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A MICROSCOPIC EXAMINATION OF PRIVATEER GOLD ORE #3 VEIN.

GEOLOGY 409.

Poorly written

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CONTENTS

Abstract:

A laboratory examination of selected ore samples in polished sections, by means of the reflecting microscope.

Introduction:

This report is respectfully submitted in partial fulfillment of the Geology (409) course at the University of B.C.

The purpose of this report is to establish as far as is possible the mineralogy and paragenesis of the ore minerals, with particular reference as to the nature and occurence of the gold. All sections studied were prepared from a sample taken along the #3 vein of the Privateer mine.

Acknowledgement:

I wish to acknowledge the technical assistance and friendly advice offered by the following members of the staff; Dr. R.M. Thompson, Dr. H.C. Gunning, Dr. H.V. Warren, Mr. J. Fyles and Mr. J. Donnan.

General Information

Location:

The Privateer mine is situated on the west coast of Vancouver Island B.C. at the head of Zeballos arm. The mining claims are in the Clayoquot Mining Division.

The mine may be reached in one and a half hours by airplane from Vancouver B.C. An alternative route is by C.P.R. steamship from Victoria to Ceepeecee and thence by motor launch to the head of Zeballos arm, this journey taking about two days.

General Geology:

Briefly the geology of the area is as follows; The Privateer veins lie outside the southwest contact of the quartz diorite mass forming the Zeballos batholith; they are in a band of hard, brittle hornfels intruded by dykes and irregular bodies of the diorite. This band of hornfelsic rock follows a sinuous northerly course, bordered on the east by the intrusive contact, and on the west passing gradationally into less altered volcanic rocks of the Vancouver group. The bedded rocks are essentially vertical with the veins cutting through the silicated rocks almost at right angles to the bedding. The veins are the result of fissure filling by ascending hydrothermal waters containing characteristic high temperature sulphides in solution.

Megascopic Examination:

The following minerals were identified in the ore by means of the binocular microscope; Pyrite, arsenopyrite sphalerite, chalcopyrite, pyrrhotite,and galena. The gangue consisted of mainly quartz and calcite with locally rather abundant sericite in small shears within the ore.

Coarse banding in the ore is a rather prominent feature with the bands arranged in the following order; Quartz, arsenopyrite, sphalerite, arsenopyrite, quartz, sphalerite, chalcopyrite and pyrrhotite. The banding may be caused by either successive deposition, ribboning, or by a delicately changing phase of the mineralizing solution. Subsequent investigation has led me to believe that a combination of fracturing during deposition and a change in phase of the solutions has been the cause of the banding. No gold was noted during the megascopic study.

Microscopic Examination:

In addition to the minerals listed under megascopic examination the following were observed; Native gold and a rather strange occurence of magnetite and hematite. A detailed description of the individual minerals is as follows, in order of their relative abundance in polished section.

Chalcopyrite:

Recognized by its brass yellow color, C hardness and brittle nature, weakly anisotropic and by the positive etch with HNO_3 and aqua regia. The chalcopyrite appears in the massive variety exhibiting mutual boundaries with the sphalerite, also disseminated in blebs along the grain boundaries of the sphalerite. Chalcopyrite is intimately associated with the gold, an x-ray of a mineral at first believed to be millerite proved only the presence of gold and chalcopyrite and may have been a very intimate mixture of the two minerals.

Sphalerite:

Color bluish grey, soft with a peculiar manner of forming a depression when scratched with a needle. The resinous internal reflection is quite distinctive of this mineral. Sphalerite is abundant and massive in the section and its cleavage planes act as a host for other sulphides namely chalcopyrite, pyrrhotite and a great deal of gold.

Pyrrhotite:

Color creamy with a tinge of pink, hardness D-brittle, this mineral was positively identified by its anisotropic colors, the polarization colors range from bluish grey to brown and are rather irregular. When scratched with a needle particles of the mineral will adhere to the needle due to its magnetic properties. This mineral occurs in the massive variety and as scattered grains replacing the other sulphides, it may also be found oriented along the cleavage planes of the sphalerite. In section 5 pyrrhotite appeared in juxtaposition with the gold in almost every instance, and smooth even boundaries existed between the two minerals.

Pyrite:

Recognized by its pale brass yellow color and the fact that it can barely be scratched with a needle under heavy pressure. It is isotropic and has a positive etch with HNO_3 and there is also slight effervesence. The pyrite occurs as distinct crystals, as a highly fractured massive variety, and as rims about grains of chalcopyrite and pyrrhotite both of which replace the pyrite. Pyrite occurs fairly early in the sequence of mineralization.

Arsenopyrite:

This mineral has a silvery white color, cannot be scratched and has prominent polarization colors, a characteristic etch with HNO_3 produces slow effervesence and the mineral stains differentially iridescent. The arsenopyrite occurs as distinct diamond shaped crystals in the quartz, in aggregates of crystals forming bands, and as rims about the pyrite which is replacing it.

Galena:

Galena only appears in very minor amounts in the polished sections, it appears as a light grey mineral, and was observed veining the chalcopyrite in a minor way. The grain of galena was so small that a microchemical test for lead was applied, with positive results. The fact that gold might occur in the cleavage planes of the galena was taken into account and a microchemical test for gold was made using pyridine bromide as a reagent, the results were negative.

but with negative results.

Gold:

Gold was recognized by the orange yellow color, by its softness and sectility, and also by the peculiar texture of the mineral, it has a roughened surface. The native gold occurs in three ways, the main occurence appears to be along fractures in the sphalerite where it appears in juxtaposition with pyrrhotite. It may also be found locked in grains of chalcopyrite, and lastly in fractures in the quartz.

English punctuation!

The average grain size of the gold is less than 200 mesh,varying from .015 mm. to a maximum of .15 mm.

The factors governing the deposition of the gold appear to have been highly selective, out of a total of ten polished sections gold was observed in only two, and in section 5 the native gold was very abundant. The fact that the gold was observed only in super-polished sections may perhaps indicate plucking from the hand polished sections.

Period

Magnetite and Hematite:

These two minerals are grouped together because of their peculiar manner of occurence, and the minute size of the grains.

Magnetite was identified by the dark grey color, the flexible hardness and the fact that the powder was distinctly magnetic.

Hematite appears as a lighter grey replacement of the magnetite,could not be scratched, and gave a red internal reflection.

The two minerals appeared together as small rossetes in pyrite which had been almost entirely replaced by pyrrhotite. Apparently the laths of magnetite were deposited during an early stage of mineralization under oxidizing conditions, the hematite then started to replace it from the outside of the laths. Pyrite was introduced in the fluids and surrounded the oxides cooling rather quickly in the massive state. The pyrite acted as a buffer against the reducing action of the later pyrrhotite and thus preserved the oxides. The fact that there are oxides present indicates that the very early phase of mineralization was vastly different to the later ore-producing stage. No microchemical test was made on the above minerals as the association of other iron minerals would have made such a test superfluous.

Gangue minerals:

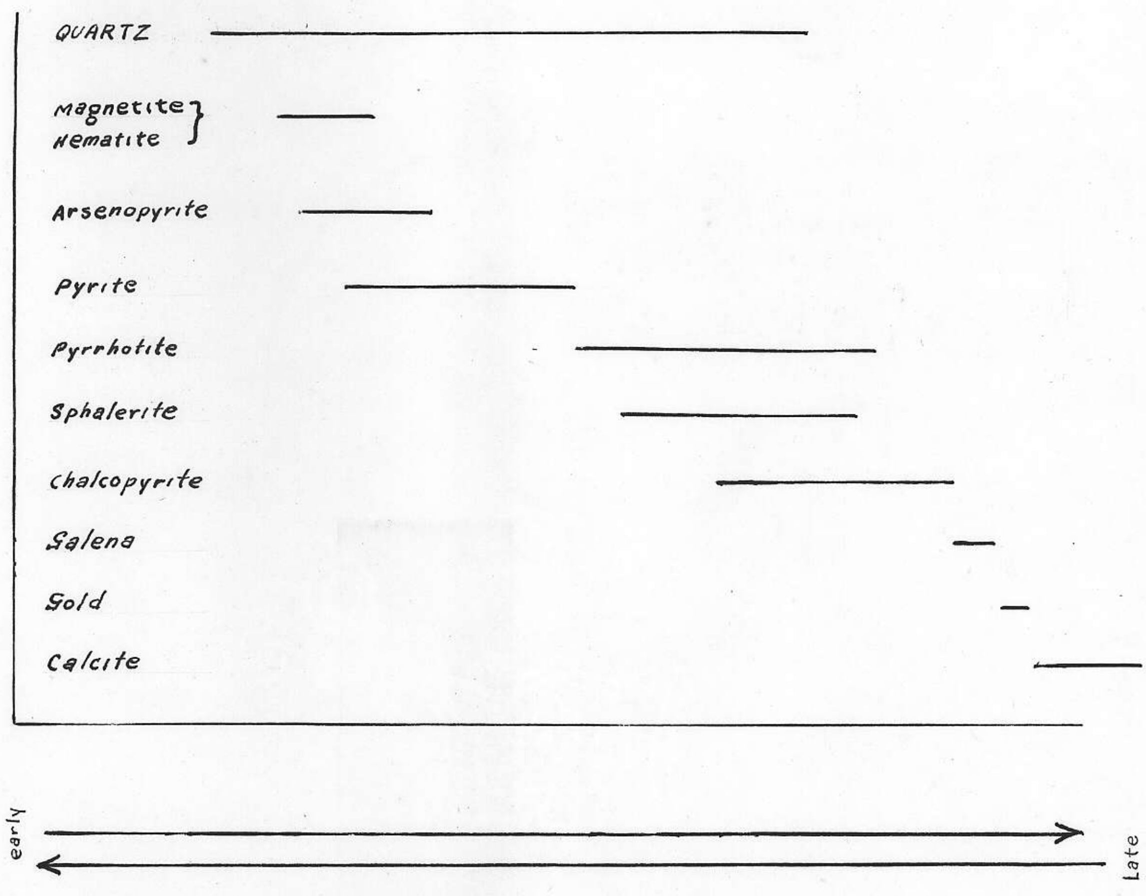
Quartz appears in a variety of grain shapes varying from euhedral to massive, and as veinlets cutting earlier grains.

Calcite forms a few rhombs but its main occurence is in veinlets cutting all other minerals.

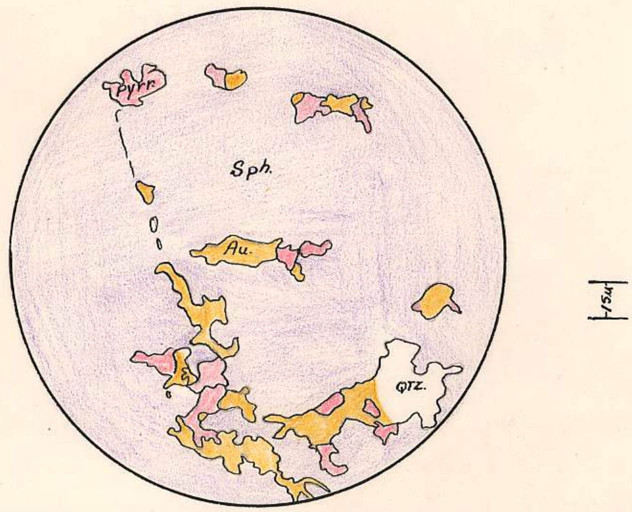
Sericite formed along planes of minor shearing which are quite well developed right within the ore.

Paragenesis:

Quartz appeared first and continued throughout the mineralization, although less abundant during the later stages. Minor amounts of magnetite and hematite accompanied the early silicification closely followed by arsenopyrite and pyrite. The arsenopyrite overlapping the pyritization to some extent. Pyrrhotite, sphalerite, and chalcopyrite followed in that order; the last named minerals exhibited considerable overlap and contemporaneous deposition. Native gold was deposited next followed by minor galena. The last stage was the calcite.

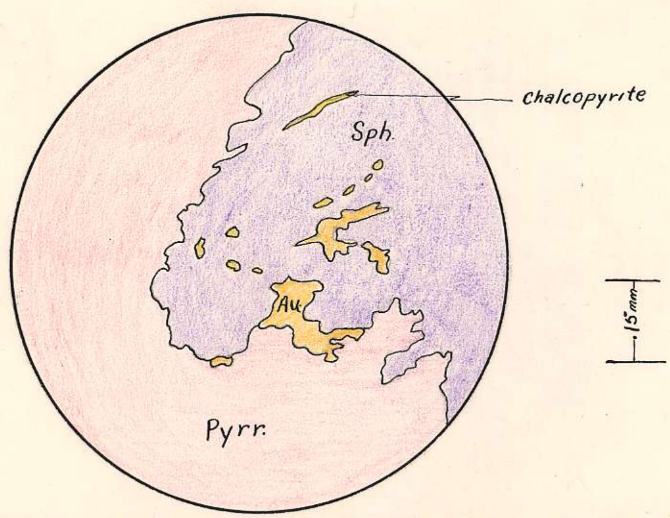


Section #5.



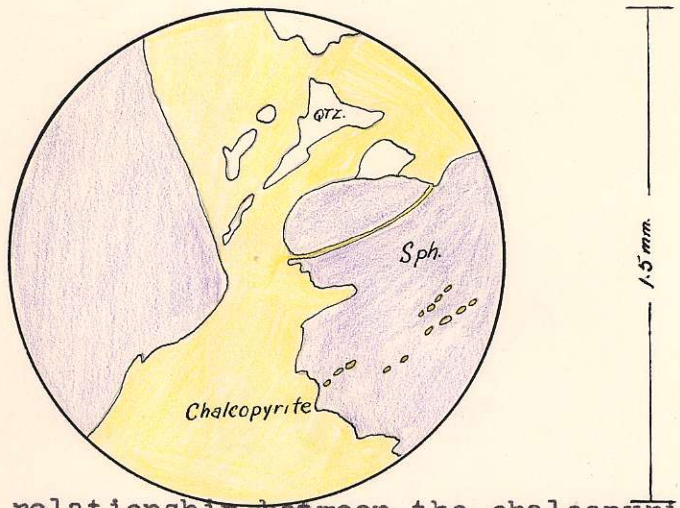
Caries texture, with gold and pyrrhotite along fractures in the sphalerite.

Section #5.



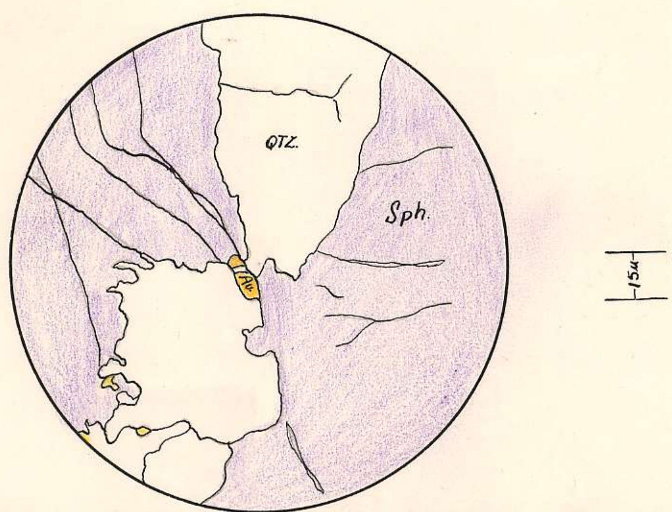
The gold appears to be replacing both the sphalerite and the pyrrhotite.

Section #2.



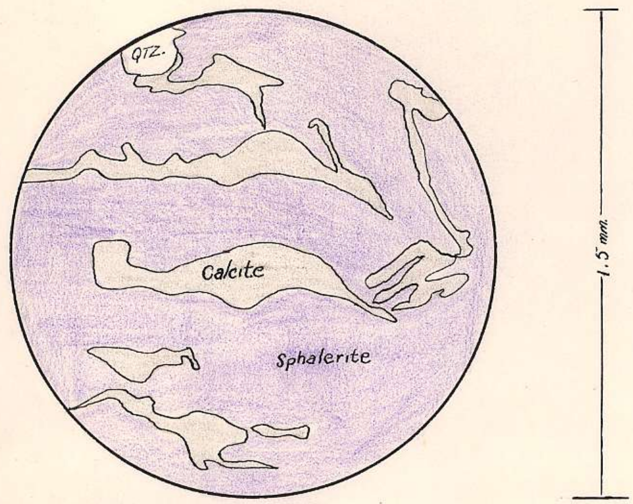
Mutual boundary relationship between the chalcopyrite and the sphalerite. Replacement of the quartz by chalcopyrite.

Section #5.



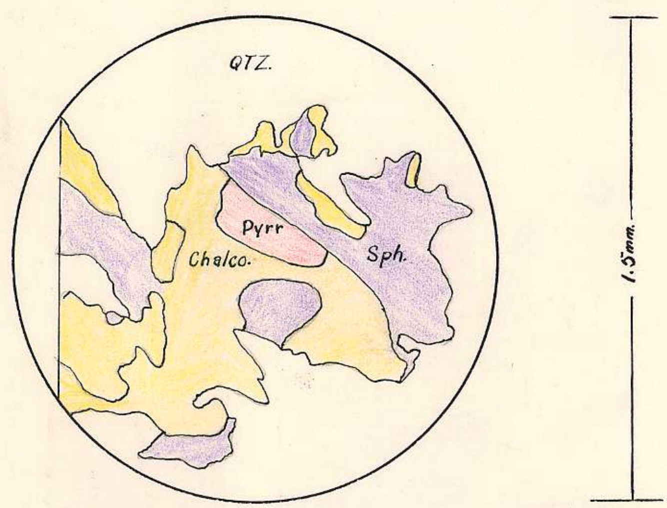
Native gold along a fracture in the quartz, the grain of quartz is being replaced by the sphalerite.

Section #3.



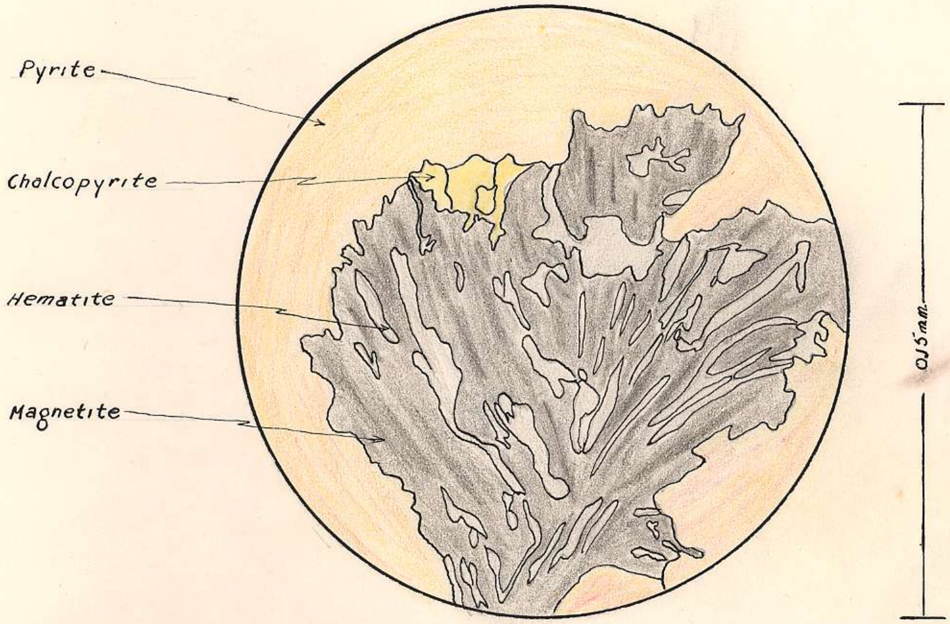
Calcite veining the sphalerite.

Section #2.



Mutual boundary relationships between chalcopyrite, sphalerite and pyrrhotite.

Section #7.



Hematite replacing magnetite laths, chalcopyrite is also replacing magnetite. ?

Sequence of events:

1. Metamorphism of the Vancouver group of sediments and volcanics resulting in their increased competency.
2. Faulting with formation of the major vein fissures.
3. Silicification.
4. Further movement along the fault produces fractures in the quartz.
5. Pyritization.
6. Shearing and the introduction of more quartz.
7. Introduction of the main sulphides.
8. Native gold introduced.
9. Minor shearing,and sericitization.
10. Introduction of calcite.

Conclusion:

The minerals forming the ore appear to have been precipitated from weakly acid to neutral high temperature ascending hydrothermal solutions. Apart from arsenopyrite and pyrite the remaining sulphides most probably were deposited from a delicately changing phase of the ore forming fluid, and conditions favoring the deposition of an individual mineral were dependant on the concentration of the mineral in solution rather than on its temperature of formation. The native gold favors small fractures in the sulphides and in the quartz, sphalerite by reason of its numerous cleavage planes is most compatible to the gold.

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