and pyrite beginning slightly later. Sphalerite and chalcopyrite followed in that order, but exsolution of one in the other indicates some overlapping. Galena was deposited mostly later than the chalcopyrite, but these minerals are in part contemporaneous. Most of the tetrahedrite was deposited with the galena but a small amount is contemporaneous with the chalcopyrite on one side, and the pyrargyrite on the other. Pyrargyrite is mainly later than the galena, filling cleavage planes and replacing that mineral.

A second period of fracturing followed and these <sup>fractures</sup> were filled with white, cloudy quartz (Fig. 2.).

A third period of quartz mineralization filled tiny fissures which cut all other minerals. This quartz is somewhat opaque and may be chalcodonic. These small fissures

contain some tetra<sup>a</sup>hedrite and pyrargyrite (Fig. 3).

The calcite and ankerite were the last minerals deposited, and are probably secondary.

TEMPERATURE AND TYPE OF DEPOSIT

Criteria used for temperature determination are:<sup>1</sup>

pyrrhotite (melting point)	- 1157-1187° C.	<i>(much lower in a melt containing other materials)</i>
marcasite (unstable above)	- 300° C.	
Chalcopyrite in sphalerite (unmix at)	- 350-400° C.	
sphalerite in chalcopyrite (unmix at)	- 550° C.	

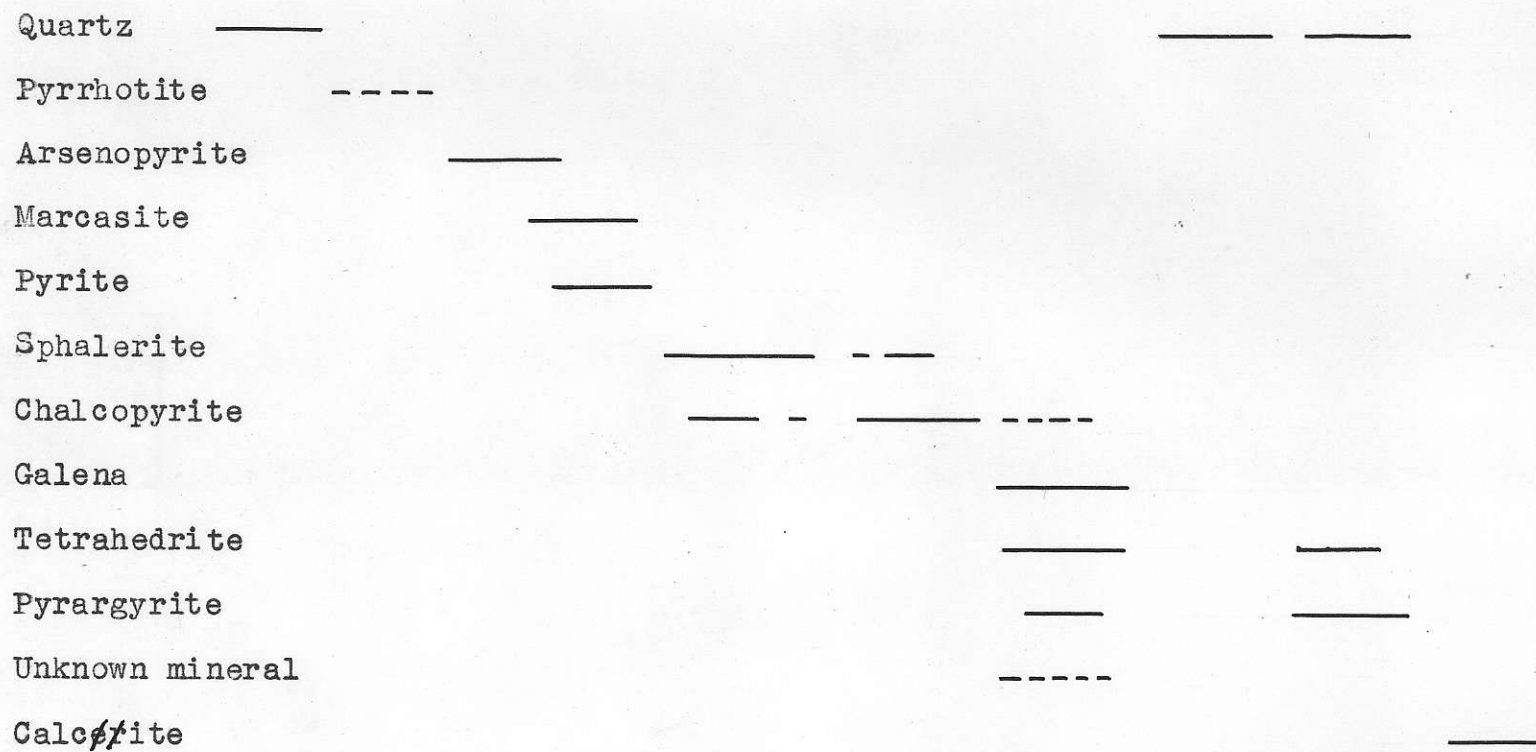
These criteria, and the presence of such rather typical intermediate temperature minerals as arsenopyrite, chalcopyrite, galena, sphalerite, and tetrahedrite, suggest that the deposit is of Mesothermal type. Presence of pyrrhotite and exsolution of sphalerite and chalcopyrite indicate that the temperature is near the upper end of the mesothermal range.

On the basis of this conclusion it is possible to say the deposit has good depth potentialities without much change in mineralization. The late pyrargyrite will probably die out at depth as it was deposited below 250° C.

1 Edwards - Textures of the Ore Minerals



PARAGENETIC SEQUENCE



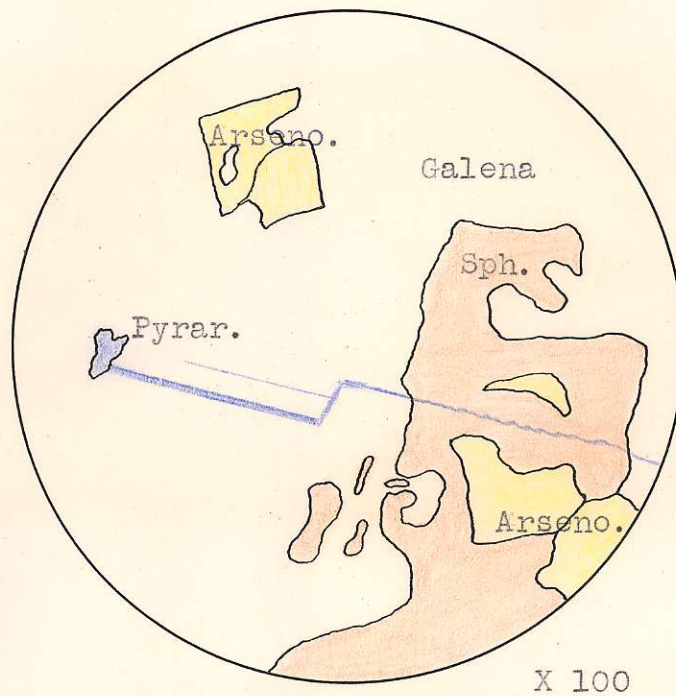


Fig.1 (Spec.11-A)

- Replacement of arsenopyrite by galena and sphalerite.
- Replacement of sphalerite by galena.
- Replacement of galena by pyrargyrite.
- Deposition of pyrargyrite in cleavage planes of galena.

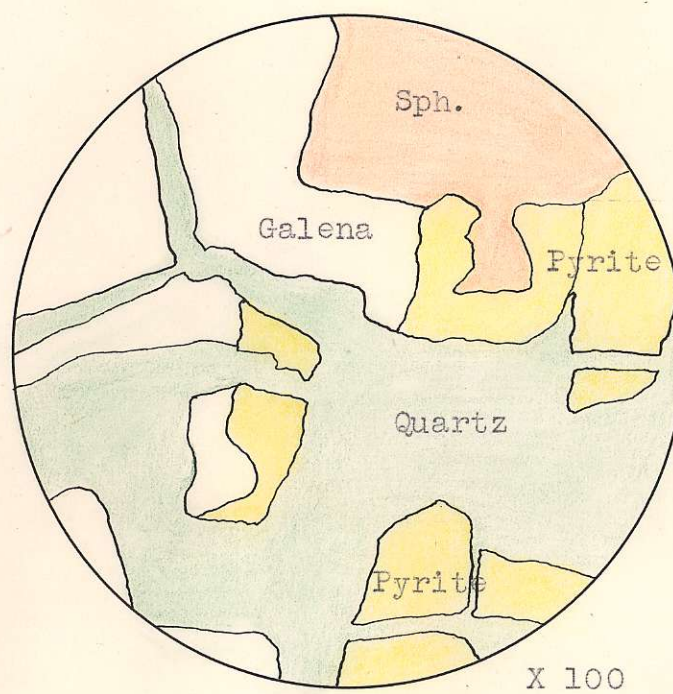


Fig.2 (Spec.7)

- Replacement of pyrite by galena and sphalerite.
- Quartz cutting galena and pyrite.

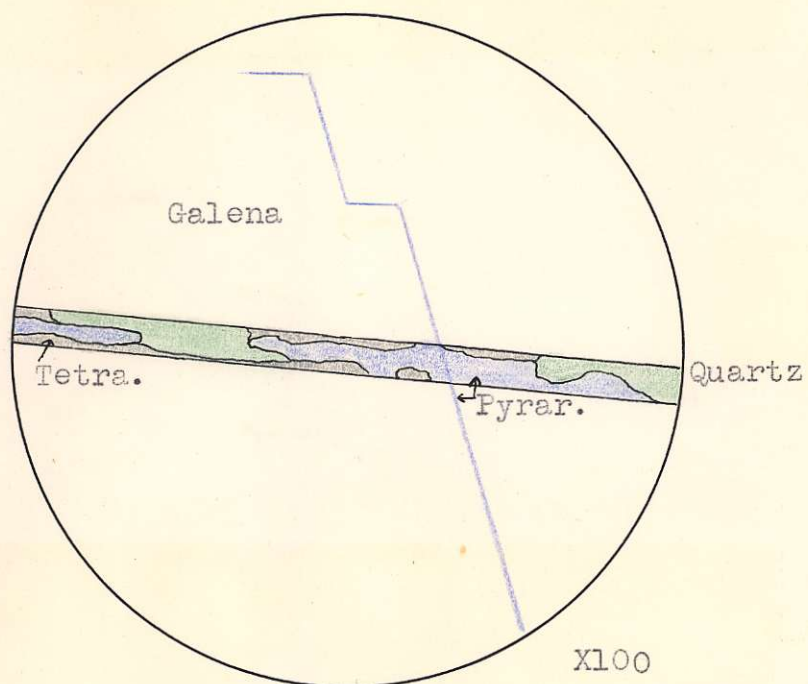


Fig.3 (Spec. 11-B)

- Small fissure of chalcodonic quartz, tetrahedrite, and pyrargyrite cutting the galena.
- Deposition of pyrargyrite in cleavage planes of galena.





X 240

Fig.4 (Spec. 11-B)

-Tetrahedrite and pyrargyrite in galena.



X 240

Fig.5 (Spec. 11-B)

- Tetrahedrite, pyrargyrite, and unknown mineral in galena.
- Replacement of galena by pyrargyrite (preservation of cleavage).
- Blebs of chalcopyrite in unknown mineral.



BIBLIOGRAPHY

1. B.C. Minister of Mines Reports, 1921, 1932 and 1934
2. Edwards, A. B. - Textures of the Ore Minerals and their  
Significance
3. G.S.C. Summary Report, 1925
4. Okulith, V. J. - Ore Deposits of the Eastern Side of the  
Coast Range, Batholith (with special reference  
to Atlin District), Thesis for Master's degree in  
Applied Science, 1932.
5. Short, M. N. - Microscopic Determination of the Ore Miner-  
als, U.S. Dept. of Int., Bulletin 914, 1948.
6. Uytendogaardt, W. - Tables for Microscopic Identification  
of Ore Minerals, Princeton University Press, 1951.