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A MICROSCOPIC STUDY of GOLD ORE from the KING WILLIAM and ENTERPRISE Veins

Nicola Mines, B.C.

by

Robert B. McLellan

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Contents.

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Introduction

Location and Extent of the Mine.

The King William and Enterprise claims are included in a group of 26 claims belonging to the Nicola Mines and Metals Ltd.. Situated at Stump Lake, 30 miles from Merritt, properties are accessible by a good road branching off to the north from the Merritt-Kamloops highway which is about 2 miles distant. The main group lies on the western flank and the summit of Mineral Hill on the south-east shore of Stump Lake.

History and Development of the Mine.

Between 1882 and 1885, claims were staked on Mineral Hill and prior to 1890 several shafts were put down by the Nicola Mining and Milling Co. and the Star Mining Co.. The latter company also erected a small concentrating plant. Little further work was done on the ground until 1916 when the Donahue Mines Corporation built a mill and shipped out 62 tons of ore. Again in 1925 work was started on the Enterprise vein by the Planet

Mines and Reduction Co. of Nicola, Ltd.. The main developments were the entention of the shaft and a crosscut at the 320 ft. level and the erection of an 80 ton mill. From 17,000 tons of ore, only $1000,000 worth of gold was recovered owing to the low grade of ore in the upper part of the vein. Operations were again abandoned in 1931. Two years later the Nicola Mines and Metals Ltd. took up the development work. Operation since then has been continuous except for a few months in 1934-35.

Microscopic Study and Acknowledgements.

Previous microscopic studies of the ore from the Nicola mines have been made by the Department of Mines, Victoria. A detailed report is being prepared on the King William and Enterprise veins by Mr. E.J.W. Irish, a graduate student in geology. The present report is the result of a study performed in the winter months of 1939-40.

The writer wishes to acknowledge his indebtedness to the assistants of the Geology Department and to Dr. H.V. Warren whose valuable instruction and assistance made this work possible.

Bibliography.

In compiling this report, the following references were consulted:

Report of the B.C. Minister of Mines, 1931.

Contains an outline of the mine's development and gives several assays of the various veins.

Report of the B.C. Minister of Mines, 1933.

Contains a map of the veins and describes further development of the mine.

Report of the B.C. Minister of Mines, 1934.

Describes further development and gives the results of several assays.

Topography.

The properties lie in a region of sparsely wooded hills with drift-covered slopes and a relief of 300 ft.. Stump Lake, however, is locally flanked by rocky bluffs and is over 400 ft. below the summits in the region.

General Geology.

The general geology of the region is extremely simple. The rocks underlying the entire group of claims consist of greenstone of the Nicola formation. This is an andesitic rock usually fine grained and bright green in color, but locally it is coarser grained with a diabasic to dioritic texture. The rock is all chloritized but on the whole it is massive and only locally sheared. Occasional bands of tuff and bressia are included in this formation. The major structure is not known, but in the vicinity of the workings the greenstones are nearly vertical and strike about north-east.

Descriptive Geology of the Ore Deposit.

The claims cover a series of veins which occur as quartz fillings in the shear fracture zones in the regional diabase. Dark colored hornblende andesite dikes younger than the veins, and from a few inches to 7 or 8 feet in width, occur cutting and in some cases tending to follow the vein fissures.

Of the principal veins the strike varies between N. 45°W. and N. 25°E. and the dip varies from 45° E. to vertical. The vein at the Enterprise 320 foot level pinches and swells from 4 to 46 inches and averages probably 18 inches in width. To the north the vein bends off strike and to the south numerous faults offset the vein several feet.

The veins are usually accompanied by prominent alteration of the wall-rocks which are bleached and pyritized up to a maximum width of 15 feet but do not carry appreciable values. The quartz is white and vitreous and is mineralized irregularly with sulphides including pyrite, galena, sphalerite, tetrahedrite chalcopyrite and a small amount of bornite. These occur in segregations, thin seams, and disseminations which make up a usually low proportion of the veins. Gold and silver values are rudely proportional to the amount of sulphides in any one vein, but the sulphides vary in amount and proportion in different veins.

The King William vein strikes northerly and is almost vertical at the shaft where the quartz is 12 to 36 inches in width. Heavy drift makes prospecting difficult but this vein lines up well with the Enterprise and No Surrender veins.

The most important vein of the series is the Enterprise vein. Assuming that the King William is the same vein it is known to be 3300 feet long, of which 1500 feet have been developed.

Mine Sampling and Assays.

Certain sections of the Enterprise vein carried values of about .8 oz. of hold per ton as well as a small amounts of silver, lead, and copper. Other sections varied from 80¢ to $2.00 per ton so that in aggregate the ore is comparatively low grade.

Various levels in the vein yielded the following assays: On the 320-foot level, across 14 inches:

Gold, 0.30 oz. per ton; silver, 1.5 oz. per ton; lead, 0.5 per cent; zinc, 0.8 per cent.

On the 440-foot level, across 31 inches:

Gold, 0.01 oz. per ton; silver, 1.6 oz. per ton; lead, 1.5 per cent; zinc, 4.4 per cent.

On the 550-foot level, across 18 inches:

Gold, 0.12 oz. per ton; silver, 5.2 oz. per ton; lead, 3.5 per cent; zinc, 2.6 per cent.

The Suite of Ores.

The suite of ores from which the polished sections were made is comprised of samples obtained from the Nicola Mines by Dr. H.V. Warren in July, 1939.

Three of the samples studied are from the King William vein. These are No. 1, from 4N. 600 ft. crosscut, and Nos. 2 and 3 from the 675 ft. level, stopes 14 and 20. The other samples are taken from the Enterprise vein. No. 4 was located on the 800 ft. level N., stopes 13 and 16, while No. 5 was on the 900 ft. level S., stope 4.

Megascopic Description of the Specimens.

In general the specimens are composed of nearly equal amounts of quartz and sulphides. A definite zoning of minerals is a structural feature of some specimens, but others show an irregular distribution of sulphides and gangue minerals. These are some of the characteristics observed in the hand specimens. After the minerals have been identified a megascopic examination of the polished sections reveals the following general features.

Section No. 1.

This polished section is made up essentially of pyrite fragments in a ground mass of quartz and calcite. In the calcite portion the fragments are mostly small and scattered, while in the massive quartz area larger pyrite masses occur along with irregular particles of sphalerite and galena. The boundary between the quartz and calcite is well defined and fairly regular.

Section No. 2 (a).

Tetrahedrite, quartz and a silicate gangue mineral are equally abundant in this section. The boundary between the two last-named minerals is difficult to distinguish with the unaided eye, but the quartz area is quite definitely marked. Fragments of pyrite, sphalerite, and galena are scattered through the quartz, and calcite veinlets fill large fractures in several of the minerals.

Section No. 2 (b).

This polished section, cut from the same specimen of ore as was No. 2 (a) and only 2 inches away, shows a quite different structure and mineral assemblage. Masses of sphalerite and pyrite are separated by a band of galena. Isolated quartz areas are the only gangue mineral besides minute calcite veinlets.

Sections Nos. 3 (a & b).

A megascopic examination of the polished sections from sample No. 3 reveals irregular and scattered sulphides imbedded in massive quartz. Pyrite is the most prominent sulphide, but sphalerite and galena are also present.

Sections Nos. 4 (a & b)

The polished sections of this specimen from the Enterprise vein contain the sulphides: pyrite, sphaterite, galena, and chalcopyrite, irregularly distributed in the quartz gangue.

Sections Nos. 5 (a & b)

A band of massive pyrite enclosed between two areas of sphalerite is displayed in both of these sections. A zone of quartz in which fragments of the sulphides are abundant is also characteristic of this specimen.

Microscopic Description of the Specimens.

The mineral relationships, characteristic outlines, and other indications of the contemporaneous or sequential deposition of the minerals are outlined in the following description of the polished sections as observed under the microscope. The Roman numerals refer to the diagrams.

Section No. 1.

This polished section of ore from ths King William vein was the only one showing free gold visible under ordinary magnification. The particle measured about 50 microns in diameter. The section is divided almost equally into two parts, namely quartz and massive carbonate groundmasses. Pyrite and sphalerite bear similar relationships to the quartz mass (Fig. I) insofar as they are both imbedded in it as irregular fragments. Pyrite only, however, is scattered through the carbonate gangue (Fig. II) where it occurs mostly as fine remnant particles. Imbedded in one of these pyrite particles, the gold was observed. While the sphalerite generally follows the crystal outline of the pyrite forming regular lines of contact the quartz crosscuts both minerals. Every sphalerite area is dotted with particles of chalcopyrite. Stringers of Calcite cut across all other minerals present.

Section No. 2 (a).

Under the microscope this polished section shows an intimate relation between bornite and a silicate gangue mineral. Both of them enclose corroded remnants of pyrite which tends to be concentrated near the quartz areas. They are both extensively corroded by by quartz. Along many of the boundaries between these two minerals (Fig. III) are delicate rims of tetrahedrite.

Chalcopyrite is not abundant in this section, but small particles of it occur in the quartz and bornite. Galena and sphalerite are the only other sulphides observed. Galena is confined to one edge of the section where there are only a few angular patches of it in the quartz. Sphalerite is also fragmentary (Fig. IV) occurring in close association with pyrite remnants in the quartz. Calcite veinlets cut across the section regardless of mineral occurrence.

Section No. 2 (b).

This section Fig. V shows clearly the relations between the sulphides and the gangue minerals as well as between the sulphides themselves. Pyrite is extensively corroded by all other minerals. Large areas of sphalerite and quartz, as well as pyrite, contain veinlets and fracture fillings of galena and calcite, while small fragments of the three earlier minerals are enclosed in galena. In places, quartz occurs conformably with the crystal outline of pyrite crystals, but its contacts with the other minerals are always uneven. Calcite takes its usual place in this section as a filling for fractures in the whole rock.

Sections Nos. 3 (a & b).

The notable feature of this specimen is that galena and chalcopyrite occur with somewhat similar relationships to sphalerite. Both are included in it, (Fig. VII), but chalcopyrite is in some places formed around pyrite remnants in the sphalerite. Galena, as well as sphalerite, is present as larger masses in quartz and pyrite. The galena, however, forms veinlets in the quartz masses. Calcite (Fig. VI) fills many areas between the various minerals and has been responsible for much corrosion of the sulphides.

Sections Nos. 4 (a & b)

The same minerals occur in this specimen from the Enterprise vein as in specimen No. 3 from the King William vein. In general, the sulphides present consist of corroded crystals of pyrite and irregular masses of sphalerite (Fig. VIII) with galena and chalcopyrite veining their fractures and generally surrounding them. Chalcopyrite is the most common material to vein the pyrite. It also occurs in the sphalerite both as large corrosive tongues and as tiny inclusions. The inclusions persist throughout the sphalerite, and show a tendency to follow some crystallographic direction of the mineral.

Galena occurs in a similar manner to chalcopyrite inasmuch as large masses of it (Fig. IX) surround particles of pyrite, quartz, and sphalerite. Also, its boundaries with chalcopyrite are sometimes quite indefinite and are often interlocked as indicated in Fig. X.

Sections Nos. 5 (a & b).

As in other sections of this ore pyrite is present as corroded remnants among the other minerals. Sphalerite contains both irregularly disseminated blebs and regular streaks of chalcopyrite (Fig. XI). The streaks are oriented in three different directions in the same sphalerite crystal. Small inclusions of pyrite occur in a similar arrangement in the sphalerite, and where these are most abundant, no chalcopyrite is found.

Masses of galena shown in Fig. XII appear to separate and to vein irregular particles of pyrite, sphalerite, and quartz. The only other mineral in evidence is calcite which is present in the form of veinlets crosscutting the other minerals as well as filling gaps between them.

Summary of Microscopic Observations.

Gold.

The only gold observed in any of the polished sections was a tiny particle in section No. 1 of the King William ore. It was irregularly globular in shape, and measured about 200 microns in diameter. It occurred imbedded in a solid crystal of pyrite which was isolated from the other sulphides by a large area of calcite.

Pyrite.

This mineral is abundant in all of the ore samples from the property. In each of the polished sections it occurs as fractured and corroded masses and remnant particles, with various other minerals between them. The fractures are generally irregular and often filled with calcite. In several places rough crystal outlines of pyrite are discernible.

Tetrahedrite.

Tetrahedrite is observed only is section No. 2 (a) where it occurs as a delicate intergrowth graphically associated with bornite at its contact with the silicate gangue mineral.

Bornite.

This mineral occurs in the same section as the tetrahedrite, but was not observed in any of the others.

Similar to sphalerite in mineral relationships, this mineral encloses many particles of chalcopyrite and a few remnants of pyrite crystals.

Sphalerite.

Sphalerite is almost as plentiful as pyrite in these specimens. It is characteristically irregular in outline, and erratic in distribution. It occurs as large masses, stringers, and corroded remnants, almost invariably enclosimg blebs of chalcopyrite, and, in some specimens, galena and pyrite. In some cases, notably sections 5 (a & b), these inclusions are arranged in definite lines, presumably parallel to crystallographic directions of the sphalerite.

Chalcopyrite.

The close association of chalcopyrite inclusions in sphalerite as just described is the more common mode of occurrence of chalcopyrite in this ore. It is also associated with bornite. In section No. 4 (a) (Fig. VIII), it appears in a more massive form, similar to galena and as interstitial material between pyrite and sphalerite grains. In other places (Fig. VII), it can be seen developing around pyrite grains in sphalerite.

Galena.

This mineral is found in all of the sections examined except No. 1. Its distribution is quite erratic in these sections, but its relation to the other minerals is quite definite. In most cases it is associated with chalcopyrite, and in places it is included as tiny blebs in sphalerite.

Quartz.

Quartz is naturally the main gangue mineral of this ore, and large masses of it make up the greater part of the mineralized veins. In polished section it is commonly massive, but there are also euhedral crystals of it among the sulphides. Quartz veinlets and crosscutting relationships suggest more than one period of silicification.

Calcite.

Commonly associated with the later development of quartz, calcite forms the other abundant gangue mineral. Its usual mode of occurrence is in the form of veinlets and fracture fillings, but massive carbonate is important in some specimens as in No. 1.

Silicate.

The undetermined silicate mineral of section No. 2 (a) is intimately associated with bornite and tetrahedrite as well as with quartz. This association indicates the early development of the silicate mineral in the vein.

Paragenesis.

The mineral occurrences described above lead to the conclusion that in all probability the minerals present were deposited in the following general order:

Pyrite and Gold.
Quartz I and Silicate.
Bornite and Tetrahedrite.
Sphalerite and Chalcopyrite.
Galena.
Quartz II.
Calcite.

There is abundant evidence in the polished sections to support this conclusion. The earliest period of mineralization involved the formation of quartz veins carrying pyrite and small quantities of gold. That the quartz had not entirely solidified until after the pyrite had crystallized is indicated by the corroded aspect of the sulphide grains. Along with the quartz small amounts of a silicate mineral, and the sulphides bornite and tetrahedrite were also developed, forming graphic intergrowths as shown in Fig. III. That

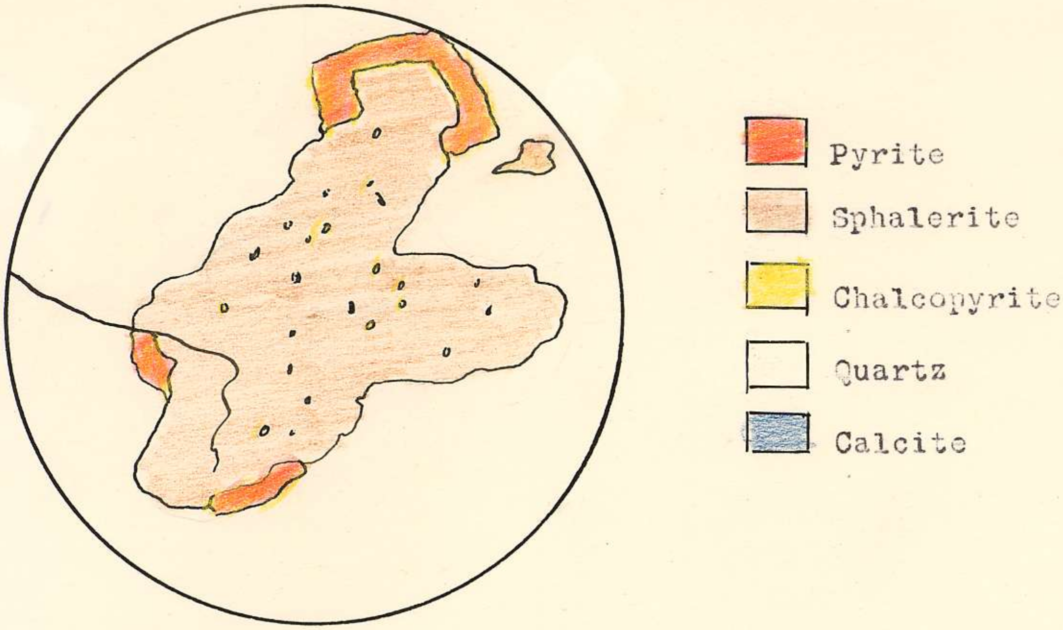
Sphalerite was introduced at some later period than the pyrite, is indicated by its pseudomorphous relationship to the earlier mineral in quartz, and by the remnant pyrite particles imbedded in it (Fig. XII). There is no evidence to show that sphalerite and bornite might not have formed during overlapping periods. It is very definite, however, that chalcopyrite and galena developed partly along with and partly later than the sphalerite. That Chalcopyrite is the more closely associated with this mineral is shown by its constant presence.

The presence of galena in localized zones and as interstitial veinlets among the other sulphides indicates that its injection followed certain fractures of the mineralized veins. The crosscutting relationship and the occasional well-developed crystal form of quartz indicates a further period of silicification. This development probably took place during a late stage in the formation of galena.

The final action of mineralizing solutions was the injection of calcite into the fractures and along zones of weakness in the ore body. This is strongly supported by evidence in each of the polished sections.

Conclusion.

From the paragenesis of minerals in these ore-bearing veins of the Nicola Mines, it is evident that the gold values of the veins are the result of an early phase of the mineralization process. There is no indication of the rearrangement or enrichment of gold in visible form since that time.

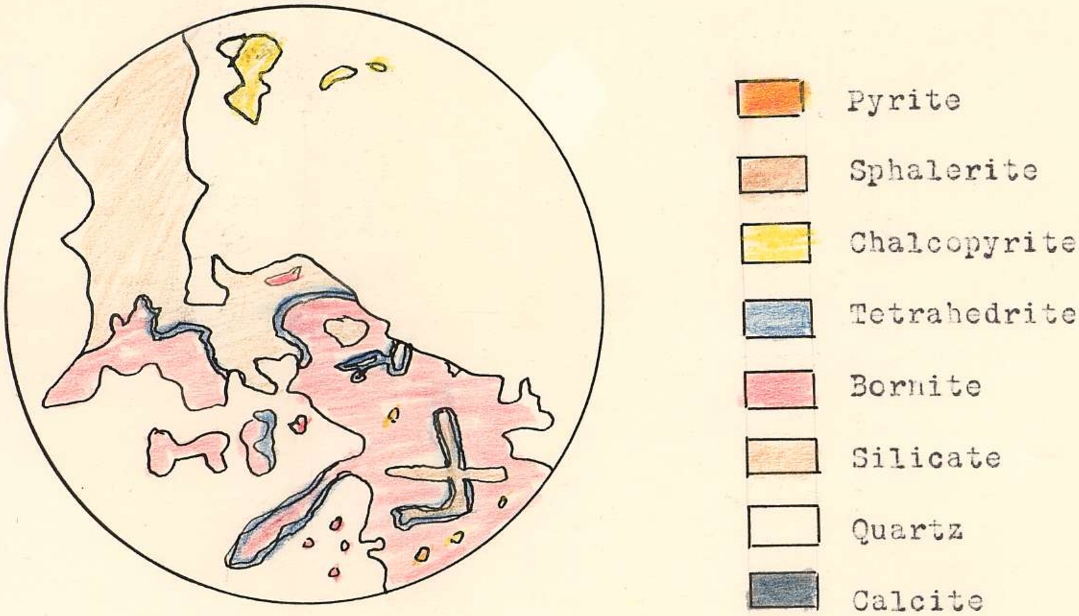


x40

Fig. I

x 40

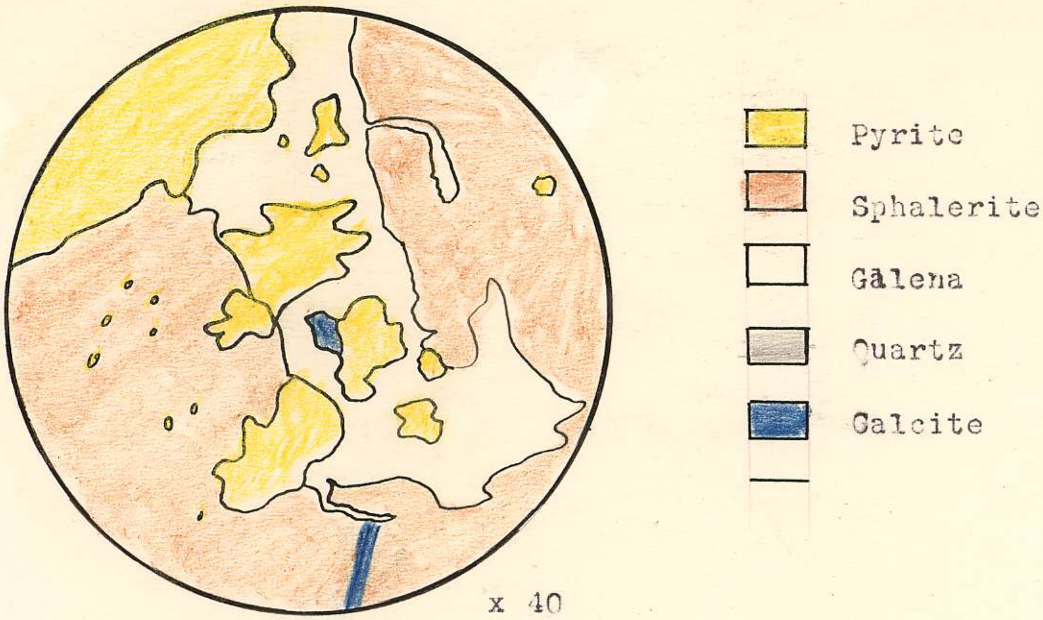
Fig. II



x 40

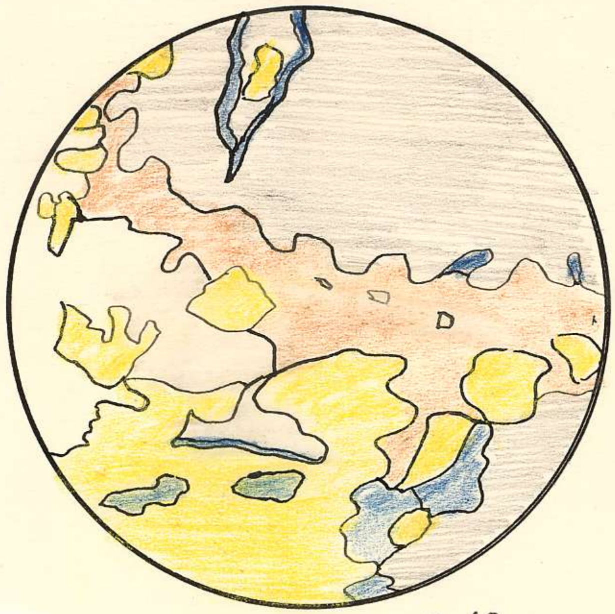
Fig. III

Fig. IV



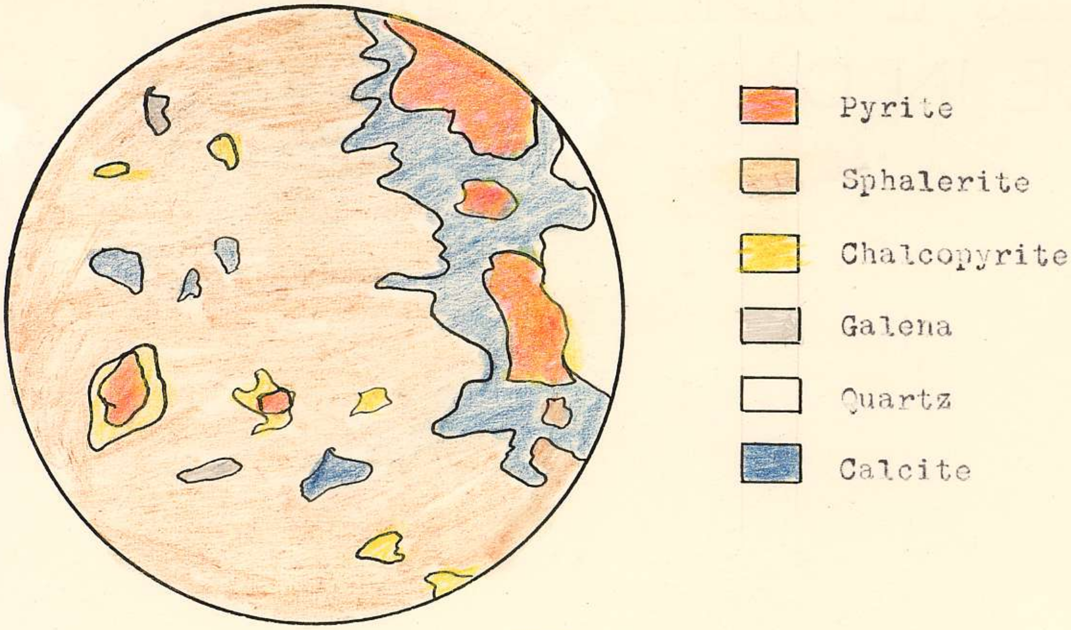
x 40

Fig. V



x 40

Fig. VI

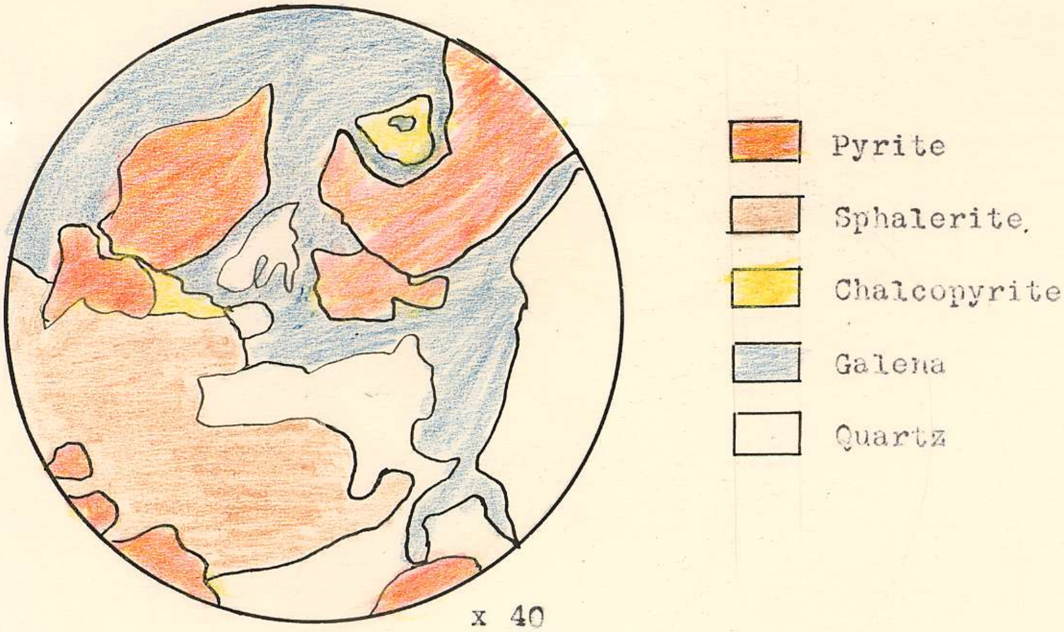


x 200

Fig. VII

x40

Fig. VIII



x 40

Fig. IX

x 60

Fig. X

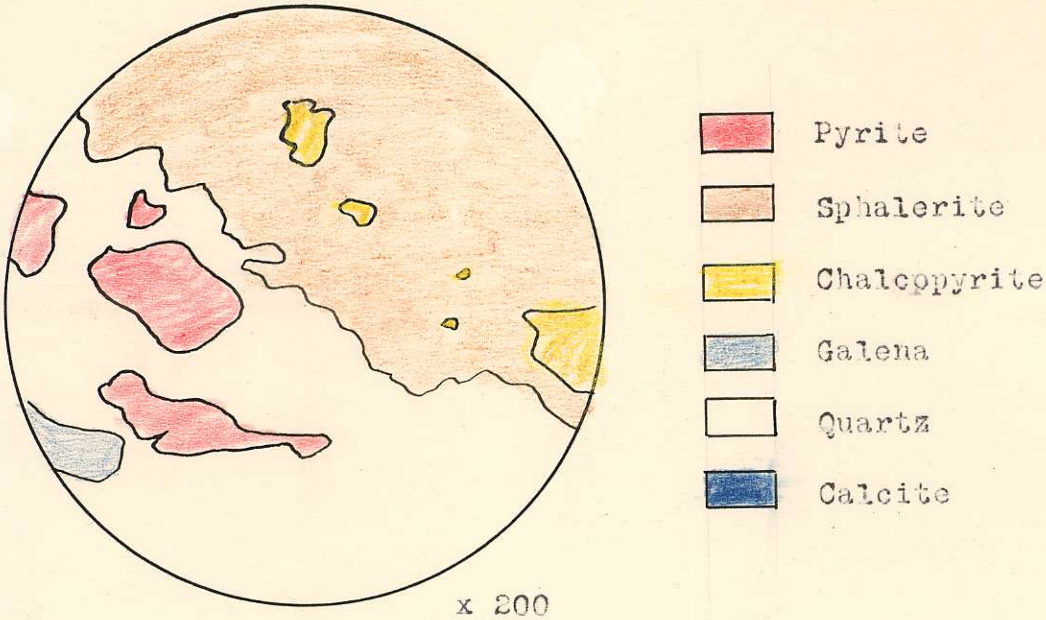


Fig. XI

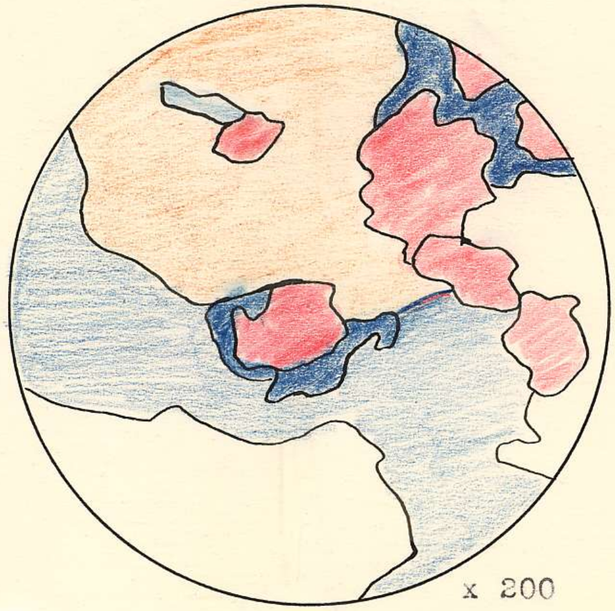


Fig. XII