# A MICROSCOPIC EXAMINATION OF ORE FROM THE QUEEN MINE BRITISH COLUMBIA.



GEOLOGY 9 THESIS

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## I. INTRODUCTION.

The following is a report on the microscopic examination of the Queen Mine ore. The purpose of this examination was to determine the minerals present in the ore, the paragenesis of these minerals, the manner of occurrence and association of the valuable minerals, and to discuss matters affecting the treatment of the ore. The first part of this report deals briefly with the location of the mine, the general geology of the district, and the geology of the Queen Mine. The main part of the report gives a short megascopic study of the specimens, and in detail, the observations of the microscopic examinations, discussing the relationship and paragenesis of the various minerals, and the occurrence and association of the gold. The latter part of the report gives the conclusions drawn from the study of the ore in relation to crushing and treatment of the ore.

## II. *LOCATION OF THE QUEEN MINE.

The Queen Mine is located in southeastern British Columbia. It is in the Salmo map-area, which lies between longitudes 117° and 117°30', and latitudes 49° and 49°15', just south of the Nelson Kootenay district. In this Salmo map-area is, what is known as, the Sheep Creek area. This area takes its name from that of a tributary of the Salmon river, which joins this river at a point about four miles from the village of Salmo. The area is about twenty-five miles due south of Nelson, B.C. The Queen Mine is just above the junction, of Waldie Creek with Sheep Creek.

*The Miner, Ymir Sheep Creek Number, July 1935.

This mine can be reached by a branch line of the Great Northern Railway, which passes through Salmo, and thence twelve miles by road.

## III. *HISTORICAL NOTE.

In July 1896 the first of the group known as the Yellowstone (lying 800 ft. north of the Queen) was located and in September of the same year the Queen mine was staked. Development of the Yellowstone commenced late in the summer of that year and in the three succeeding years all of its known ore was developed. The erection in 1900 of a 10 ton stamp mill, using amalgamation only, was completed for the purpose of extracting the gold from this ore. During this and the following year approximately 17,000 tons of ore were treated which produced 5,552 oz. of gold and 4.354 oz. of silver. No data is available following any further production from the Yellowstone vein.

During this time the development of the Queen Mine was pushed ahead and in 1902 its first ore shipment was made. In 1906 an amalgamation between Yellowstone and Queen took place, the Yellowstone mill was increased to 20 stamps and table concentrators were added. During the 16 year operating period, government records and other data show total production from the Queen mine to have been in the neighborhood of 118,000 tons valued at $1,024,726. The efficiency of the mill was not great and it is doubtful if the gold produced represented a 65% recovery.

Adverse economic conditions caused by the World War

*The Miner, Ymir Sheep Creek Number, July 1935.

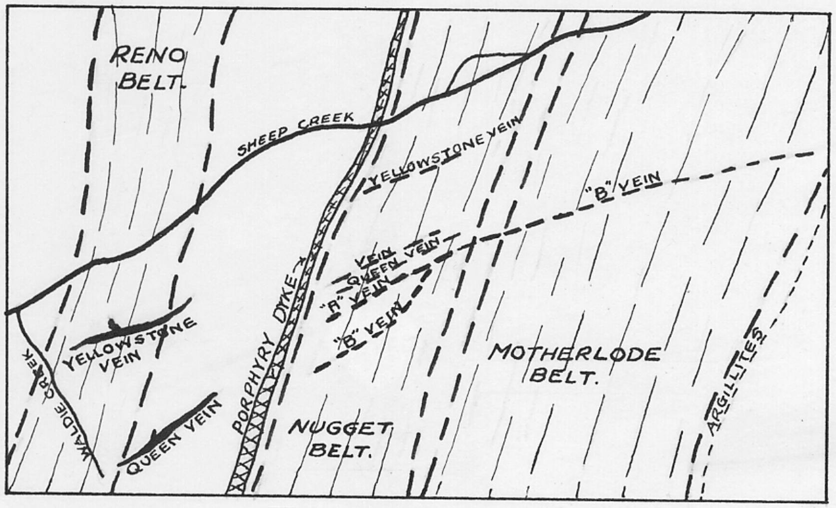
resulted in the closing down of the mine in 1915. It was reopened in 1916 to mine the broken ore remaining in the stopes. Unsuccessful development on the lowest level and high miner wages influenced the decision to suspend operations.

In September, 1933, after securing options on several adjoining groups of claims a consolidation was effected, and the present company-Sheep Creek Gold Mines, Ltd., was formed. Dewatering was completed late in February 1934. Exploratory work warranted the construction of a 150-ton mill, which went into operation on May 20, 1935.

## IV. *GENERAL GEOLOGY OF SHEEP CREEK AREA. (see page 3(a).)

The gold deposits now being developed in the Sheep Creek area occur as fissure veins cutting the harder quartzites of the upper part of the Reno and Quartzite Range formations. Locally these ore-horizons are recognized as being three in number and are termed the Reno, Nugget, and Motherlode quartzite beds. These three ore-horizons strike about 15° east of north and dip steeply to the east. They vary somewhat in thickness. The Reno quartzite shows a greatest width of 1500 feet measured horizontally. The Nugget quartzite is 700 feet in thickness and the Motherlode quartzite is nearly as thick at these points. Between 300 and 400 feet of argilaceous schist separate the Nugget and Motherlode quartzites, while over 1000 feet of schist and calcareous sediments separate the Nugget from the Reno quartzite beds.

*The Miner, Ymir Sheep Creek Number, July 1935.
*Memoir 172, Geological Survey of Canada, 1934.


RENO BELT.
SHEEP CREEK
YELLOWSTONE VEIN
"B" VEIN
VEIN
QUEEN VEIN
"R" VEIN
"B" VEIN
PORPHYRY DYKE
YELLOWSTONE VEIN
QUEEN VEIN
WALDIE CREEK
NUGGET BELT.
MOTHERLODE BELT.
ARGILLITES

The gold occurrences can be described as mineralized quartz-filled fault fissures cutting the three recognized quartzite beds in an easterly direction, and in most cases nearly normal to the strike of the beds. The direction of movement in these fault fissures is described as a westerly movement of the south wall with relation to the north wall, with the displacement varying from a few feet to about 200 feet. The amount of movement along the fissures, controls to a certain extent the formation of ore-shoots, in that it has been responsible for the opening as well as compression of certain parts along the sinuous fissures.

## V.* GEOLOGY OF THE QUEEN VEIN.

The Queen vein strikes north 65°E. and is in general practically vertical. It has a length of about 1200 feet in quartzites. The mine workings show the quartzites to be in the form of a tight overturned anticlinal fold. The west ore-bodies in the mine dip to the west, and in the eastern end the ore bodies dip to the east. The quartzites in the centre of the workings are arched and tightly folded, and so few ore bodies have been found in this section. Oxidation of the Queen vein ceased at the level of Waldie Creek. Secondary lead and zinc minerals have been almost entirely removed.

## VI.** ORE RESERVES AND PRODUCTION.

The ore reserves of the Queen vein apparently have been depleted. The total value of production amounted to $2,500,000. The Sheep Creek Gold Mines, Ltd., now obtain

*The Miner, Ymir Sheep Creek Number, July 1935.
**C.I.M.M. March, 1938.

the greater part of their ore supply from the *Hideaway vein.

## V11. MINERALOGY OF THE QUEEN MINE ORE.

Minerals in order of prominence.

1, Quartz.
2. Pyrite.
3. Pyrrhotite.
4. Sphalerite.
5. Chalcopyrite.
6. Galena.
7. Gold (native)

The gangue minerals consist mainly of white, grey, and occasionally brown stained, quartz and in a few samples a ve very small amount of calcite.

The metallic minerals are mostly in the form of sulphides, which constitute about 10 per cent of ore. Of these sulphides; pyrite and pyrrhotite are by far the most abundant.

## V111. DESCRIPTION OF POLISHED SECTIONS.

### A. Megascopic Examination.

Specimen No. 1.

The gangue is grey, white, and brown stained quartz, making up about 50 per cent of the specimen.

The only abundant metallic mineral present is pyrite.

Specimen No. 2.

The gangue is mostly white and grey quartz, and is about 50 per cent of the specimen.

* An east west fissure 800 feet south of Queen vein, on the east side of Waldie Creek (Page 7a)

The metallic minerals consist primarily of pyrrhotite. A small amount of pyrite and chalcopyrite can also be seen.

Specimen No. 3.

The gangue is quartz, making up 75 per cent of the specimen.

The metallic minerals consists of pyrrhotite filling fractures in the quartz.

Specimen No. 4.

The gangue is white, grey and brown stained, quartz amounting to about 50 per cent of the specimen.

The metallic minerals, present in considerable quantities, are pyrrhotite and sphalerite. A small amount of chalcopyrite can also be seen.

Specimen No. 5.

The gangue is white and grey quartz, which is about 50 per cent of the specimen.

The metallic mineral is massive pyrite.

Specimen No. 6.

The gangue is white and grey quartz. which is about 25 per cent of the specimen.

The metallic mineral is massive pyrite. The character of this specimen is similar to specimen No. 5.

Specimen No. 7.

The gangue is white quartz, amounting to 10 per cent of the specimen.

The metallic minerals are practically massive sphalerite with a very small amount of pyrite in the quartz gangue.

B. Microscopic Examination.

Specimen No. 1. (see page 12. )

The gangue in this specimen is mostly white, grey, and brown, quartz. In the brown stained quartz there appears to be a few dots of calcite.

The metallic minerals present are pyrite and a few small irregular grains of chalcopyrite.

Pyrite obviously was the first fissure filling mineral. It occurs in this specimen both as rather coarse cubic grains, and as a fine-grained irregular mass. Evidently there has been a marked fracturing of the pyrite and the liberated cubic crystals and the fine broken material have been cemented into position by the later quartz. It is interesting to note that in the later fracturing of the pyrite-quartz-mass the fracture, in almost every cawe, traversed through the quartz and around the pyrite embedded in the quartz, indicating the greater resistance of pyrite to a shearing force. No free gold was observed in this specimen.

Specimen No. 2. (see page 13.)

The gangue in this specimen is white, grey, and brown stained, quartz.

The metallic minerals present are pyrrhotite, pyrite, sphalerite, and small amounts of chalcopyrite, galena and gold.

The pyrrhotite, pyrite, and sphalerite, occur as an admixed mass. The chalcopyrite appears only in the fractures of the quartz gangue.

Galena occurs in rare, very small specks and can be seen only under a high magnification. The galena appears to border the quartz and sphalerite.

Native gold in this specimen was very scarce and extremely fine. Only one particle of gold was observed under a high magnification. The gold was associated with the sphalerite and galena.

Specimen No. 3. (see page 14.)

The gangue consists of white and grey quartz. A few particles of brown stained quartz were also observed.

The metallic minerals present are pyrrhotite, and small irregular grains of sphalerite, galena and gold.

The pyrrhotite occurs as small irregular masses, stringers, and discontinuous veinlets in the quartz gangue.

The sphalerite occurs as irregular small grains similar to specimen No. 2.

The galena and native gold are intimately associated. The galena appears to be either earlier than the gold or contemporaneous with the gold.

Specimen No. 4. (see page 15.)

The gangue consists of white, grey, and brown stained quartz.

The metallic minerals are pyrrhotite, pyrite, sphalerite, and chalcopyrite. These sulphides occur both massive and disseminated in the quartz gangue.

The pyrrhotite in this specimen appears to have been deposited earlier than the sphalerite.

The chalcopyrite seems to be contemporaneous with, or later than, the pyrrhotite and sphalerite.

No galena or gold were observed in this specimen.

Specimen No. 5. (see page 16.)

The gangue in this specimen consists of white and grey quartz, and is considerably fractured.

The only metallic mineral present is pyrite. This mineral occurs massive in both coarse and fine, irregular grains. Evidently there has been intense fracturing of the pyrite.

No gold was observed upon a very close examination.

Specimen No. 6.

The gangue is white and grey quartz, which has been fractured considerably.

The metallic mineral is pyrite, occuring massive in both fine and coarse irregular grains. This specimen is similar in character to specimen No. 5. Two similar specimens were chosen because there was an absence of any of the later minerals; pyrrhotite, sphalerite, chalcopyrite, and galena; and would illustrate whether there was any association of gold with the pyrite or quartz.

No native gold was found and previous observations were confirmed. The gold obviously came later than the pyrite and quartz.

<u>Specimen No. 7.</u> (see pages 17-22.)

The gangue is white quartz. It occurs as small islets in the massive sphalerite. After a period of fracturing, a small portion of the quartz and pyrite have been carried along and cemented into position by the later sphalerite.

The metallic minerals present are sphalerite, pyrite, pyrrhotite, galena, and gold.

The sphalerite occurs massive and is deeply fractured.

The pyrite is found closely associated with the quartz, in small irregular masses.

The pyrrhotite in this specimen apparently came later than the sphalerite because pyrrhotite can be seen veining the sphalerite. (page 17.)

The galena occurs as very small blebs and is usually found in the sphalerite bordering the quartz. (page 21.)

Gold was found in this specimen in relative abundance. The gold invariably was associated with galena and sphalerite, and in nearly every case was found bordering the quartz gangue. The reason for this is probably, that during a period of fracturing the softer sulphide mineral (sphalerite), tend to break away from the harder minerals (quartz and pyrite), leaving an opening into which the later galena and gold may be deposited. The gold came later than sphalerite and pyrrhotite as it was found veining these two minerals. (plate 12.)
(page 22.)

## IX. PARAGENESIS.

Sequence of deposition of minerals in vein.

1. Deposition of pyrite.

2. A period of movement in the vein, with intense fracturing.

3. Deposition of quartz.

4. A period of fracturing.

5. Deposition of pyrrhotite and sphalerite.

6. A period of fracturing.

7. Deposition of pyrrhotite and chalcopyrite.

   (The chalcopyrite continued to be deposited after the pyrrhotite had ceased.)

8. A period of light fracturing.

9. Deposition of galena and gold.

   (The gold continued to be deposited after the galena had ceased.)

Sequence of deposition of minerals in vein, shown graphically.

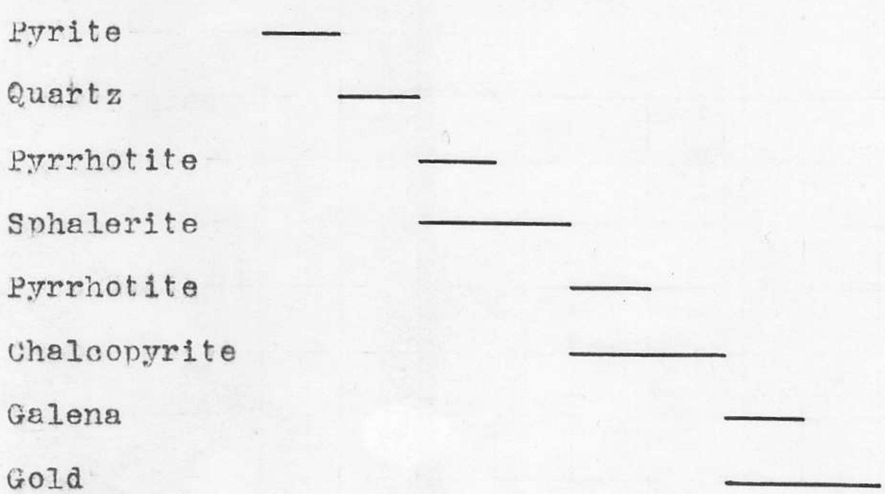
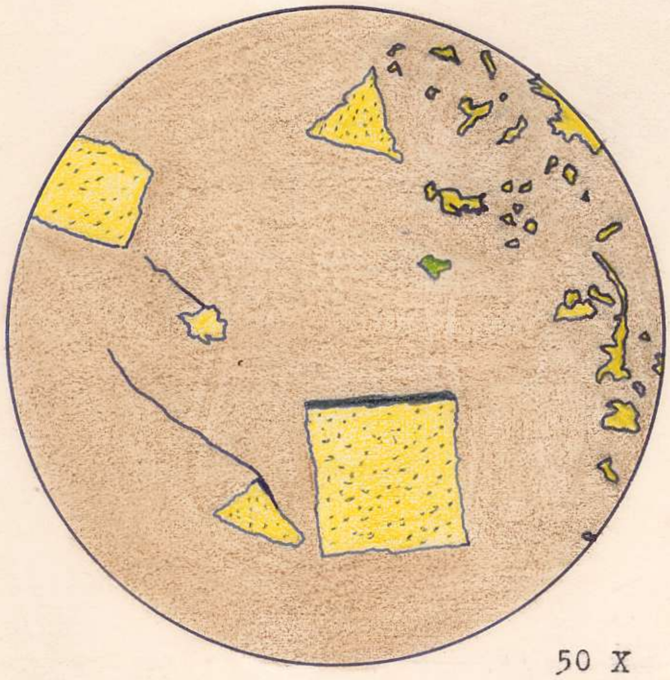


PLATE 1. SPECIMEN NO. 1.



50 X

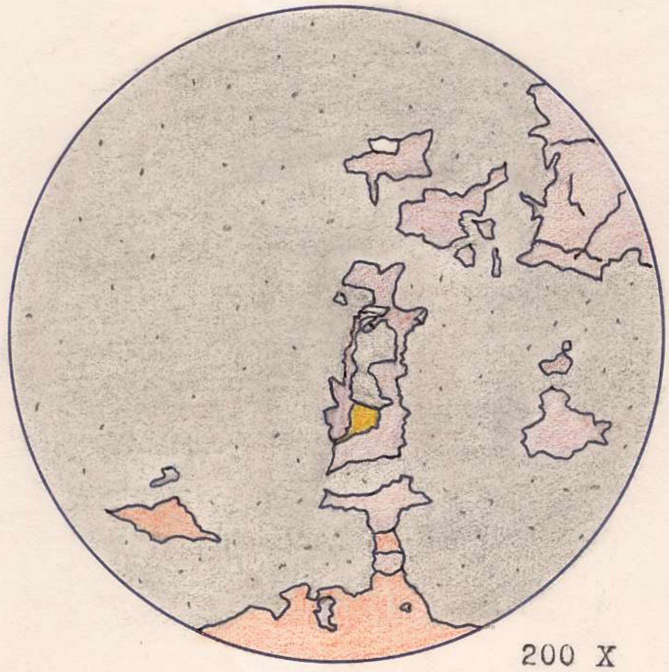
| | |
|---|---|
| Gangue............. | Quartz (stained brown) |
| | Calcite |
| Metallic Minerals... | Pyrite |
| | Chalcopyrite |

Remarks.

Pyrite cubic crystals and fine broken material cemented into position by the later quartz.

Calcite gangue filling fracture between pyrite and quartz.

PLATE 2. SPECIMEN NO. 2.



200 X

Gangue.............. Quartz.

Metallic Minerals... Sphalerite.

Pyrrhotite.

Galena.

Gold.

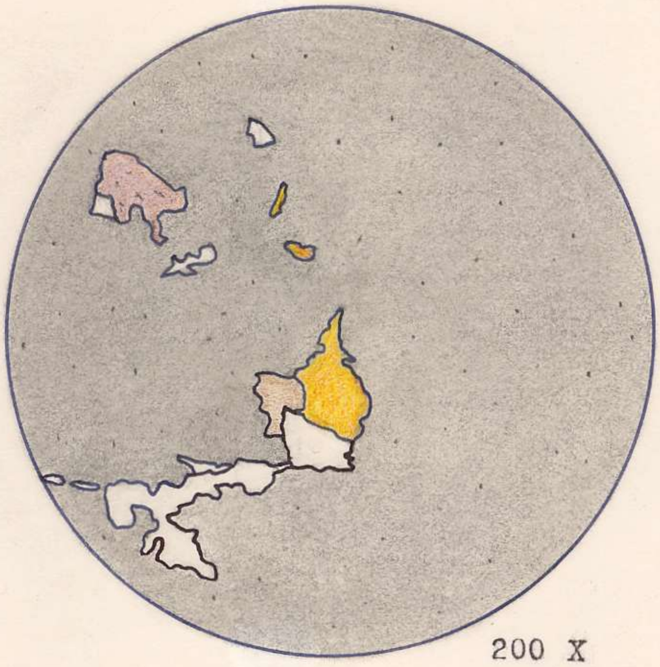
<u>Remarks</u>.

Gold associated with sphalerite and gelena.

Note also association of sphalerite and pyrrhotite.

PLATE 3.

SPECIMEN NO. 3.



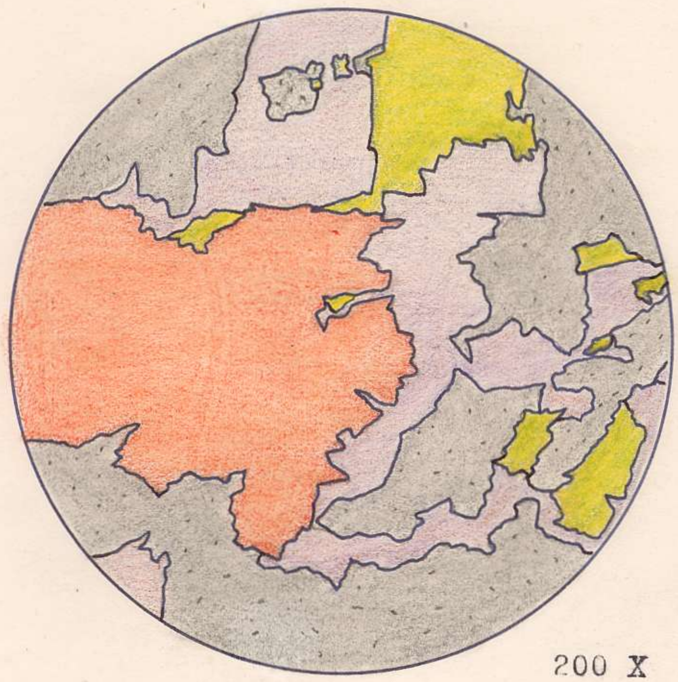
200 X

| | | |
|---|---|---|
| Gangue.............. | Quartz (Grey and stained brown) | |
| Metallic Minerals... | Galena | |
| | Sphalerite | |
| | Gold | |

Remarks.

Gold closely associated with galena and sphalerite.

PLATE 4. SPECIMEN NO. 4.



200 X

Gangue............. Quartz (Grey)

Metallic Minerals... Pyrrhotite

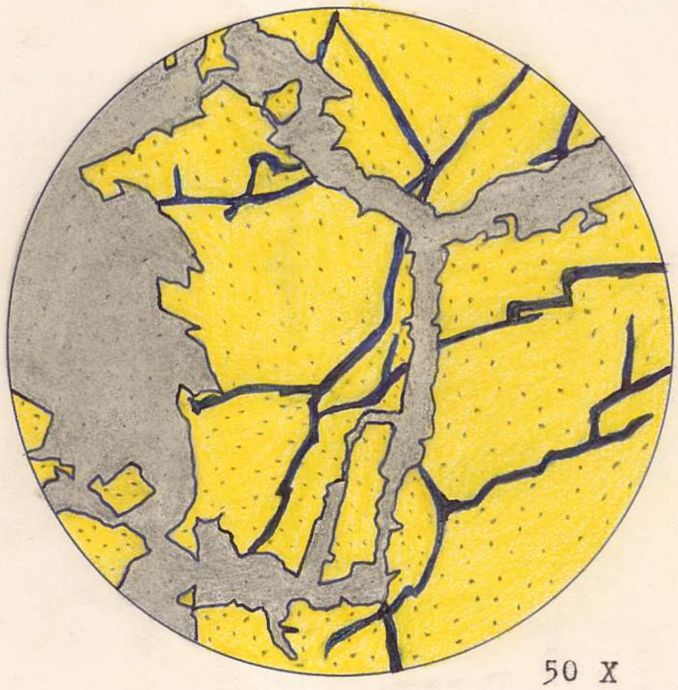
Sphalerite

Chalcopyrite

Remarks.

Typical association of pyrrhotite, sphalerite and chalcopyrite, in specimen No. 2. 3. and 4.

PLATE 5. SPECIMEN NO. 5.



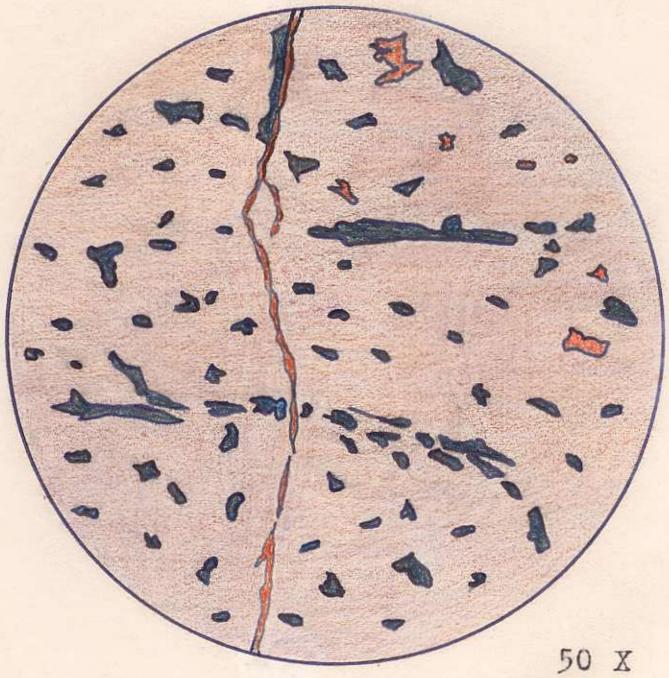
50 X

| | | |
|---|---|---|
| Gangue............. | Quartz (Grey) |  |
| Metallic Mineral... | Pyrite |  |

Remarks.

Fractured pyrite cemented into position by the later quartz.

PLATE 6. SPECIMEN NO. 7.



50 X

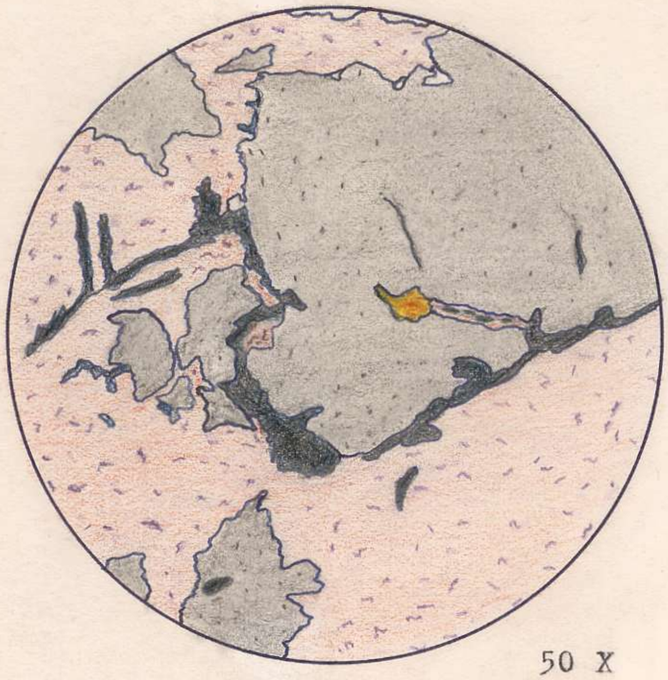
Metallic Minerals... Sphalerite

Pyrrhotite

Remarks.

Pyrrhotite veining the sphalerite.

PLATE 7. SPECIMEN NO. 7.



50 X

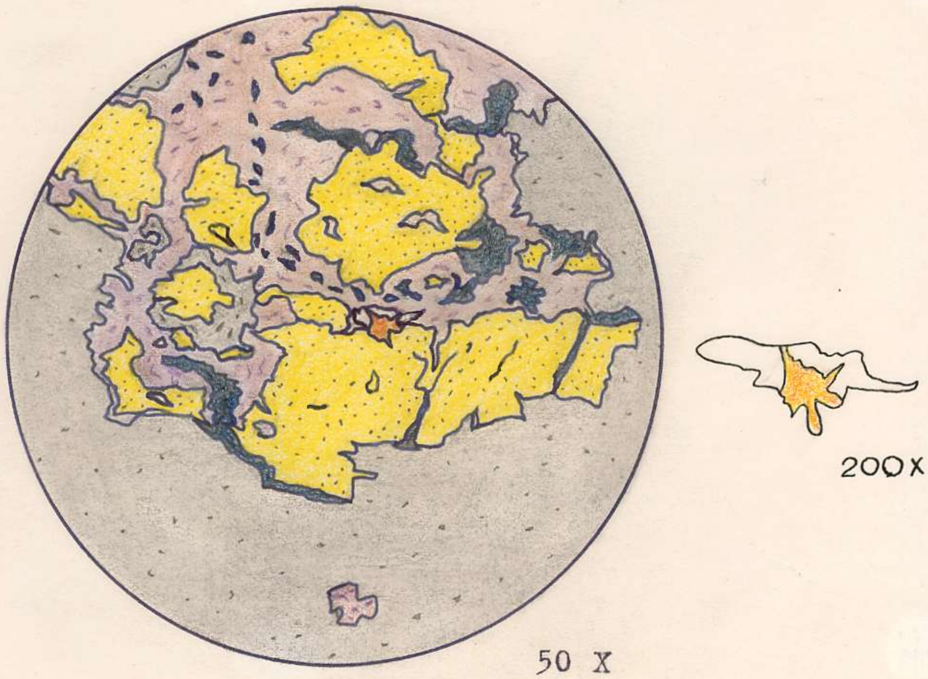
| | | |
|---|---|---|
| Gangue............. | Quartz | |
| Metallic Minerals... | Sphalerite. | |
| | Galena. | |
| | Gold. | |

Remarks.

Gold associated with sphalerite and galena.

Gold found at the tip of a sphalerite-filled fracture in quartz.

PLATE 8. SPECIMEN NO. 7.



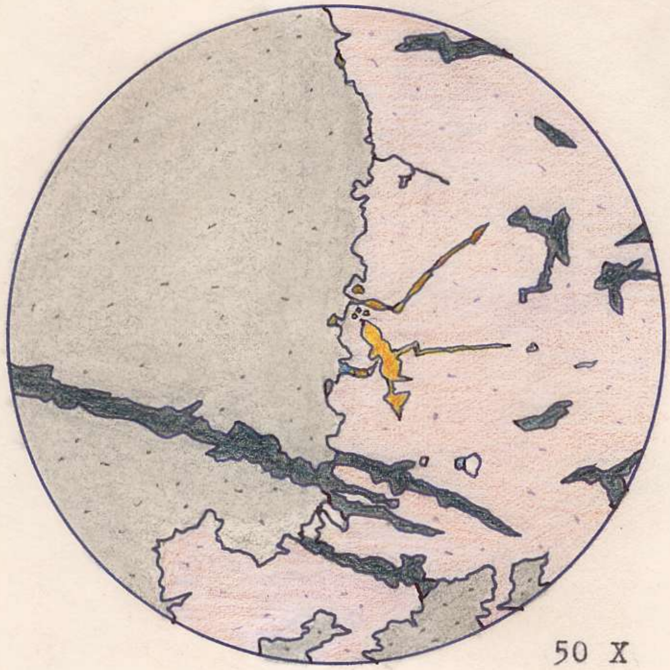

| | | |
|---|---|---|
| Gangue.............. | Quartz | |
| Metallic Minerals... | Pyrite | |
| | Sphalerite | |
| | Galena | |
| | Gold | |

Remarks.

Gold associated with galena.

Sphalerite filling fractures in pyrite.

PLATE 9. SPECIMEN NO. 7.



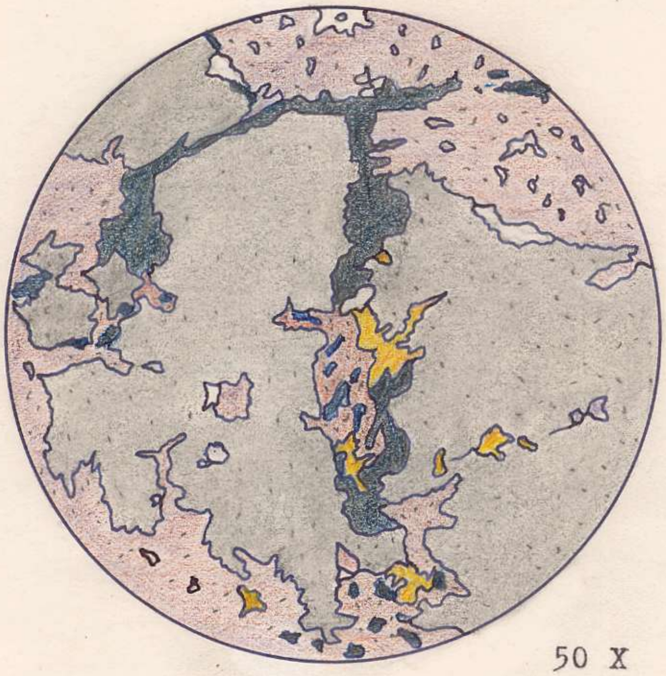
50 X

| | | |
|---|---|---|
| Gangue.............. | Quartz | |
| Metallic Minerals... | Sphalerite | |
| | Galena | |
| | Gold | |

Remarks.

Gold veining sphalerite.

PLATE 10. SPECIMEN NO. 7.



50 X

Gangue.............. Quartz

Metallic Minerals... Sphalerite.

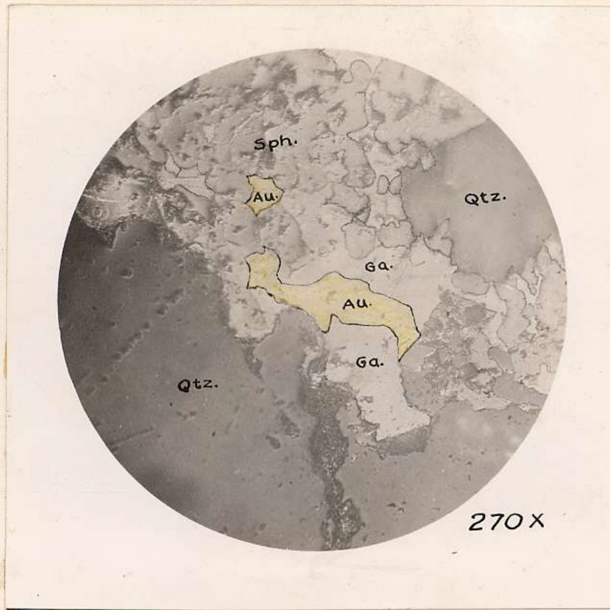
Galena

Gold

<u>Remarks</u>.

Gold intimately associated with the galena and sphalerite.

PLATE 11. SPECIMEN NO. 7.



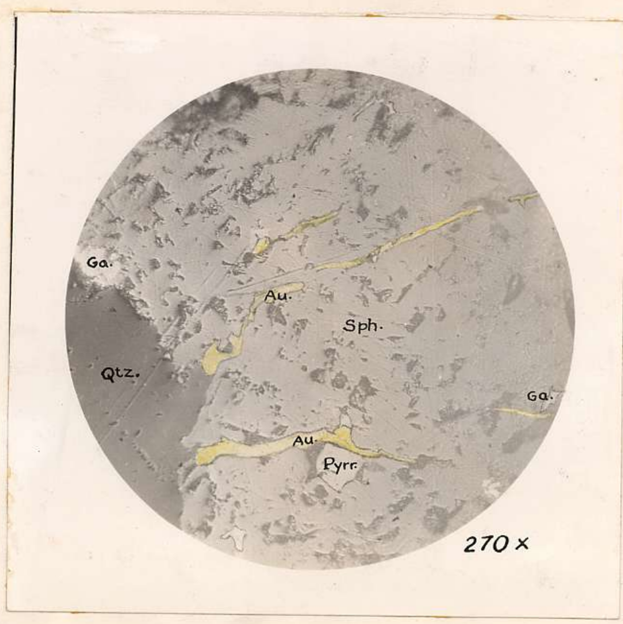

Qtz....Quartz
Pyrr...Pyrrhotite
Au.....Gold
Sph....Sphalerite
Ga.....Galena

Remarks.

Gold closely associated with sphalerite and galena.

Gold and galena probably contemperaneous.

PLATE 12. SPECIMEN NO. 7.




Remarks.

Gold veining sphalerite and pyrrhotite.

## X. CONCLUSION.

The gold in this ore occurs in the native state and is closely associated with galena and sphalerite, especially where these minerals border the quartz gangue. The amount of gold present seems to be directly proportional to the amount of galena present.

For a high recovery of gold the ore should be ground fairly fine since a considerable amount of the gold occurs almost microscopic in size. While part of the gold occurs as very fine particles, since it is associated with the softer sulphide minerals, galena and sphalerite, it should be freed relatively easily.

A portion of the gold is quite coarse (170 michrons) and should be caught easily on a blanket. The ore appears to be fairly suitable for amalgamation but cyanidation should give a much higher recovery due to its ability to seep through the grains of ore and dissolve the fine gold. Chalcopyrite (a cyanicide) does not occur in sufficient quantities to prevent the successful use of cyanidation. If the chalcopyrite content should increase it could easily be floated off, with a negligible loss of the gold, since the gold does not appear to associate with this mineral.

ACKNOWLEDGEMENT

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