No mention of unusual position of magnetite in order of deposition. HVW

40/50

A MICROSCOPIC STUDY OF A SUITE OF ORE FROM THE DIVIDEND-LAKEVIEW PROPERTY OSOYOOS, B. C.

An essay submitted in Geology 409, Department of Geology, University of British Columbia

M. M. MENZIES

April 1949

1st Class

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M. M. Menzies

April, 1949

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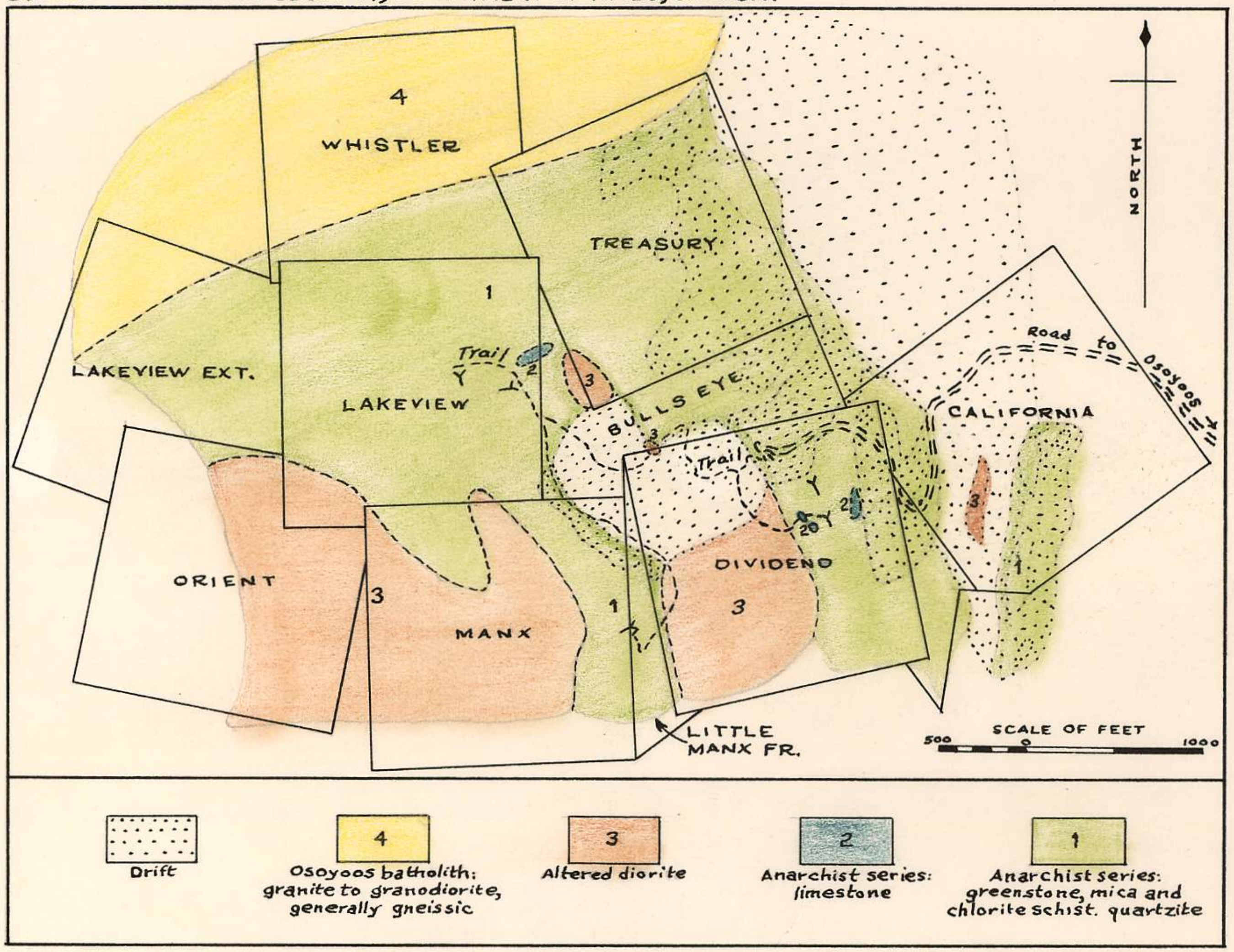
ILLUSTRATIONS

BUREAU OF ECONOMIC GEOLOGY, DEPARTMENT OF MINES, CANADA.



PUBLICATION NO. 2389

DIVIDEND-LAKEVIEW PROPERTY

SIMILKAMEEN DISTRICT, BRITISH COLUMBIA:

A MICROSCOPIC STUDY OF A SUITE OF ORE FROM THE DIVIDEND-LAKEVIEW PROPERTY OSOYOOS, B. C.

Introduction

The purpose of this report is to determine the minerals present in the suite of Dividend-Lakeview ore, to work out the probably paragenesis of the ore, and to find the minerals with which the gold is associated.

Location

(49 degrees north, 119 degrees west)

The Dividend-Lakeview property is located in the Southern Okanagan Valley, approximately 1 mile north of the International Boundary. A roadway joins the camp to the town of Osoyoos, 2 miles to the northeast. Osoyoos is served by the Southern Trans-Provincial Highway, a spur of the Canadian Pacific Railway, and a branch of the West Kootenay Power and Light Company, Limited, transmission line.

General Geology

The orebodies occur as irregular replacement and vein type deposits in the limestone and volcanics of the Kobau group. This group consists of micaceous quartzite, mica and chlorite schist, crystalline limestone, and greenstone. Diorite, possibly an intrusive phase of the greenstone, is abundant in the area. An irregular granitic body, gneissic in character, lies within a half mile of the various deposits. It trends in a northwesterly direction and is about 6 miles long by 1 mile wide. A larger body of syenite is exposed 2½ miles to the west.

References

W. E. Cockfield:

Lode gold deposits of Fairview Camp, Camp McKinney, and Vidette Lake Area, and the Dividend-Lakeview Property near Osoyoos, B. C., Memoir 179, G.S.C. 1935.

M. S. Hedley and K. DeP. Watson:

Lode-Gold Deposits, Central Southern British Columbia, Bulletin No. 20, Part 3, B. C. Department of Mines, 1945.

Mineralization

Megascopic Description of Specimens

Sample No. 3

This specimen is greenstone mineralized by indistinctly banded, medium-grained pyrite. Bands and stringers of calcite, up to ½ inch in width, occur throughout the sample. Small amounts of chalcopyrite are observed in calcite stringers on the fresh surface. The weathered face is characterized by rusty pyrite, and is stained in places by alteration copper minerals. Very fine-grained magnetite is abundant in the greenstone.

Sample No. 4

This specimen is similar to sample No. 3 but the mineralization is much lighter and the pyrite somewhat finer grained in places. Calcite occurs throughout the rock and is roughly banded. Very little chalcopyrite was observed in this specimen, even with the aid of a hand lense, but its presence is shown by a little copper stain on the weathered surface. Finely disseminated chalcopyrite was seen, however, in small pyrite chips. The greenstone has been largely altered, probably to chlorite, and shows a schistose structure under the hand lense. Fine-grained magnetite is abundant.

Sample No. 8

The ore is massive, fine-grained pyrite in a siliceous gangue. The gangue may be quartz but is more likely composed of garnet. Minute amounts of chalcopyrite and alteration copper minerals are present. Calcite is not readily observed but concentrated HCl produces a slight effervescence over most of the surface.

Sample No. 9

This specimen is heavily mineralized by pyrrhotite. Small amounts of pyrite occur throughout the sample but chalcopyrite was not observed. The characteristic copper stain, however, suggests that it is finely disseminated through the pyrrhotite. Substantial amounts of calcite are present in the ore, some of it showing distinct cleavage without the aid of the hand lense. Very fine bands of pyrite are found in the specimen. Some of the gangue is of a siliceous character.

Reported Assay Results

Sample No. 3

Au. 4.28 oz/ton   Ag. 0.96 oz/ton

Sample No. 4

Au. 2.56 oz/ton   Ag. 0.60 oz/ton

Sample No. 8

Au. 2.02 oz/ton   Ag. 0.30 oz/ton

Sample No. 9

Au. 0.94 oz/ton   Ag. 0.18 oz/ton

Conclusions Drawn from Reported Assay Results

Higher gold and silver assays were obtained from greenstone samples heavily mineralized by medium to coarse-grained pyrite. Sample No. 9, containing heavy pyrrhotite mineralization and siliceous gangue, was poorest in precious metal content. From the above data it would appear that the gold is not associated with pyrrhotite and the pyrite present may account for the values recorded. There is also a suggestion that the greenstone is a more favorable host-rock for the formation of coarser grained pyrite deposits and, therefore, of greater economic importance. Definite conclusions cannot be formed on the meager evidence available.

Microscopic Determination of Siliceous Wall Rock

Sample No. 8 - Description of Minerals Present

Garnet

The tightly packed crystals, probably grossularite, are normally subhedral, zoned, and birefringent. They are euhedrel when in contact with calcite and quartz, and subhedral to euhedral when in contact with amphibole.

Calcite

The calcite is interstitial to the garnet and also occurs as veins throughout the rock. Some veins show calcite crystals forming angles of about 30 degrees with the walls of the vein indicating late fracturing and deformation. In other veins calcite crystals are found lying parallel with the walls.

Chlorite

Chlorite is interstitial to the garnet and also occurs as veins in the rock. In places it is found associated with calcite in small fractures.

Quartz

Quartz is mainly interstitial te the garnet.

Amphibole

The amphibole is strongly pleochroic and shows excellent cleavage. It is probably hornblende.

Epidote

Epidote is interstitial to the garnet.

Relative Amounts of Minerals Present

Garnet	------	80%
Calcite	------	10%
Chlorite	------	5%
Amphibole	------	2%
Quartz	------	2%
Epidote	------	1%

Conclusions Drawn From Above Data

The wall rock represented by this thin section was originally a limestone. It may have been quite pure in character but a considerable quantity of chert probably was present. Metamorphism, with the possible introduction of silica and aluminum, resulted in the formation of a skarn rock. Only minor amounts of iron and magnesian minerals are present. Later fracturing and deformation of the rock is shown by the birefringent character of the garnet and the inclination of calcite crystals to the vein walls. The vein calcite may have been introduced into the skarn but more likely represents the calcium carbonate remaining after formation of the garnet.

(The thin section has been placed in the box of polished sections.)

Microscopic Description of Polished Sections

A total of six polished sections were prepared, two from sample No. 3, two from sample No. 4, one from sample No. 8, and one from sample No. 9. They are numbered 3a, 3b, 4a, 4b, 8 and 9 respectively.

Sample No. 3, Section No. 3a

This section is formed largely of massive pyrite with calcite gangue. The pyrite is fractured and veined by calcite showing that the calcite was introduced into the sulphide deposit. An abundance of long, slender magnetite crystals (Figure No. 3) are found throughout most of the calcite but it is difficult to distinguish between the two minerals unless the surface is etched. Small masses of chalcopyrite lie within the calcite and it also is observed veining the pyrite. Magnetite crystals cut these masses into angular fragments and are therefore younger. Tetrahedrite is a common mineral found in association with magnetite. Their relative ages are uncertain but tetrahedrite appears to be cut by the magnetite and, in places, small crystals are enclosed by chalcopyrite, (Figure No. 3). Bismuthinite is associated with chalcopyrite but also occurs in the calcite and broken pyrite crystals. One large, fractured crystal of arsenopyrite (Figure No. 2) is found in the section and is veined by calcite and chalcopyrite. Gold is observed in the pyrite (Figure No. 1) (photograph No. 1). Minor amounts of quartz or garnet are present.

Sample No. 3, Section No. 3b

This section is very similar to No. 3a. Photograph No. 2 clearly shows the cutting of chalcopyrite into angular fragments by magnetite crystals. The grouping of tetrahedrite, chalcopyrite, and magnetite within the vein of calcite is also evident.

Sample No. 4, Section No. 4a

Calcite, appearing black to the naked eye, is abundant in this section. Its colour is largely due to the abundance of magnetite, but chlorite minerals are probably present also. Tetrahedrite, and pyrite to a less marked degree, is finer grained than in sections 3a and 3b. Relationships of the various minerals are the same as in previous sections. (Figures No. 4 and 5).

Sample No. 4, Section No. 4b

This section is similar to No. 4a and need not be treated separately. It was prepared, along with section No. 3b, in an attempt to obtain a crystal of bismuthinite of sufficient size for x-ray determination.

Sample No. 8, Section No. 8

This section is largely composed of massive, fine-grained pyrite in a gangue of quartz or garnet. (Figure No. 6). Small blebs of chalcopyrite occur between the grain boundaries of the gangue mineral. Tetrahedrite, magnetite, and a few small crystals of pyrrhotite are also found. Calcite is almost entirely absent suggesting that its introduction, as noted in other sections, represents a separate, well defined period of mineralization.

Sample No. 9, Section No. 9

Massive pyrrhotite in a gangue of quartz or garnet forms most of the section. The pyrrhotite occurs along grain boundaries and fills fractures in the gangue mineral, (Figure No. 7). Although pyrrhotite is observed in contact with the pyrite their age relationship remains in doubt. The most striking observation made is that of some small chalcopyrite ex-solution bodies in pyrrhotite, (Figure No. 8), proving two periods of chalcopyrite mineralization. A little calcite and late-stage chalcopyrite is also present but no bismuthinite is found.

Determination of Minerals

The ore minerals were determined by etch reactions, polarization colours, and microchemistry tests. Flakes of bismuthinite, found only in specimens No.'s 3 and 4, proved too small for ordinary methods of determination and two samples were x-rayed.

Gangue minerals were determined in thin section.

Conclusions Drawn from the Study of Hand Specimens and Polished Sections

Minerals Identified

Ore Minerals

1. Pyrrhotite FeS_{1-x}

2.	Pyrite	FeS_2
3.	Arsenopyrite	$FeAsS$
4.	Gold	Au
5.	Tetrahedrite	$5Cu_2S.2(Cu,Fe)S.2Sb_2S_3$
6.	Bismuthinite	Bi_2S_3
7.	Chalcopyrite	$CuFeS_2$
8.	Magnetite	Fe_3O_4

Gangue Minerals

1.	Quartz or Garnet	SiO_2 or $Ca_3Al_2(SiO_4)_3$
2.	Calcite	$CaCO_3$
3.	Chlorite ?	Mg.Fe.Al.Hydrous Silicate

Probable Paragenesis of the Deposit

	1.	Pyrrhotite, with some unmixing of chalcopyrite.
Stage No. 1	2.	Pyrite
	3.	Arsenopyrite

Stage No. 2	4.	Calcite
	5.	Gold ✱

	6.	Tetrahedrite
Stage No. 3	7.	Bismuthinite
	8.	Chalcopyrite
	9.	Magnetite

✱ The relative position of gold in the order of deposition is uncertain. All unmistakable gold particles were observed in the pyrite and were apparently associated with fractures in the sulphide crystals.

Conclusions

Published reports on the Dividend-Lakeview property state that gold appears to be associated with arsenopyrite. While this may be true, only very minor amounts of the mineral were observed in the polished sections and the presence of gold was not detected. It is the view of the author that fracturing of the brittle sulphides controlled the deposition of the free gold. This would explain the low assay values received from pyrrhotite samples and the high values from samples of heavy pyrite mineralization. Both pyrite and arsenopyrite would obviously be amenable to this type of gold mineralization. Why.

Very minute crystals of gold are thought to be located in the calcite but definite proof of this was not obtained.

The largest particle of gold found measured 58 microns by 29 microns. Remaining particles were of considerably smaller size. The ore should be ground to at least minus 270 mesh in order to ensure recovery of the coarser gold. An economic milling process might well require a still finer grind.

Photograph No.I

Sample 3, Section 3b

Magnification I50x

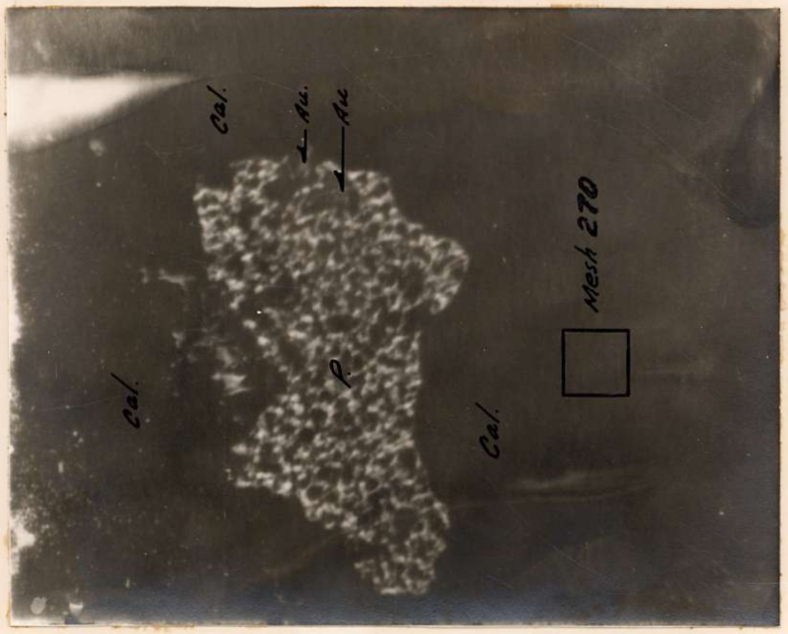
P --- Pyrite

C --- Chalcopyrite

T --- Tetrahedrite

M --- Magnetite

Cal - Calcite

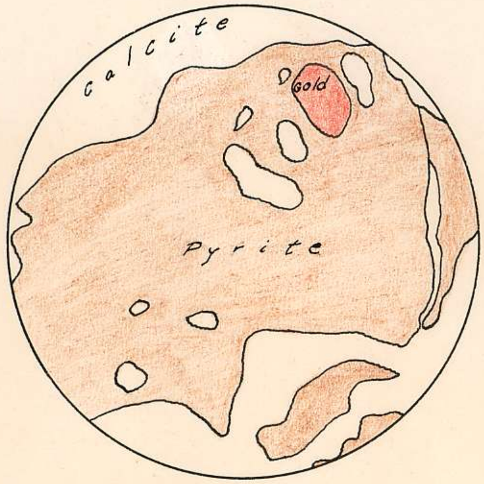


Photograph No.2

Sample 3, Section 3b

Magnification I50x

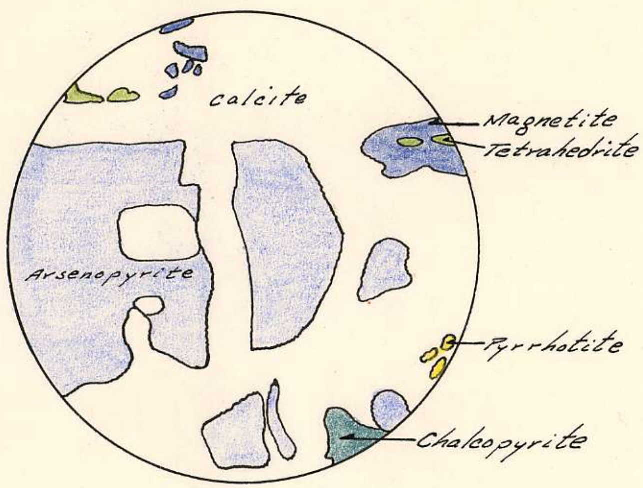
P ---	Pyrite
Au --	Gold
Cal -	Calcite



Sample 3, Section 3a

Figure No. I

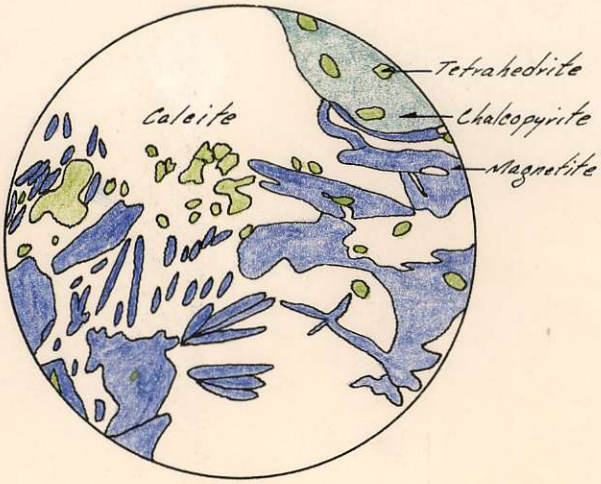
Diameter Imm.



Sample 3, Section 3a

Figure No. 2

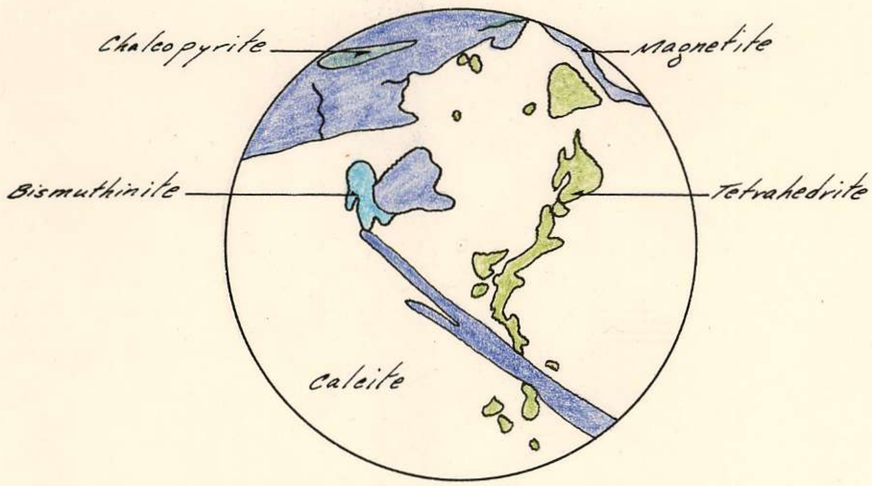
Diameter Imm.



Sample 3, Section 3a

Figure No.3

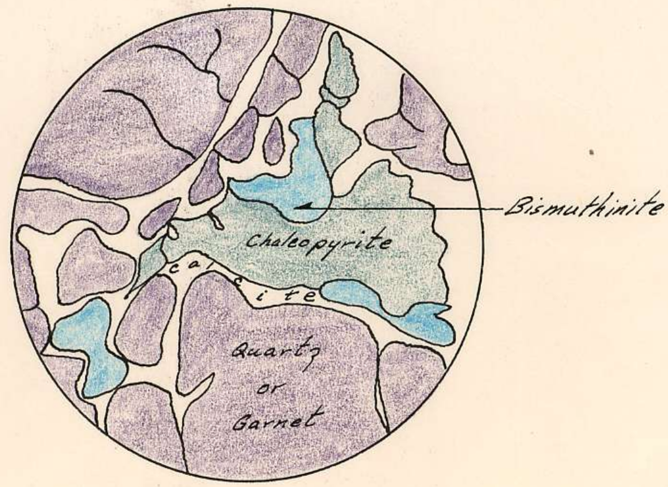
Diameter 465 microns



Sample 4, Section 4a

Figure No.4

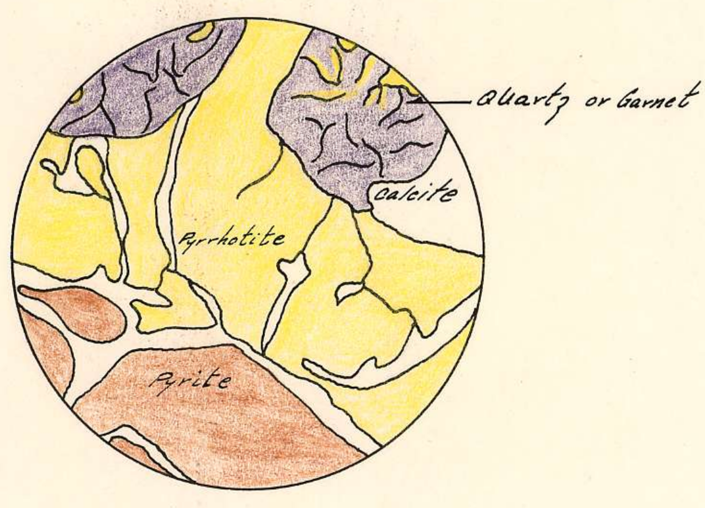
Diameter 465 microns



Sample 4, Section 4a

Figure No.5

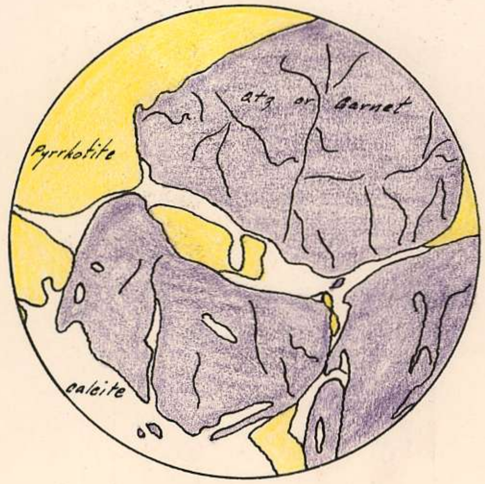
Diameter 465 microns



Sample 8, Section 8

Figure No.6

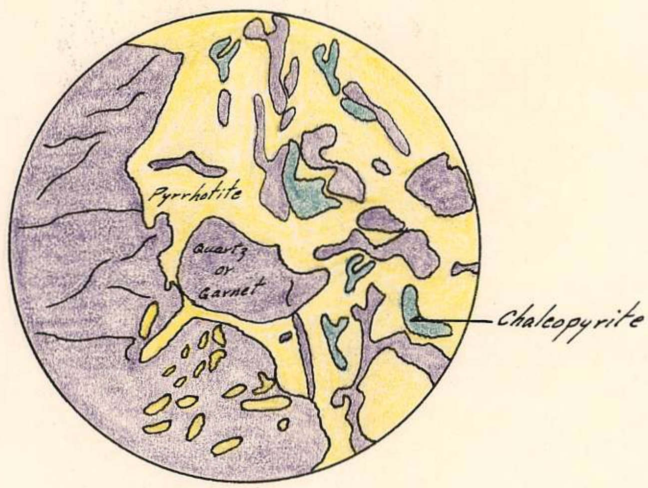
Diameter Imm.



Sample 9, Section 9

Figure No.7

Diameter Imm.



Sample 9, Section 9

Figure No.8

Diameter 465 microns