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A MINERALOGRAPHIC STUDY OF ORE
FROM THE NEW ROSSLAND MINE
ROSSLAND, BRITISH COLUMBIA

A report submitted in partial fulfillment
of the requirements for the Geology 409
mineralography course of the University of
British Columbia

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Introduction

The purpose of this study is to determine the mineral assemblage present in the ore and to ascertain the relationships and paragenesis of these minerals.

Location and Description

The mine is situated just over a mile south of the village of Rossland, in the Trail Creek Mining Division, British Columbia.

The properties consist of two orebodies known as the Mayflower and Bluebird workings. These deposits are part of a series called the South Belt. This is a basin-shaped area, immediately south of Rossland, which is surrounded by hills rising some 2000' above the valley of Trail Creek.

The Canadian Pacific Railway crosses the property and it is accessible by road from Rossland.

History

Most complete development has occurred at the Mayflower Deposit. It has been known since 1899 and was worked intermittently until 1911.

The South Vein and the North or Main Vein were first to be explored. In 1939 the main adit was driven in from the bottom of Gopher Creek. This contained a drift on the Main Vein and a crosscut in search of the South Vein. This search was not successful.

In 1948 and 1949 five ore shoots were mined in the main adit of the Mayflower deposit. The ore milled amounted to a total of 681 tons, for the two years, and the gross contents of the concentrates shipped amounted to: Gold, 55 oz.; Silver, 5,254 oz.; Lead, 35,053 lbs.; Zinc, 86,958 lbs.; and Cadmium, 297 lbs.








The total ore mined, up to 1949, in the Bluebird deposit was 538 tons.

The ore from the mine was trucked to Retallock, where it was milled in the Whitewater Mill.







The Rossland Mines Ltd. carried ^{out} geological and geophysical surveys in the area in which the mine is situated in 1949. Some of the geophysical anomalies were tested by diamond drilling.

In 1950 some work was done in the Bluebird Deposit, and

LEGEND

-  SLATE
-  AUGITE PORPHYRYTE
-  CONGLOMERATE
-  DIORITE PORPHYRY
-  NON-MICA LAMPROPHYRE
-  MICA LAMPROPHYRE
-  GRANITE PORPHYRY DYKES

SYMBOLS

-  OPEN CUTS
-  WINZE OR OLD SHAFT
-  UNDERGROUND WORKINGS
-  OXIDIZED MINERALIZED ZONES
-  OUTCROP AREAS
-  DRILL HOLES SHOWING MINERALIZED INTERSECTIONS

SCALE 100 0 100 200 FEET

NO 7 -30°
NO 11 -75°

24
MAG.
NORTH

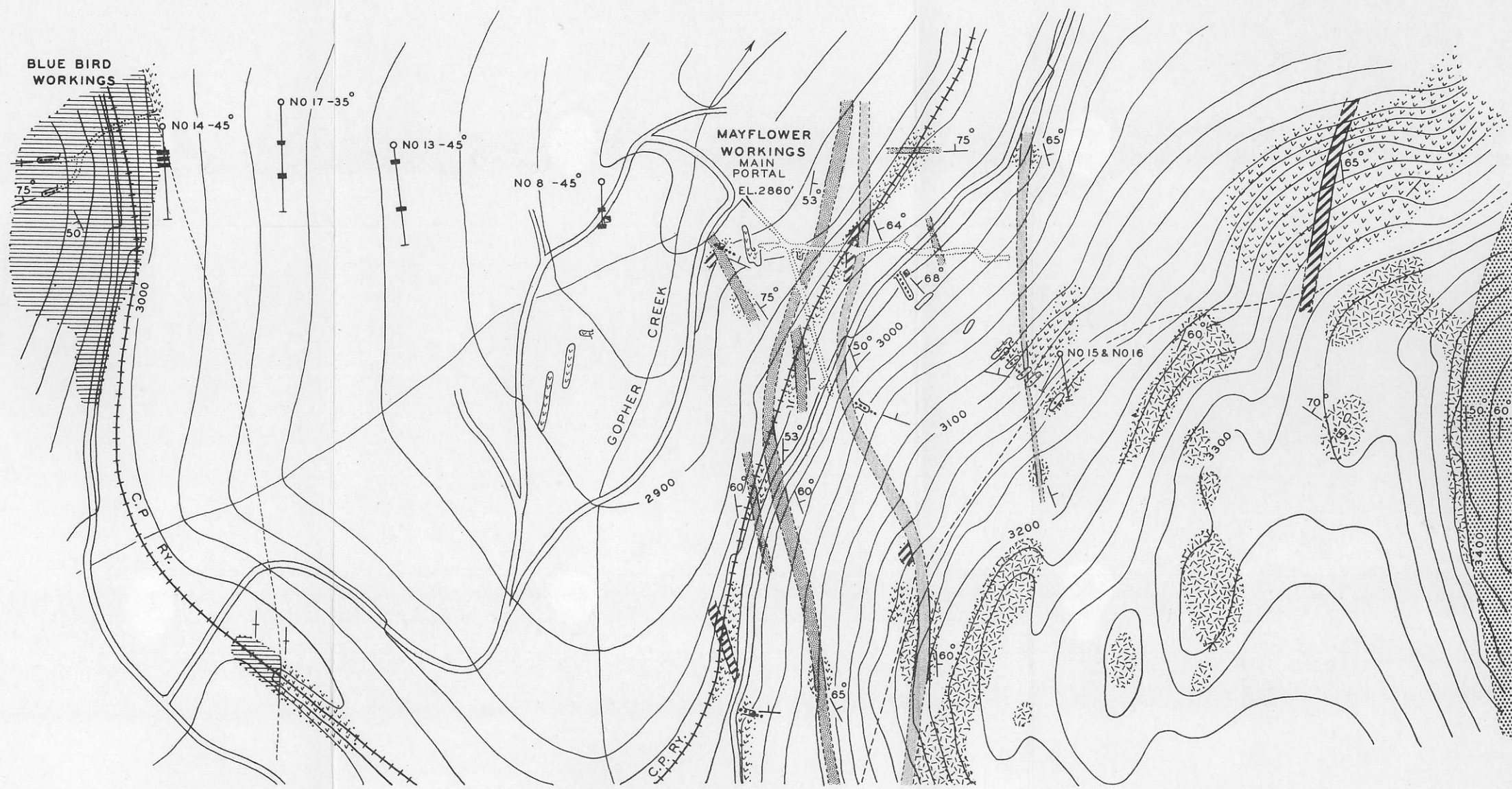


FIG.19. SURFACE GEOLOGY NEAR MAYFLOWER WORKINGS.

96 Tons of ore was shipped to Trail. From 1951-53 work continued but no ore was shipped.

General Geology

The area is covered by thick drift which has hampered geological development.

The predominating rock type is "Augite Porphyrite". This rock is characterized by prominent crystals of altered dark green augite. The rock is badly altered and, in some places, brecciated. On the southeastern borders the porphyrite grades into volcanic tuffs and agglomerate. W.H. White believes this rock is thermally metamorphosed, and that^{the} original rock was probably the Trail Volcanics of Mesozoic Age.

In the South Belt district the Porphyrite occupies an embayment in a large monzonite intrusion which lies to the north. W.H. White believes this intrusion is of Tertiary age and is part of a differentiated sequence of acid-intermediate intrusions.

Above the Bluebird workings the porphyrite members are exposed in contact with the Mount Roberts formation of Permian Age. This rock is a thin bedded siliceous slate.

Intrusive into the porphyrite and the Mount Roberts formation are series of acid, intermediate, and lamprophyre dykes.

The lamprophyre dykes are of economic interest because in the whole area the mineralization is related to fractures

near and contingent to the other lamprophyre.

Mine Geology

Detailed mine geology is available only for the Mayflower workings. The main adit was driven in 90 feet until it hit the ore zone. It followed this ore zone for 375 feet.

The rock in the adit is augite porphyrite breccia cut by one diorite porphyry dyke and five lamprophyre dykes. The adit follows a shear zone in which the porphyrite and diorite has been altered and the lamprophyre is unaffected. The lamprophyre dykes follow and cross the shear zones and it appears they were intruded subsequent to the alteration period and the period of shearing.

There are five ore shoots in the shear zone, all adjacent to the hanging wall sides of dykes. The best mineralization is closest to the dyke contacts. The mineralization fractures and partially replaces the lamprophyre. Thus the mineralization is younger than the lamprophyre which plays an important role in localizing deposition of ore minerals within the still older shear zone.

Mineralography

Introduction:

The study of thirty two polished sections has revealed

the presence of nine sulphides and sulpho-salts. The ore is generally massive and fine-grained. The sequence of deposition appears to be fairly simple and there is some evidence of local post-mineralization faulting (Figure 6).

The minerals are described individually and are listed in their order of deposition. Reasons for the choosing of the depositional sequence will be discussed under the next heading.

Metallic Mineralization:

1. Pyrite

This appears to be the most abundant metallic mineral in the ore deposit. It is present in nearly all the sections and, in many cases, is the predominant mineral.

It forms large well-formed euhedral grains. Characteristic cubes, rectangles and triangles are developed.

In many grains cleavage and fractures are well-developed and the subsequent cracks are filled with later mineralization (Figure 1, and 2).

The mineral is hard, isotropic and pale yellow. Rare anisotropism was not observed, though the mineral does not show complete extinction under crossed nicols.

2. Arsenopyrite

The occurrence of this mineral is widespread but not abundant. In only a few sections does it occur in large amounts.

It forms large well-crystallized grains. Diamond-shaped cross-sections are extremely common.

The mineral is hard, white; takes a good polish; and shows strong anisotropism colours of violet, brown and greenish yellow.

Although no inclusions were seen under high power and micro-chemical tests were negative, it is assumed that the gold values of the mine are carried in the arsenopyrite.

3. Pyrrhotite

This mineral is common but not abundant in the ore. It is very fine-grained and appears as crystalline aggregates, visible under crossed nicols, rather than in distinct crystals. It commonly occurs in cracks in pyrite and arsenopyrite.

Distinctive properties are its distinct magnetism and its very strong anisotropism.

4. Tetrahedrite

Occurrence of this mineral is widespread and common. It appears to be the main ore mineral.

It forms massive irregular grains in polished section. In hand specimen it appears as fine-grained crystalline aggregates. It commonly shows large inclusions of earlier minerals. Minute inclusions of sphalerite are visible along crystallographic directions.

The mineral is dark grey and shows complete extinction under crossed nicols. The streak is brownish.

Microchemical tests for silver were positive in some samples, indicating silver is probably present, in the tetrahedrite lattice.

5. Sphalerite

Sphalerite is widespread but not abundant in occurrence.

The mineral is most common as blebs and lens in crystallographic directions in the tetrahedrite.

It has red-brown internal reflection.

In hand specimen it appears as crystal intergrowths with the tetrahedrite. It is rosinous brown and has a high lustre.

6. Chalcopyrite

This mineral is the least abundant of all observed. It was seen as a few, small irregular blebs in two sections.

It is bright yellow and has weak anisotropism.

In all cases it appeared in contact with or inclusions in tetrahedrite.

7. Boulangerite ($5 \text{PbS} \cdot 2\text{Sb}_2\text{S}_3$)

Boulangerite is common and fairly abundant. It probably constitutes a major source of the economic values.

It is white and takes an excellent smooth polish. No cleavage is visible.

Under crossed nicols the mineral appears as fibrous and granular aggregates. It occurs as concentrations of fingering fibres in galena. (Figure 4). The fibres are optically oriented within the group. The anisotropism is strong, - tan, brown, and bluish grey.

Tests for silver were negative.

8. Galena

This mineral is common and occurs in varying amounts in most sections. It is not as abundant as boulangierite.

The mineral is characteristically smooth, white, soft and frequently has triangular pits. The cubic cleavage traces are always present.

The mineral surrounds partly or completely encloses grains of the above listed minerals.

9. Owyheeite ($5 \text{ PbS Ag}_4\text{S } 3\text{Sb}_2\text{S}_3$)

This is a rare mineral and occurs as a few grains scattered throughout the galena. *+ boulangierite*

The mineral is usually well-crystallized and is in elongate grains. Length of larger grains ranged between 150 - 180 μ .

The mineral is a shade darker than galena and lighter than tetrahedrite. It is distinguished from both by its distinct anisotropism. The grains have triangular pits, similar to those of galena, but no cleavage traces.

Depositional Sequence:

The earliest formed mineral appears to be pyrite. It is well crystallized and when in contact with the other mineralization shows fracture filling, and replacement controlled by crystallographic directions.

Arsenopyrite shows textural relationships with later mineralization similar to those of pyrite. It is well crystallized and is replaced or fractured by later mineralization.

There was only feeble evidence present that arsenopyrite followed the pyrite. In Figure 1, one of the few examples of pyrite and arsenopyrite in contact is illustrated. It appears that arsenopyrite was later and has partially replaced or fractured pyrite. There is no evidence of later deposition of pyrite, therefore this author concludes that pyrite was the first to be deposited.

There are many textural evidences of pyrrhotite, in fine-grained masses, attacking and replacing the above two minerals. It fills fractures in broken grains and shows the beginning of replacement along crystallographic directions. (Figures 1 and 2).

Tetrahedrite seems to be the next mineral to be deposited. Large irregular masses of tetrahedrite have isolated cubic grains of pyrite, (Figure 6), replaced pyrite along cracks, (Figure 3), and isolated euhedral grains of arsenopyrite as well as blebs, the latter suggesting incomplete replacement of the arsenopyrite rounding the edges of originally euhedral grains. (Figure 3).

Sphalerite in the unpolished hand specimen appeared to be intimately intergrown with tetrahedrite in crystalline aggregates in which the crystals were all of similar size. In polished section most of the sphalerite appeared as blades and inclusions in crystallographic directions within the tetrahedrite. This suggests exsolution (Figure 3) or, at least, contemporaneous deposition of sphalerite and tetrahedrite.

There was very little chalcopyrite seen and no indicative textures were observed. Its close association with tetrahedrite suggests its deposition immediately followed that of tetrahedrite. There is no evidence of either replacing the other.

Boulangerite has crystallized in granular and fibrous aggregates around the previous minerals. There is little evidence it has replaced a significant amount of the earlier mineralization, but it can be seen, in all instances to be filling fractures and cracks in and around the above mineral. (Figure 6).

Where boulangerite and galena are seen together the texture illustrated in Figure 4 is evident. The boulangerite fibres are optically oriented within a group suggesting the galena has replaced, in part, a large whole crystal of which these fibres are remnants. The cubic crystal outlines of galena have broken right across the boulangerite suggesting the cubes of galena crystallized around the boulangerite needles and the tendency to cleave was strong enough to ~~fracture~~^{cut} the needles.

Owyheeite occurs only in the galena. It has formed elongate euhedral grains which have replaced the galena. Perhaps the owyheite entered along cleavage traces and replaced the mineral with sufficient strength to crystallize in what seems to be the main mass of the mineral rather than lying along cleavage traces.

Gangue Minerals:

Due to the massive nature of the sulphide ore very little gangue was observed.

In unpolished hand specimen coarse grained quartz is intergrown with coarse grained pyrite. This suggests the two may have crystallized together. Fine grained silicate minerals and fine grained white to grey carbonate occurs with the later mineralization.

Paragenesis:

Pyrite	_____		
Arsenopyrite		_____	
Pyrrhotite			_____
Tetrahedrite			_____
Sphalerite			_____
Chalcopyrite			_____
Bowlingite			_____
Galena			_____
Oxyheite			_____
Quartz	_____	_____	_____
Other gangue			_____

Temperature of Formation

The temperature of mineralization could be fixed only within broad limits.

Many sulphides such as pyrite, pyrrhotite, and chalcopyrite are common at all temperatures.

Arsenopyrite is usually a reasonably high temperature mineral. The sulphosalts, tetrahedrite and boulangerite are usually moderate to low temperature minerals.

Textural evidence suggests a moderate to high temperature formation. There are none of the usual epithermal characteristics, no vugs, cavities, and encrustation, and there appears to have been little wall rock alteration. There has been insufficient development to determine changes with depth.

Thus it appears the mineralization occurred at moderately high temperature in the earlier stages and there may have been some drop in temperature with the deposition of the sulpho-salts.

The gangue minerals, quartz and some carbonate, uniformly fine-grained, seem to agree with this suggestion.

Hence the temperature of formation seems to have been moderately high to medium temperature.

Conclusions

This deposit carries Lead-Zinc-Silver mineralization with minor gold values.

The zinc is won from the sulphide, sphalerite.

Lead is won from the sulphide and lead sulpho-salts.

Argentiferous tetrahedrite yields the silver. The small gold values are probably carried in the arsenopyrite.

The deposit is one of massive sulphides controlled by older shear zones and the environment of lamprophyre dykes presents favorable conditions for deposition of the mineralization from hydrothermal solutions.

very little.

APPENDIX A

BIBLIOGRAPHY

Edwards, A.B. Textures of the Ore Minerals, 1954, Australian Institute of Mining and Metallurgy.

Short, M.N., Microscopic Determination of the Ore Minerals, 1940, United States Department of the Interior, Geological Survey Bulletin 914.

Uytenbogaardt, W., Table for Microscopic Identification of Ore Minerals, 1951, New Jersey : Princeton University Press.

White, W.H., Geology 408, Classroom Notes.

British Columbia Department of Mines, Annual Report, Victoria, Queen's Printer. Annual Report: 1949, 1950, 1951, 1952, 1953.

APPENDIX B

APPENDIX B

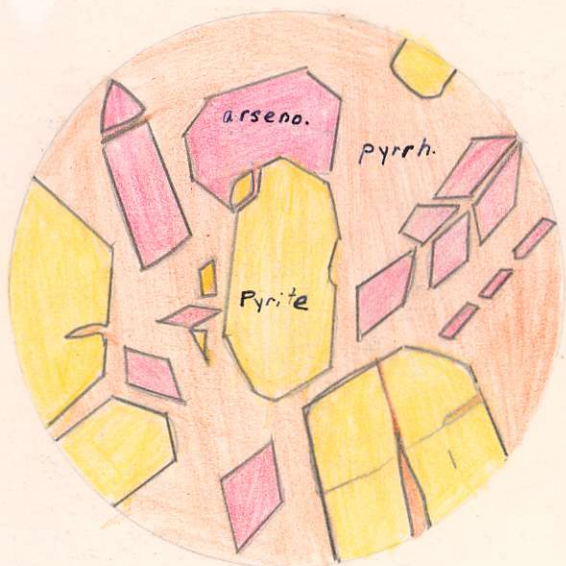


Fig. 1
Fine grained pyrrhotite
surrounding crystals of
earlier pyrite and arseno-
pyrite. Arsenopyrite filling
fractures in pyrite.

X30

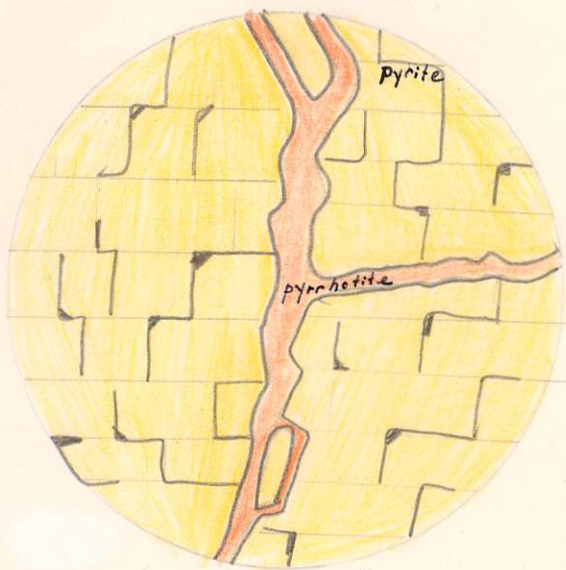


Fig. 2
Pyrrhotite filling
fractures in pyrite.
Note matching walls.

X72

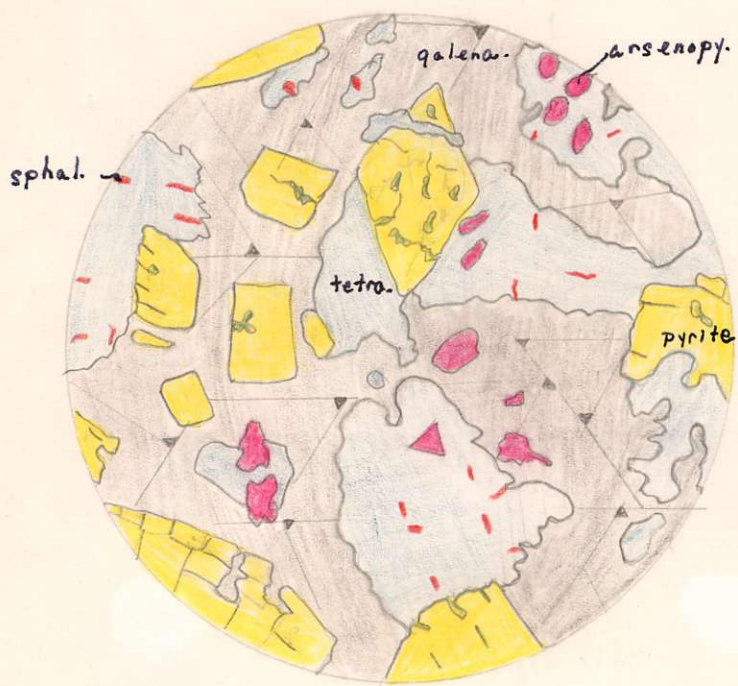


Fig. 3
Tetrahedrite replacing pyrite and surrounding arsenopyrite. Sphalerite exsolved in cracks in tetrahedrite. Late galena corroding and replacing earlier minerals.

X 82

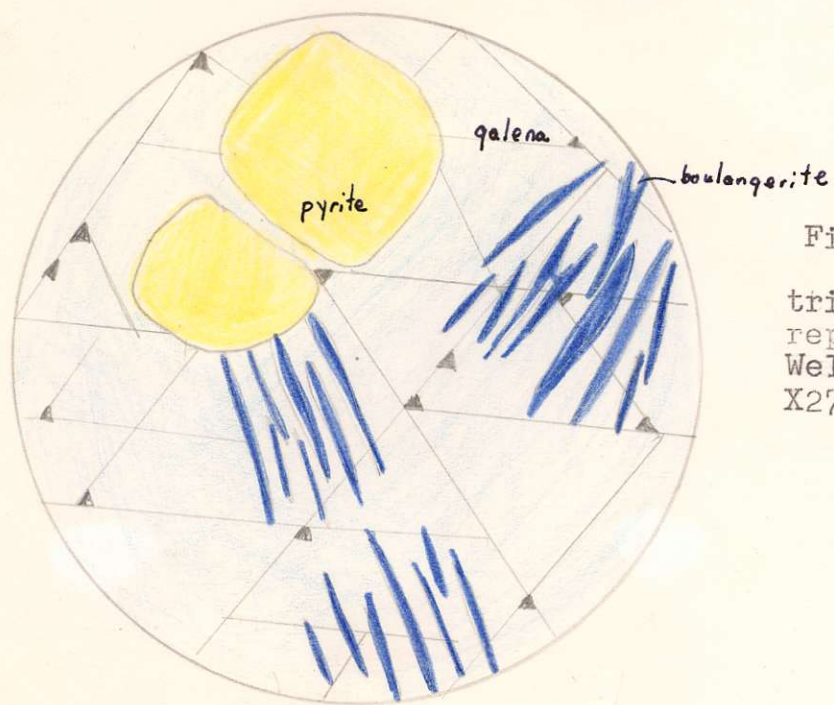


Fig. 4
Galena, exhibiting triangular cleavage and pits, replacing boulangerite. Well crystallized early pyrite.
X27

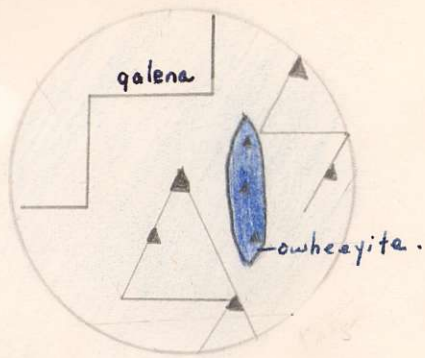


Fig. 5
Owheeyite replacing
galena.

X115

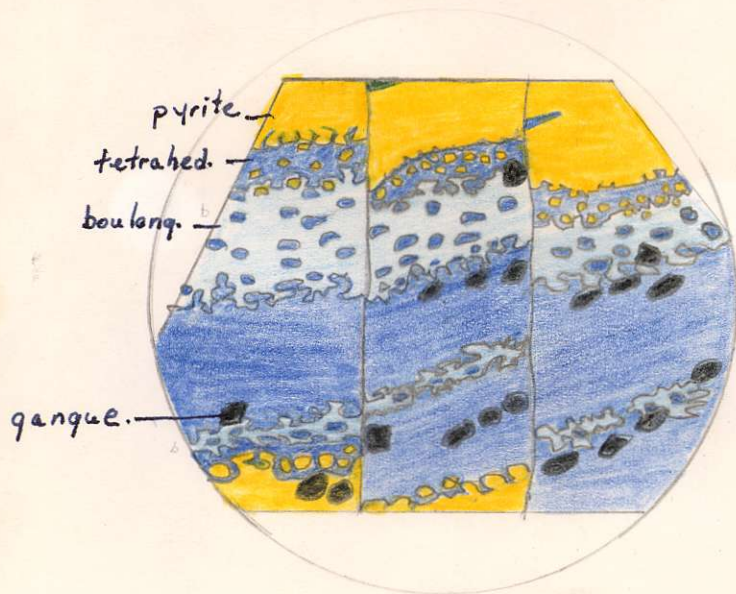


Fig. 6
Post mineralization
faulting. Pyrite cubes
isolated by later tetrahedrite.
Boulangerite replacing and
isolating tetrahedrite grains.

X4