Geology 9. Report.

POLISHED SECTION STUDY OF THE ORE MINERALS IN THE YMIR AND GOODENOUGH MINES, YMIR MINING CAMP, B. C.

by

R. G. McEachern.

University of British Columbia.

April, 1941.

CONTENTS

POLISHED SECTION STUDY OF THE ORE MINERALS IN THE YMIR AND GOODENOUGH MINES, YMIR MINING CAMP, B. C.

Introduction:

This report describes the microscopic study of a suite of polished section ore specimens, carried out as part of the course in mineralography given by Dr. H. V. Warren at the University of British Columbia.

Location and Description of Mines:

The specimens came from the Ymir and Goodenough mines, which are adjoining properties situated on the North Fork of Wild Horse Creek, five miles above the town of Ymir, British Columbia.

The most complete study of the properties was made in 1914 by C. W. Drysdale, for the Canadian Geological Survey. His report is published in Memoir 94. The writer is not personally acquainted with the properties. All general information was obtained from Mr. Drysdale's report, and from the annual reports of the Minister of Mines.

Development was started about 1898. An eighty-stamp mill was built at the Ymir mine in 1900, and a cyanide plant the next year. Production lasted until 1908 when the mine was closed down. Little work was done on the Goodenough during this period and both properties were idle until 1934, when they were reopened by by the Ymir Consolidated Gold Mine Limited. Intermittent production has taken place since, but only small tonnages have been mined. The Goodenough has been the most impprtant producer since reopening.

The deposits are fissure veins occuring in the Pend d'Oreille schists near their contact with the Nelson Grano-diorite. The ores are mined primarily for their gold content but carry also important amounts of silver, lead, and zinc.

Location of Specimens:

Eight polished sections were made and studied, four from each mine. The Goodenough sections are: one from No. 1. level, two from No. 2. level, and one from Coates Tunnel. The writer does not know where the Coates Tunnel is located in the mine. The Ymir sections are: one from No. 5. level, one from No. 3. level, and two from No. 9. level.

According to Drysdale the veins of the two properties are of the same general type, have approximately the same strike and dip, and contain the same minerals.

Because of a difference in elevation of the mines, No. 1. level in the Goodenough is at about the same elevation as No. 4. level in the Ymir. Since levels in each mine are about 100 feet apart, the specimens represent a vertical range of 500 feet. The Ymir specimens alone represent a range of 400 feet. Therefore, little information relating to depth is added by combining the study of the two veins.

Description of Minerals:

The most abundant minerals identified in the specimens were quartz, sphalerite, galena and pyrite. Also identified, but in smaller quantities, were gold, chalcopyrite and pyrrhotite. A soft gangue mineral of minor occurrence was observed but not identified.

Quartz is the principal gangue mineral. It has been fractured, and then replaced to a varying degree by sulphides. The replacement has apparently been controlled by a tight fracture system. The replacing minerals often penetrate into the quartz as abruptly tapering tongues, from the ends of which closed fissures extend a short distance. More often the quartz occurs as unfractured island remnants in the sulphides, replacement apparently having gone to the extent that the controlling fractures are obliterated. No open veining of quartz by sulphides was seen.

Pyrite occurs in quartz, galena, and sphalerite, and has originally been euhedral, but many crystals have been fractured, veined and replaced. In the one specimen that carries gold, pyrite is in a massive form. Many crystals in galena contain minute, rounded inclusions of the later mineral.

Sphalerite is the most abundant sulphide. It replaces quartz and is intimately mixed with and replaced by galena.

Galena replaces quartz to a great extent and sphalerite to a lesser extent. Galena penetrates farther into the quartz fissures than sphalerite foes. It contacts quartz more than sphalerite, often separating these two, even where it is not abundant. Galena-sphalerite contacts are usually very irregular, often being a fine intergrowth. Galena is commonly widely disseminated through sphalerite in minute amounts, but sphalerite is never disseminated through the galena in the same manner.

Gold was found only in one specimen. The specimen is from No. 3. level in the Goodenough mine, and has a distinctly different appearance from the rest of the sections. A banded structure of fine-grained to massive pyrite in quartz is prominent. More pyrite and less sphalerite and galena are present than in other specimens. Sphalerite and some galena, in irregular patches, form a lineation roughly parallel to the pyrite. These minerals are also scattered through the pyrite bands. The gold is near the quartz-sphalerite contact, chiefly between the two minerals, but some small pieces are entirely in quartz and others entirely in sphalerite. The sphalerite replaces quartz along fractures and some of the gold occupies the heads of these fractures. The relationship is similar to that of galena and sphalerite where these minerals replace quartz along cracks, the gold occupying the place of the galena.

The largest piece of gold seen was about .4 mm. long.

Chalcopyrite occurs only as small rods and irregular specks in the sphalerite. In one specimen the rods are arranged in a definite pattern, more commonly they are irregularily spaced.

Pyhrrotite was seen only in the Coates Tunnel specimen. Most of it occurs as isolated islands and minute disseminations in the sphalerite.

Soft Gangue also seen, only in the Coates Tunnel specimen. It has the appearance of a carbonate, but was unaffected by acid. It is closely associated with quartz and contains islands of sulphides.

Description of Specimens:

A. Goodenough Mine-

No. 1. Level.

Minerals: quartz, sphalerite, galena and pyrite.

Quartz appears to be strongly replaced by sulphides. It is penetrated by irregular tongues of galena. Galena-quartz contacts are embayed, but sphalerite-quartz contacts are smooth. Sphalerite is in pure bands, or intergrowths, with galena. Pyrite occurs as rounded or fractured and veined grains in galena, and as euhedral crystals in quartz.

Parallel bands of galena containing small quartz and pyrite particles occur in the sphalerite. The sphalerite is checked with cracks, the galena is dense and shows neither fracturing nor cleavage. Post mineral movement evidently has taken place, the galena healing, but the sphalerite remaining fractured.

No. 3. Level.

Specimen 1. This specimen is similar in appearance to the one just described, and contains the same minerals. More pyrite occurs in the quartz and is not as euhedral in form. Galena and sphalerite both vein pyrite and most of the pyrite contains galena inclusions.

<u>Specimen 2</u>. This is the banded gold-bearing specimen already described under gold. A study of both the section and the hand specimen yielded no evidence to prove that the banding was produced by crustification.

<u>Coates Tunnel</u>.

<u>Minerals</u>: quartz, pyrite, sphalerite, galena, chalcopyrite, pyrrhotite, and a soft gangue mineral.

The different mineral content of this section indicates that the Coates Tunnel is not close to the other workings from which specimens have been studied. It contains the only occurrence of pyrrhotite and the soft gangue. Massive sulphides surround quartz islands. The soft gangue mineral is closely associated with quartz. It contains small amounts of pyrrhotite and large islands of galena and sphalerite. Galena and sphalerite have the usual relationships. Pyrite is attacked by them both. Most of the pyrrhotite is in the sphalerite as large isolated bodies and as minute disseminated particles. A minor amount is scattered through the galena. A few small chalcopyrite specks are in the sphalerite.

B. <u>Ymir Mine</u>-

<u>No. 5. Level</u>.

<u>Minerals</u>: quartz, sphalerite, galena, and pyrite.

Quartz occurs as isolated bodies in the sulphides. Sphalerite and galena are more cleanly separated than in the Goodenough specimens, having smoother contacts and fewer inclusions of each other. They embay quartz equally. Pyrite crystals are euhedral in all three other minerals.

No. 8. Level.

Minerals: quartz, sphalerite, galena, pyrite and chalcopyrite.

Sphalerite and galena replace quartz along fissures. Pyrite is entirely euhedral. Chalcopyrite is disseminated in the sphalerite.

900 Level.

Specimen 1. Minerals: quartz, pyrite, sphalerite, galena, and chalcopyrite.

Quartz replacement is pronounced. ~~quartz~~ Quartz occurs as well separated, rounded and embayed bodies. Sphalerite and galena are intimately mixed. A strong post mineral fracture system checks the sphalerite but does not affect the quartz.

Specimen 2. Sulphides are minor in quantity. Galena and some sphalerite replace the quartz along cracks. Pyrite, as rounded and euhedral crystals, is in the galena. It has inclusions of galena and is attacked by it.

Paragenesis:

The mineralization of the vein fissures can be separated into three stages:

(1) Deposition of quartz and pyrite.

(2) Fracturing of the quartz and pyrite.

(3) Deposition of sphalerite, pyrite, galena and gold.

These periods, though separate, may have followed one another very closely.

The filled fractures in the quartz and some of the pyrite indicate that these two minerals were earlier and that movement took place after their deposition.

Solutions bearing zinc, iron, lead, copper and gold then came in along the fractures. Zinc was deposited slightly ahead of lead, and lead continued to be deposited after the last of the zinc; but it is probable that during most of the period these two minerals were being deposited simultaneously, the bulk of the zinc early in the period and the bulk of the lead late. The second generation of iron started to deposit with, or shortly after, the zinc and continued in slightly increasing amounts until near the end of the period. Pyrrhotite was formed probably near the end of the iron deposition because of a lack of sulphur, and its presence doesn't necessarily indicate a change in the iron sequence.

Some copper and iron deposited as a solid solution in the sphalerite, and separated out later to form chalcopyrite.

The fact that only one occurrence of gold was noted makes it impossible to definitely place gold in the period, but the observed relationship indicates that it was late--at least as late as the end of the zinc.

In the last period of mineralization most metals were depositing contemporaneously for the greater part of the time, variation in quantity, rather than variation in time, being more responsible for the observed relationships.

Conclusions:

None of the observed variation in the specimens can be attributed to a difference in the depth of their formation.

With the exceptions of the gold and Coates Tunnel specimens, the ores of the mines are very similar. The Coates Tunnel specimens certainly represent a variation in mineralization, but, as its location with relation to the other specimens is unknown, no conclusions can be made. The presence of gold in the banded ore is interesting, but further work is necessary if any definite relationships are to be proved.

Microscopic study of an ore deposit is useful in adding to the knowledge of its formation but cannot be regarded as complete in itself. Field observation of the broader structures and relationships is essential if a true and complete picture is to be obtained.

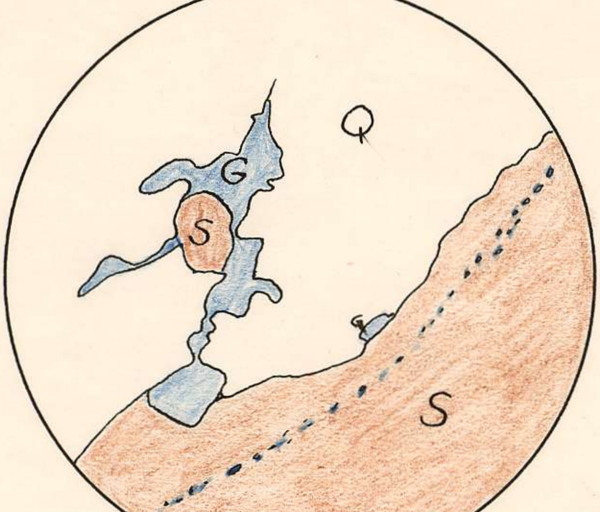
GOODENOUGH MINE

Q=Quartz
S=Sphalerite
G=Galena
P=Pyrite
Pr=Pyrrhotite
C=Chalcopyrite
Au=Gold

No. 1. Level x25

Galena replacing quartz and sphalerite.

Note lineated structure of galena in sphalerite.

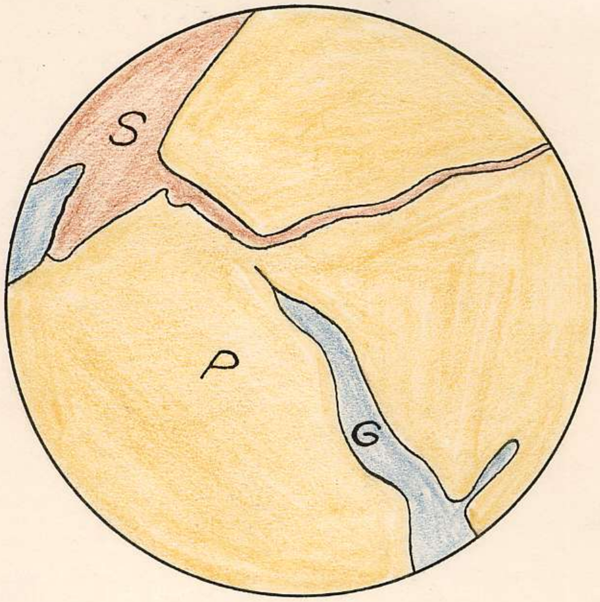


No. 1. Level x60

Galena replacing quartz along a fissure.

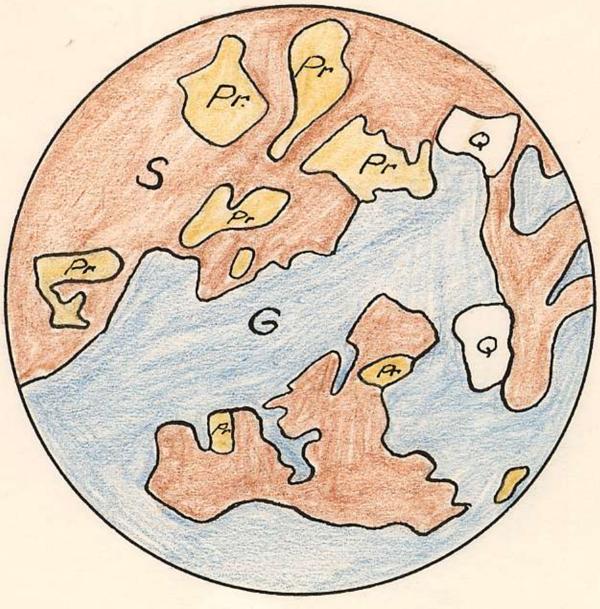
Quartz-sphalerite contact relatively smooth.

GOODENOUGH MINE



No. 3. Level -- Section 1. x210

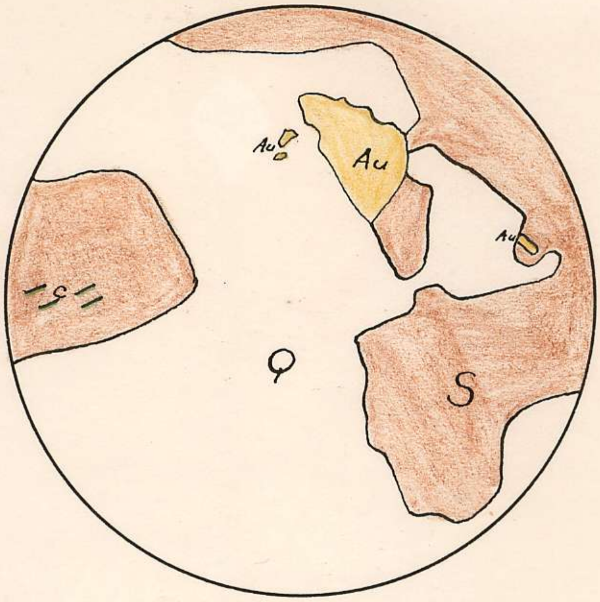
Galena and sphalerite veining pyrite.



Coates Tunnel x210

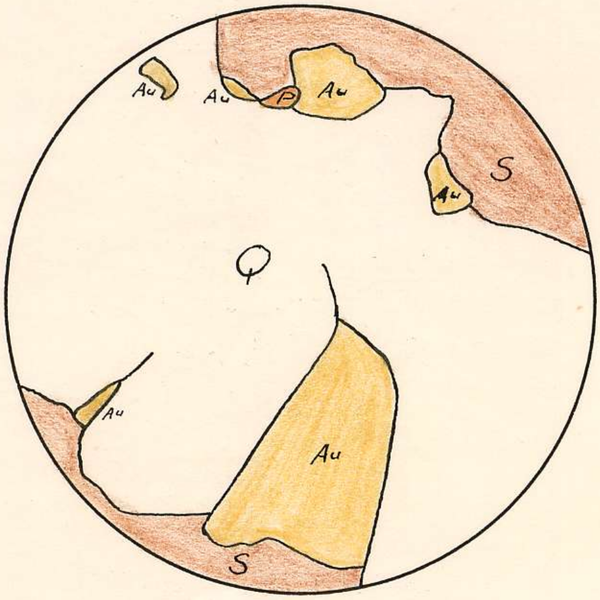
Pyrrhotite in sphalerite.

GOODENOUGH MINE



Gold x60

Gold along the quartz-sphalerite contact.



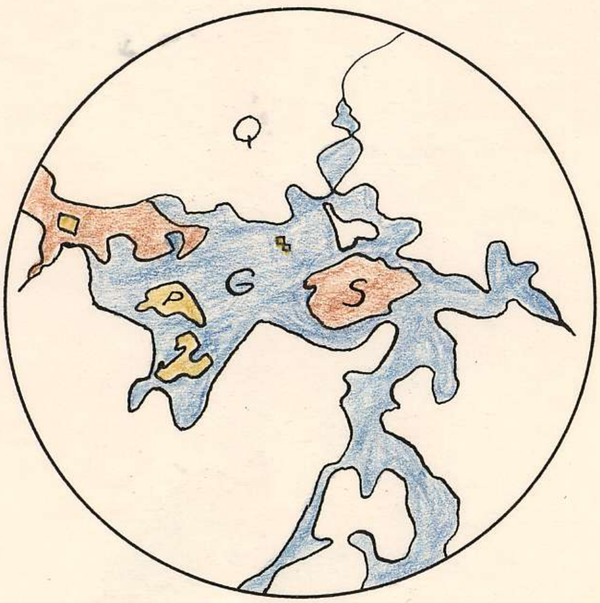
Gold x210

Note small fissures extending into the quartz from the gold.

YMIR MINE

No. 5. Level x60

Almost euhedral pyrite in galena, sphalerite and quartz. Some of the pyrite crystals in galena have galena inclusions.



No. 9. Level x60

Galena and sphalerite replacing quartz along small fissures.