# A Mineralographic Report on the Ag-Pb-Zn Deposits of Silver Island.

by

Robert H. Luning.

Geol 409.

April 1961.

A B S T R A C T

The Ag - Pb - Zn deposit of Silver Island occur in small irregular veins, 2" to 5' wide, filling shear and fracture zones. The veins lie at the contact of a Tertiary Rhyolite with a Topley diorite body. The rocks in which this deposit occur have been much carbonatized and silicified. The chief ore mineral is tetrahedrite containing a high proportion of silver and minor amounts of ruby silver including sphalerite with a little galena. The gangue is an ankeritic carbonate with quartz and barite. Very little surface oxidation is in evidence and is represented by malachite, azurite and a little limonite occurring in negligible amounts. The origin of the deposit is probably related to the rhyolitic outcropping and faults, shear and fracture zones which have provided channelways for the mineralizing solutions.
The mineralographic study of the ore deposits shows that chalcopyrite and sphalerite were the earliest minerals followed by the introduction of tetrahedrite with chalcopyrite unmixing on cooling. Residual mineralizing solutions containing antimony and silver presumably reacted with the tetrahedrite forming intimate intergrowths of polybasite with some replacement of chalcopyrite. Argentite formed at an even lower temperature with some replacement by covellite. Oxidation followed with the formation of hydrous copper carbonates.
The mineral assemblage points this deposit as an intermediate type (mesothermal) with a temperature of deposition ranging between $500^{\circ}$ - $250^{\circ}C$.

# The Ag-Pb-Zn deposits of Silver Island, Babine Lake.

## INTRODUCTION.

### Location and accessibility.

Babine Lake is situated in the Fort St.James map area which is located in east central British Columbia. The nearest settlements are the villages of Fort St. James, VanderHoof and Burns Lake including smaller settlements and Indian villages. The closest village to Babine Lake is Burns Lake, which is a station on the C.N.R. 317 miles east of Prince Rupert. From the village a good motor road and trails lead over a distance of about 28 miles to Babine Lake. Small boats are frequently used during the summer season for the transportation of supplies and much of the area that cannot be reached by road or water is provided with good trails over which pack horses can be taken and an aeroplane base is maintained at Fort St. James by the Central British Columbia Airways.

### Climate and Vegetation.

Winters in the area are cold and summers are mild with rather abrupt seasonal changes. Annual temperatures may range from a maximum of about 100$^{o}$F to a minimum of -60$^{o}$F. However, it is only rarely that summer temperatures exceed 80 degrees, and in the winter sub-zero temperatures seldom persist for more than a week at a time. Winter weather generally commences about the first week of November although in the mountains snow may fall earlier. Spring usually occurs on the larger lakes by the end of April, but snow does not leave the higher areas until early June. Summer frosts are common in the higher areas.

The abundant trees are white spruce, black spruce, lodge-pole pine, alpine fir and aspen. Willow and ground birch are common and makes travel difficult. The timber-line is around 5,000 ft above sealevel. Large expanses of forest have been burned over and are now a tangle of fallen trees. In other places the forest is over-mature with resultant windfalls.

## Local geology

The oldest rocks in the area are represented in the Wolverine complex which consists of Late Proterozoic and Lower Cambrian sedimentary strata that were partly granitized in post-Lower Cambrian time.

Apparently the Fort St. James map area was a landmass during most of middle Cambrian to Pennsylvanian time, but, commencing in the latter period and extending into at least mid-Permian time, a thick succession of steeply folded and intensely faulted sedimentary and volcanic rocks were laid down which now outcrops along two wide belts that traverse the map area from northwest to southeast.

Upper Triassic and Jurassic volcanic and sedimentary rocks occupy a large belt that cuts diagonally across the map area and are much folded and faulted.

Conglomerate and associated continental sedimentary strata of Upper Cretaceous and Paleocene age are found at widely seperated localities and in the south they are interlain with rhyolitic and related volcanic rocks. Following the deposition, the strata were subjected to widespread faulting and folding which probably were formed at the same time as the faults along the Rocky Mountain Trench.

Several small areas of Eocene or Oligocene sedimentary and minor rhyolitic rocks are exposed and unconformably above these are sveral thousand feet of nearly horizontal amygdaloidal and vesicular lava flows of a somewhat later age.

A mantle of glacial drift covers much of the map area.[1]

## Silver Island.

The Silver Island Mining Company, now defunct, owned eight mineral claims, of which one, the Silver Island, covers the surface of the island of the same name, two others lie beneath Babine Lake, and the remaining five occur on the south side of the lake. The island is about 3,000 ft from the south shore and 10 miles from the east end of Babine Lake. The island is about 1,300 ft long, 750 ft wide and has an elevation of 135 ft above the lake level.

All the showings and the workings are on the island. The veins were dveloped by surface stripping and two drift adits from lake-level immediately above the high water mark.No active work has been done on this property since the late twenties.

## Geology of Silver Island.

Silver Island is underlain by a dark green,hornblende diorite and a light-coloured rhyolitic intrusion. This rhyolite occurs as a stock cutting the diorite, which is also intersected by numerous stringers of calcite.

The mineral deposits occur as fissure veins from 1 to 6 inches wide, striking north 60 degrees west and dip about 45 degrees southwest.

---

1. Geol. Survey Mem 252. J.E. Armstrong. 1949.


LEGEND
andesites, basalts, rhyolite
rhyolite and related tuffs
muscovite granite
augite, hornblende diorite
brown porphyritic soda syenite
drift covered.
Road
54°45'N
54°30'N
54°15'N
Babine Lake
Cunningham Lake
Silver
Island
Augier Lake
Pinkut Lake
Taltapin Lake
Burns
Lake
Burns Lake

The Silver Island collection consists of about 25 handspecimens with several thin sections and 5 polished sections.

Part 1.

Examination of 4 handspecimens with thin sections.

Specimen A.

Megascopic. About 50% of the rock is composed of calcite and the remainder, which is probably a part of the wall-rock, is a fine grained, black rock and is somewhat magnetic.
A re-polishing of the surface showed magnetite with several calcite and quartz stringers, including some interstitial pyrite and arsenopyrite.

Microscopic. The slide consists of calcite which shows an excellent rhombohedral cleavage with twinning lamellae. A small vein of secondary calcite (dolomite?) cuts through the calcite and large anhedral crystals of quartz are found to lie between the calcite crystals as well as in a fine carbonate matrix.
The magnetite is traversed by veinlets of calcite and includes a few quartz fragments. Much of the quartz appears to have been broken and fragments are found which lie enclosed by the calcite.

Specimen B.

Megascopic. The specimen is mineralized with a coating of malachite and some limonite occurs in a few weathered pits. Small veinlets of chalcopyrite and ruby silver occupy a brecciated zone. The gangue consists of quartz and carbonate mineral.

Microscopic. (Two thin sections.)

1. The section shows a fine grained carbonate/quartz mesh with coarse quartz crystals enclosing and projecting into an isotropic mineral. Some minor interstitial calcite fragments.

2. Mainly carbonate mineral with interstitial quartz. Some of the carbonate sections show good cleavage with high birefringent colours and is probably calcite. A little hornblende is present as well.

Specimen C.

Megascopic. The rock is leucocratic, aphanitic with a pitted surface. It appears quite altered.

Microscopic. Quartz and carbonate are again the main constituents. The carbonate mineral is somewhat pleochroic under plain light and has a good rhombohedral cleavage. It has a high birefringence and is uniaxial negative. This may be ankerite as reported by Armstrong in his memoir[2].

Specimen D.

Megascopic. Aphanitic, leucocratic and quite heavy. It consists mainly of carbonate, some quartz and numerous crystalline barite (good 001 cleavage).

Microscopic. The thin section consists mainly of carbonate with interstitial patches of quartz. Barite is identified by the cleavage, optic angle and moderate relief.

SUMMARY. Under the microscope, the carbonate-quartz rocks are seen to be composed of about 50% calcite as coarse and fine grains, 40% quartz with the remainder as fine mafic minerals. The study of these four rocks, has revealed that the ore deposits lie in a carbonatized and silicified zone which has suffered some shearing and that the chief gangue minerals are calcite, ankerite barite and quartz.

---

2. G.S.C. Memoir 252, page 174.

PART 2. MEGASCOPIC EXAMINATION OF 8 HANDSPECIMENS.

1. The rock consists mainly of carbonate, some of which is well crystallized as bladed aggregates. The mineralization is confined to sparsely disseminated chalcopyrite with associated tetrahedrite and some tiny quartz crystals. "boxwork texture"

2. The rock consists of a well defined white vein of calcite, 1½ cm wide, which contains a few vugs into which well formed calcite crystals project. The remainder of the rock consists of a greenish-grey carbonate, containing sparsely disseminated pyrite crystals. The mineralization occurs in a zone about 1 cm wide. It consists of tetrahedrite having a distinct brownish streak/Check and is accompanied by a soft, metallic grey, very sectile mineral which appears to be argentite. Sparse disseminations of chalcopyrite occurs in the mineralized areas as well as some grains in the gangue.

3. The specimen is coarse grained with mainly carbonate gangue but contains oval inclusions about 3-4 cm long which is probably of volcanic origin. The carbonate gangue is well crystallized and in several places euhedral to subhedral crystals of calcite are present. The mineralization is confined to the carbonate portions and consists of rounded grains of tetrahedrite and interstitial chalcopyrite, the latter also occurring in the groundmass.

4. The groundmass consists of clear quartz and carbonate crystals coloured brown in places due to iron impurities. Surface oxidation is present in the form of malachite which coats calcite as a thin film. The mineralization is confined to tetrahedrite and chalcopyrite.

5. In the carbonate groundmass there are tiny,pale yellow to light brown crystals of sphalerite having a lustrous appearance. Other mineralization is confined to some crystals of barite and a few specks of chalcopyrite.

6. The main feature of the specimen is the surface coating of azurite which occurs as pale to deep blue masses. The carbonate mineral is found to contain purple patches and this is probably due to impurities.

7. MEGASCOPIC EXAMINATION OF POLISHED SURFACES:

Tetrahedrite occurs as irregular grains in a quartz carbonate groundmass, partly rimmed by chalcopyrite. The latter is also found as inclusions in the tetrahedrite as well as in the gangue. Fracture fillings are conspicuous and are occupied by chalcopyrite and tetrahedrite. Light coloured patches in tetrahedrite appear to be polybasite.

8. Tetrahedrite and chalcopyrite are the main constituents. Some sphalerite and polybasite are found partly enclosed by tetrahedrite. A little argentite fills a fracture.

SUMMARY:

A superficial examination of the handspecimens together with the polished surfaces has revealed that tetrahedrite is the main mineral. Chalcopyrite is distributed throughout the gangue and also appears to replace the tetrahedrite to some extent. Argentite and polybasite are present in minor amounts. Surface oxidation is represented by malachite,azurite and a little limonite.

## PART 3. THE STUDY OF 5 POLISHED SECTIONS AND THEIR TEXTURES.

### Polished section No. 1.

Minerals present:

Tetrahedrite - $5Cu_2S.2(Cu,Fe)S.Sb_2S_3$ --------- 10%

Chalcopyrite - $CuFeS_2$------------3%

Sphalerite -ZnS-----------2%

Polybasite - $8Ag_2S.Sb_2S_3$ ------- 3%

Native silver ?- trace.

Textures:

The most conspicuous texture of the section is the rimming of tetrahedrite by chalcopyrite. The latter is found to rim many of the grains but it does not extend all the way round tetrahedrite. Chalcopyrite is also found in the quartz-carbonate gangue in small shear fractures. Polybasite is found as myrmekitic intergrowths and as small disseminations in most of the larger grains of tetrahedrite but it is not present in the smaller grains. Some sphalerite is found and contains rounded inclusions of chalcopyrite although it may also occur as smooth rims with the latter. Under high power a silvery- white grain lying in contact with chalcopyrite and tetrahedrite is observed. It is very soft and isotropic. Because of its size, no confirmatory tests could be made, but it is inferred that the grain is native silver.

Polished section No.2.

Minerals present:

- Chalcopyrite - $CuFeS_2$-----------15%
- Sphalerite - ZnS-----------------10%
- Tetrahedrite - $5Cu_2S.(Cu,Fe)S.Sb_2S_3$- 6%
- Polybasite - $8Ag_2S.Sb_2S_3$---------- 4%
- Galena - PbS-------------------trace.

Textures:

Chalcopyrite is the main mineral. It occurs as irregular masses with some intergrowths of polybasite extending into the neighbouring tetrahedrite. The contacts of chalcopyrite with tetrahedrite are smooth and regular, whereas the polybasite boundaries appear to be more angular with many extensions into tetrahedrite. Some of the chalcopyrite is replaced by polybasite and the latter shows also decided extensions into the host.

Sphalerite and chalcopyrite, where in contact, show smooth, regular boundaries with one another. A few rounded inclusions of sphalerite in chalcopyrite and chalcopyrite in sphalerite are also observed but this feature is not frequently seen. Some chalcopyrite is observed cutting a grain of sphalerite and the overall textures indicate that sphalerite was the earliest mineral formed with overlapping deposition of chalcopyrite.

Polished section No. 3.

Minerals present:

Galena - PbS ------- 3%

Chalcopyrite - $CuFeS_2$ -------- 5%

Tetrahedrite - $5Cu_2S.2(Cu,Fe)S.Sb_2S_3$ ------- 15%

Polybasite - $8Ag_2S.Sb_2S_3$ -------- 2%

Argentite (Covellite) - $Ag_2S$ ----- Trace.

Textures:

Galena occurs as rectangular grains showing a well developed cleavage. Inclusions of other minerals are limited to tetrahedrite which shows smooth regular boundaries with its host. Some of this tetrahedrite is found to extend to the grain boundary of the galena. Oxidation of the latter is present in the form of a small rim and this may be either cerussite or anglesite. Chalcopyrite appears to replace the galena to some extent.

Tetrahedrite is the main mineral. Along parts of its borders are rims of chalcopyrite together with a scattering of the same throughout its host as well as in the quartz-carbonate gangue. Both these minerals show smooth contacts with one another with the replacing mineral having decided projections into the host. Polybasite is present in the tetrahedrite as long, discontinuous units as well as smoothly bounded grains.

Polished section No. 4.

Minerals present: Tetrahedrite - $5Cu_2S.2(Cu,Fe)S.Sb_2S_3$ -- 15%

Polybasite - $8Ag_2S.Sb_2S_3$--------3%

Chalcopyrite - $CuFeS_2$---------- 2%

Covellite - CuS---------------- 1%

Galena - PbS------------------ 3%

Argentite - $Ag_2S$--------------- 3%

Textures:

Tetrahedrite occurs as irregular grains in the quartz-carbonate groundmass from ½ c.m. to ¼ mm. in size.

Polybasite is present as irregular to spindle shaped grains having smooth boundaries with tetrahedrite. A particular feature showed what appeared to be a "vein" replacement of chalcopyrite. The latter occurs as slender, somewhat curved lamellae and in places abruptly terminates into polybasite. Chalcopyrite is also found along the grain boundaries of tetrahedrite.

The section includes subhedral grains of galena showing good cleavage. It is found to have intergrowths of the following:

1. Polybasite - this mineral occurs as smoothly bounded grains in the galena.
2. Tetrahedrite - it occurs as irregular masses, having decided projections into its host.

Chalcopyrite is found to rim the galena in part.

Covellite is well represented in the section as blue lamellae in a soft, sectile, isotropic mineral. An X-ray check by Dr.R.M. Thompson showed the mineral to be argentite. Some argentite fragments are also found to lie along the grain boundaries of tetrahedrite.

Polished Section No.5.

Minerals Present: Tetrahedrite - $5Cu_2S.2(Cu,Fe)S.Sb_2S_3$- 20%

Polybasite - $8Ag_2S.Sb_2S_3$------6%

Sphalerite - ZnS ---- 3%

Chalcopyrite - $CuFeS_2$---------5%

Argentite $Ag_2S$ - Trace

Covellite - CuS----Trace .

Textures:

Tetrahedrite as the dominant mineral has various associated minerals, occurring in the following way:

1. Chalcopyrite - This occurs as sporadic, smooth masses along the grain boundaries, as well as some inclusions.
2. Polybasite - This is found as large, euhedral grains along the boundaries,as inclusions and as worm-like intergrowths.
3. Sphalerite - Occurs as irregular inclusions in polybasite with evidence of replacement by tetrahedrite.and polybasite.

Argentite and covellite occur as irregular grains in the groundmass.

As the textures are identical to those shown in the previous polished sections, no further diagrams appeared necessary.

Date 8/3/61.

Name or number of section . . . 1. . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

Polish good

Colour bluish-grey.

Hardness C - D.

Streak metallic, somewhat reddish.

Texture massive to disseminated.

Pleochroism none.

Anisotropism isotropic.

Texture under xd. nicols -

Twinning none.

Internal reflection red, only when the surface has been scratched.

Cleavage none.

Association galena, sphalerite.

Etch tests

$HgCl_2$ -'ve.

KOH irridescent stain.?

KCN -'ve.

HCl -'ve.

$FeCl_3$ -'ve.

$HNO_3$ irridescent tarnish.

Aqua regia irridescent tarnish.

Microchemical tests Ag, Cu, Fe.

Grain size

Confirmatory features such as magnetism, sectility, fluorescence, blowpiping, radioactivity, etc. . . . . . . . . . . . . . . . . . . . . . . . .

Mineral or Group Silver bearing tetrahedrite.

Interpretation of textures.

**MINERALOGRAPHIC LABORATORY**

Date 28/2/61.

Name or number of section . . . . . 1. . . . . . . . . . . . . . . . . . . . . . . . .

Polish good.

Colour galena-white.

Hardness C-

Streak -

Texture -

Pleochroism none.

Anisotropism anisotropic. blue-grey to greenish.

Texture under xd. nicols As intergrowths.

Twinning -

Internal reflection faintly reddish.

Cleavage -

Association tetrahedrite, pyrargerite.

Etch tests

$HgCl_2$ +'ve, brown stain.

KOH -'ve.

KCN +'ve, brownish-black stain.

HCl -'ve.

$FeCl_3$ +'ve. irridescent tarnish.

$HNO_3$ +'ve. tarnish.

Aqua regia +'ve. tarnish.

Microchemical tests Ag.

Grain size -

Confirmatory features such as magnetism, sectility, fluorescence, blowpiping, radioactivity, etc. . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

Mineral or Group Polybasite. $8Ag_2S. Sb_2S_3$.

Interpretation of textures.

MINERALOGRAPHIC LABORATORY.

Date 22nd March 1961

Number of section 4

Polish good

Colour galena-white

Hardness B

Streak metallic-grey.

Texture irregular, granular.

pleochroism -

Anistropism Isotropic

Texture under xd.nicols - -

Twinning -

Internal reflection -

Cleavage -

Association covellite

Etch tests

| | |
|---|---|
| $HgCl_2$ | positive (bluish stain) |
| KOH | negative |
| KCN | positive (etches surface black) |
| HCl | negative |
| $FeCl_3$ | positive (blue, turning irridescent) |
| $HNO_3$ | positive (irridescent stain) |
| Aqua regia - | |

Microchemical tests -

Grain size -

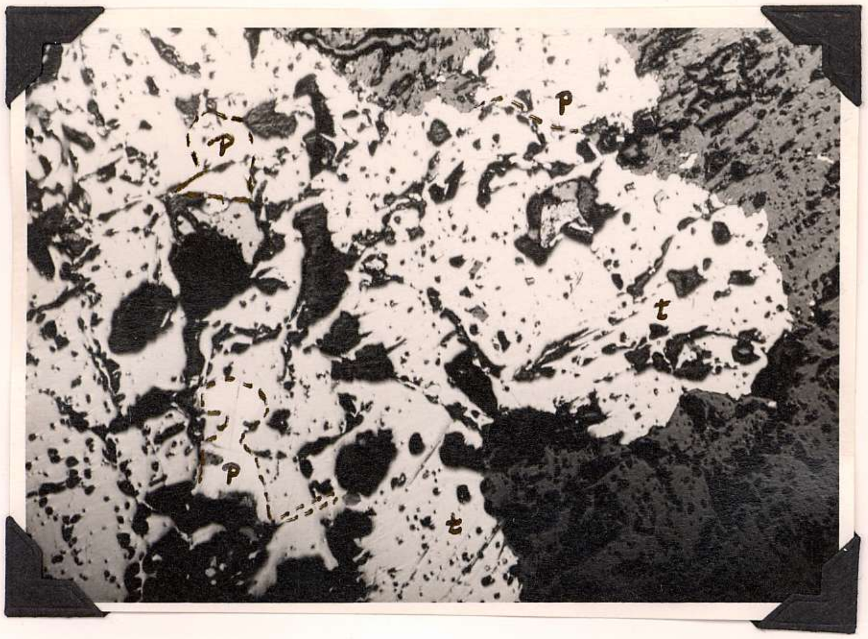
Confirmatory features such as magnetism, sectility, fluorescence, blowpiping, radioactivity, etc........sectile..................

Mineral or Group Argentite - $Ag_2S$

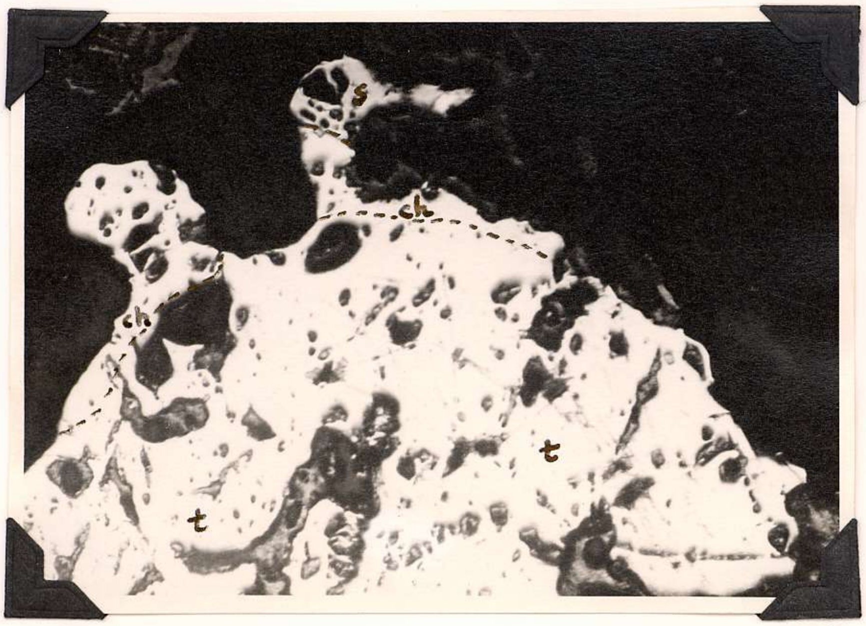
Interpretation of textures.

## Photographs of polished sections ~ medium power

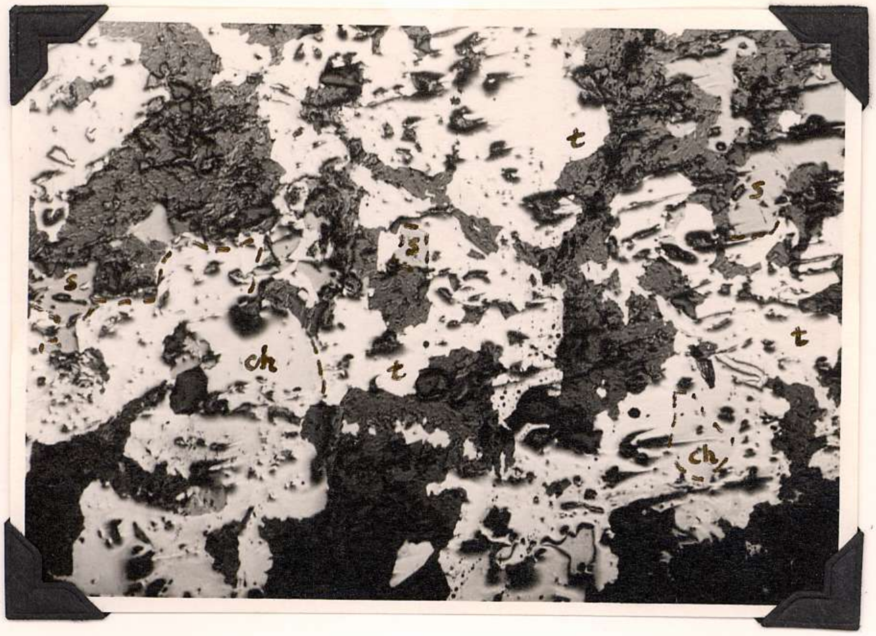
N.L. No eyepiece. Exp. 4 sec.



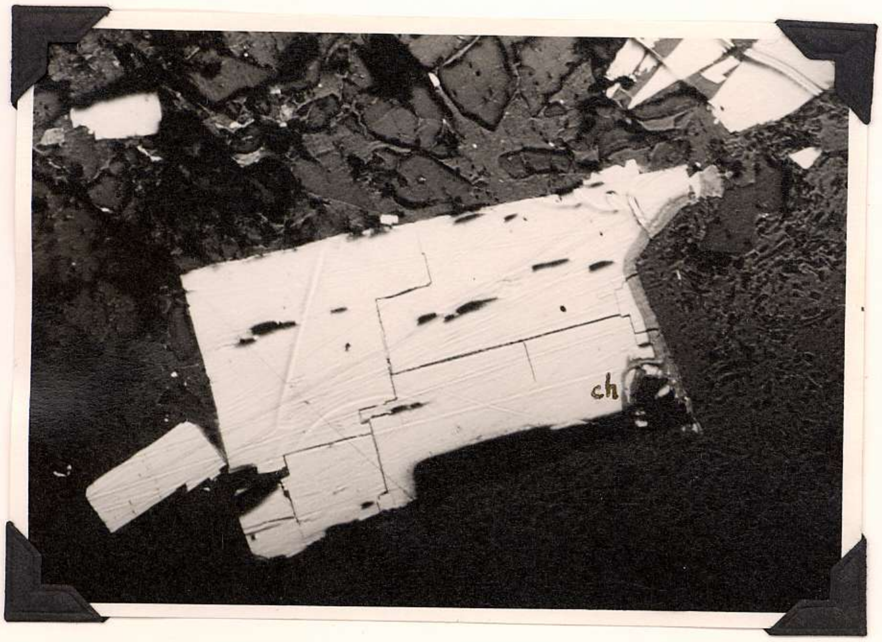

Section No 3. Polybasite replacing tetrahedrite.




Section No 1. Chalcopyrite rimming Tetrahedrite.




Section No 2. Intergrowth of Sphalerite, chalcopyrite and tetrahedrite




Section No 3. Galena with oxidation rim, partly replaced by chalcopyrite (ch)

# Polished Section No 1

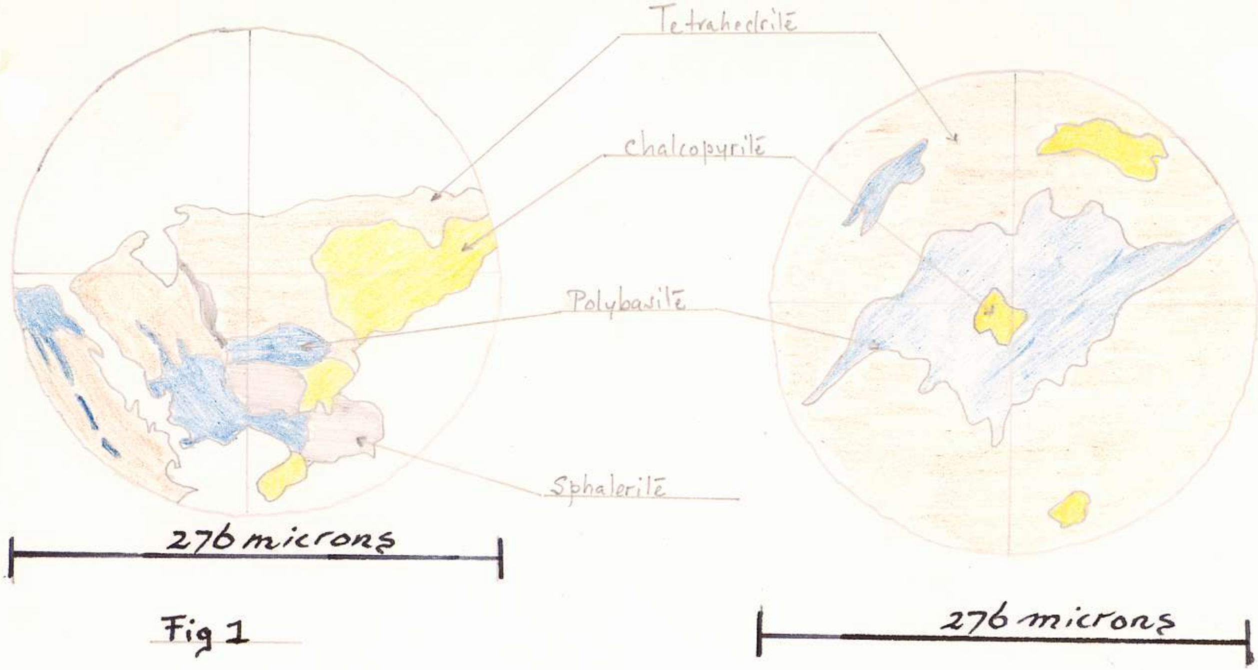



Fig 1

Fig 2

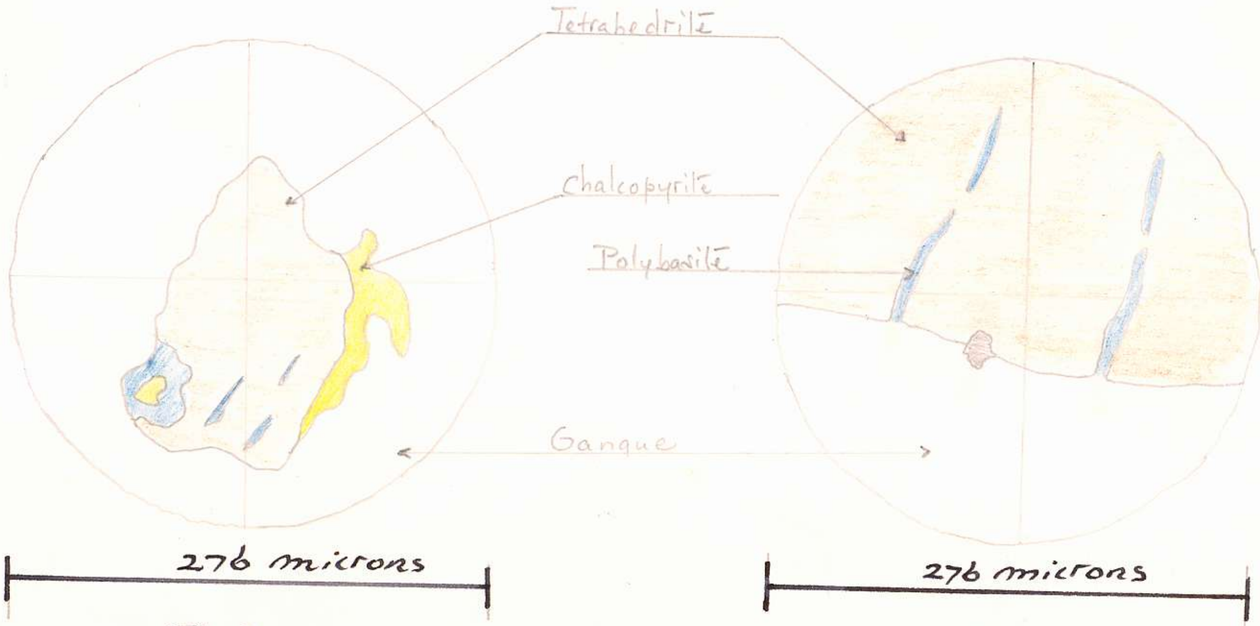



Fig 3

Fig 4.

# Polished Section No 2

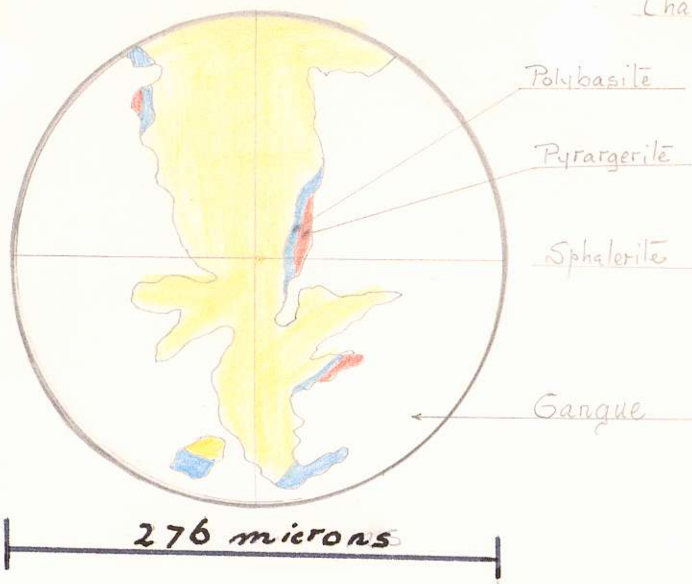



Fig 1

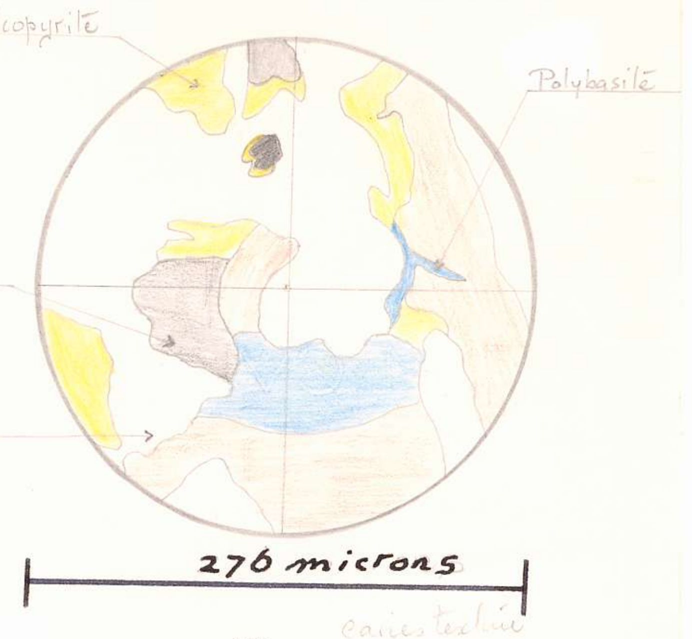



Fig 2

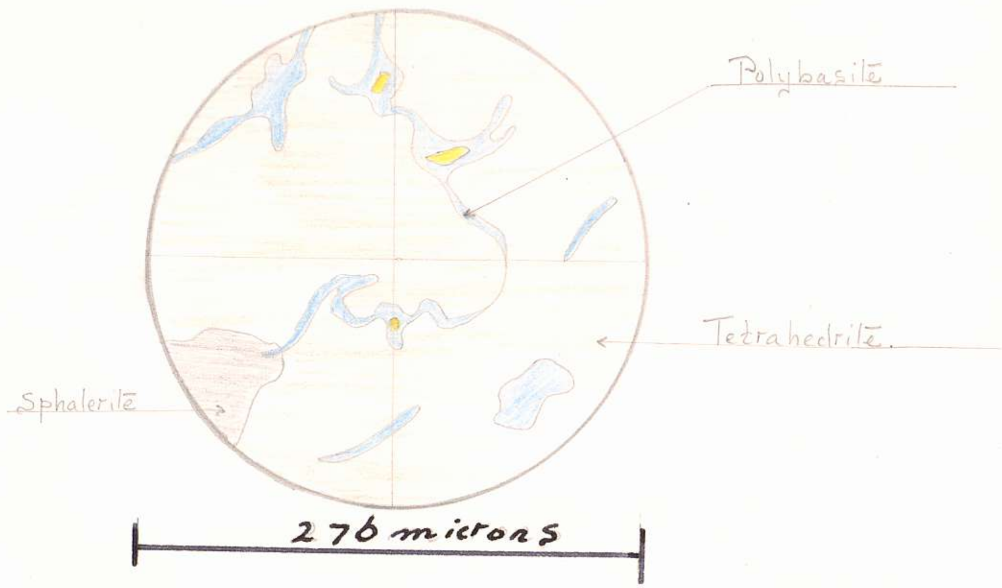



Fig 3

# Polished section no 3

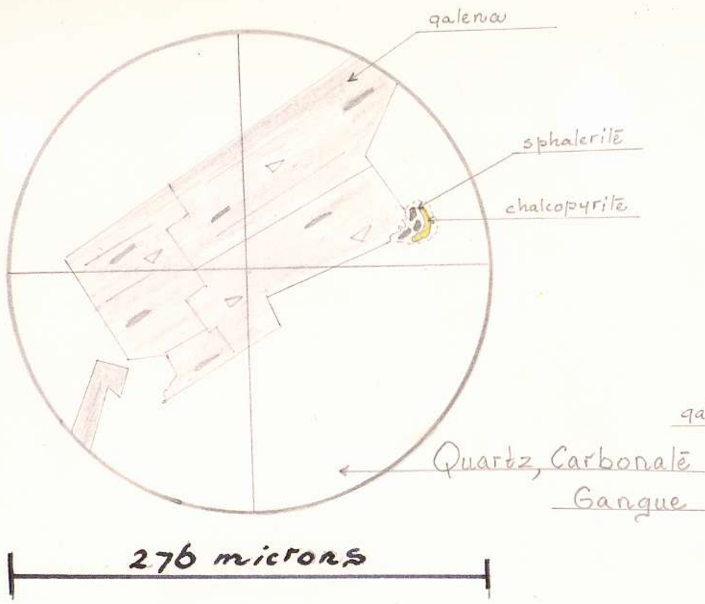



Fig 1

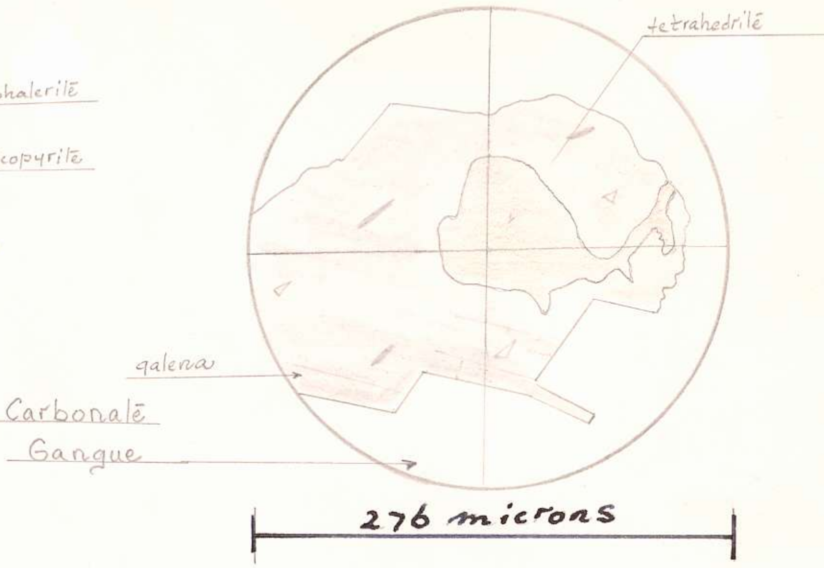



Fig 2

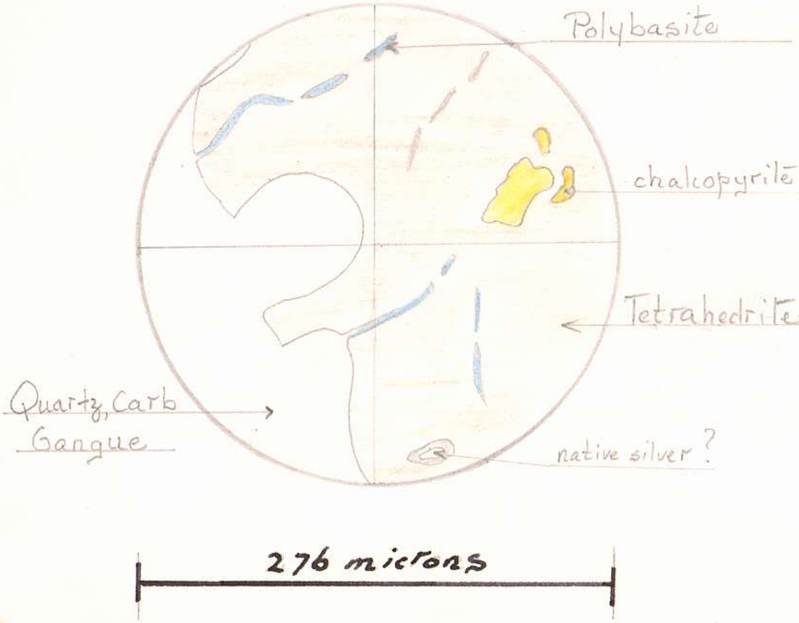



Fig 3

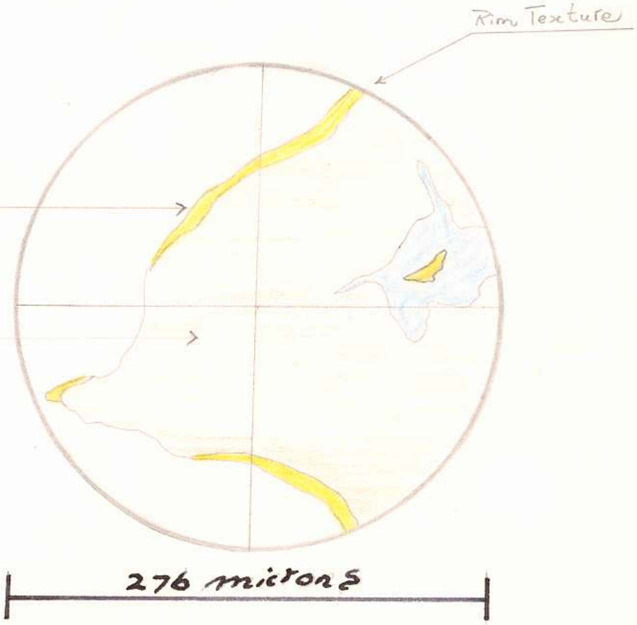



Fig 4

# Polished Section No 4

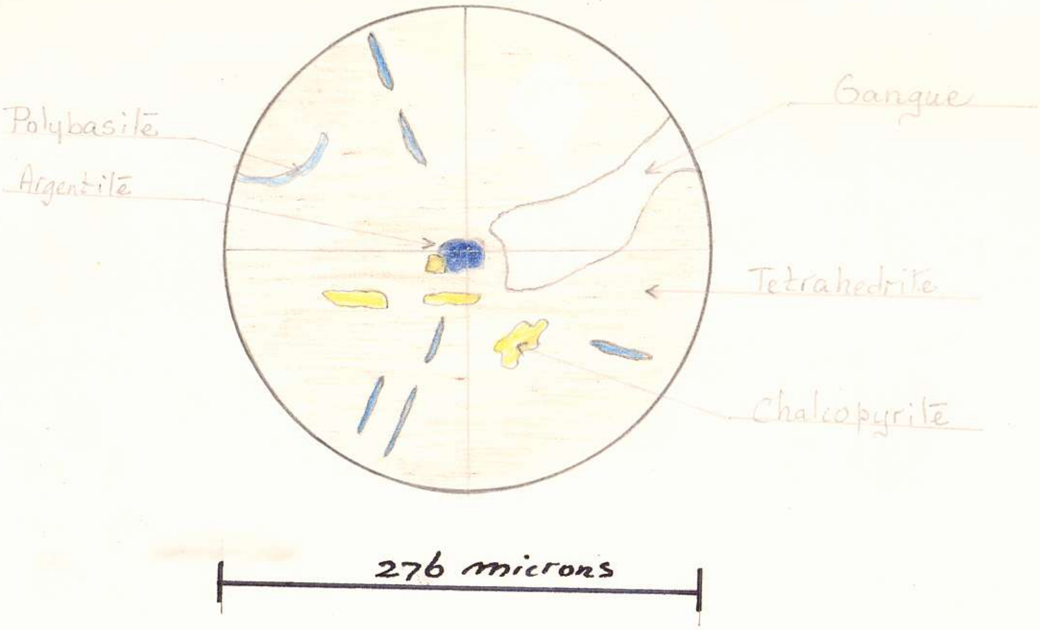



Fig 1

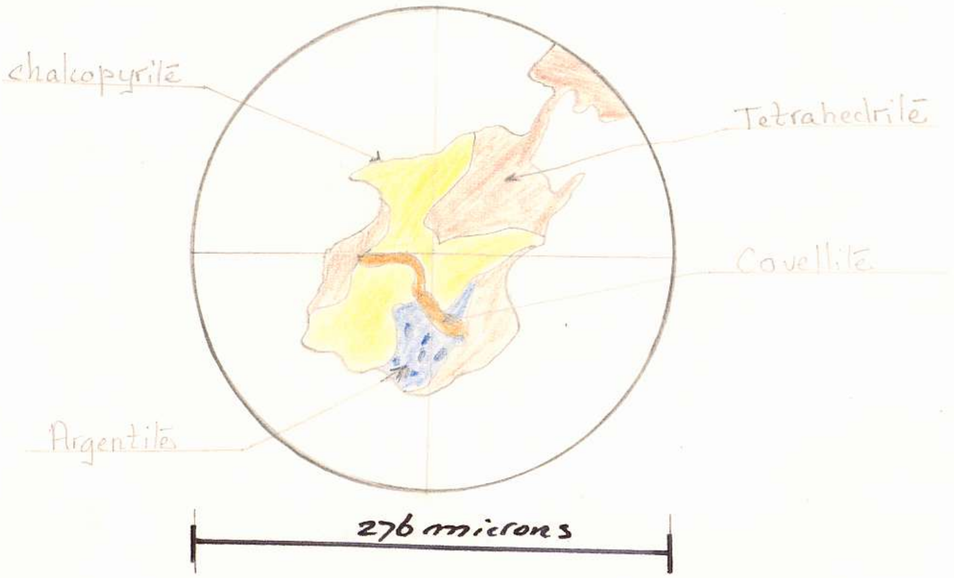



Fig 2

## TEXTURE INTERPRETATION AND PARAGENETIC SEQUENCE.

In nearly all of the polished sections examined, tetrahedrite is rimmed partially by chalcopyrite. The chalcopyrite has smooth, somewhat scalloped boundaries with its host and it is also present as isolated grains which show sharp, smooth boundaries extending towards the rim. The mineral may also be found as inclusions in polybasite and their contact surfaces are quite irregular. The sections also revealed curving lamellae of chalcopyrite in tetrahedrite with some replacement by polybasite. Scatterings of chalcopyrite are common in the quartz-carbonate gangue together with minor sphalerite.

The above features are suggestive of exsolution. This conclusion is mainly drawn from the tendency of the chalcopyrite to migrate towards the grain boundaries and the presence of some curving lamellae. The presence of chalcopyrite in the gangue is probably due to earlier mineralization together with sphalerite although the textures reveal overlapping deposition.

Polybasite is present as long, slender units in the tetrahedrite, as well as rounded grains lying along the grain boundaries which show smooth regular extensions into the host. Some of these grains contained scatterings of covellite.

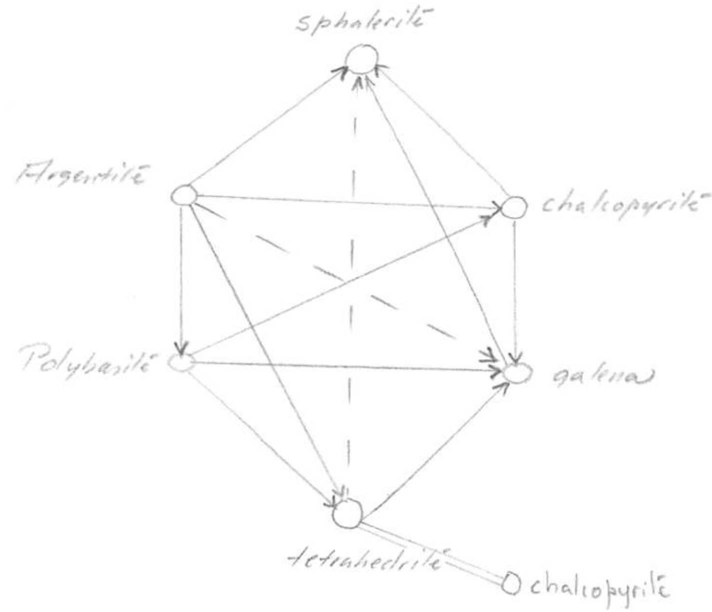
Argentite occurs as smooth grains in contact with tetrahedrite. Intergrowths of covellite are more numerous than in polybasite.

The occurrence of galena is limited and only in sections Nos. 3 and 4 it is present to a greater degree. Oxidized products of this mineral are found as small rims which may be the lead carbonate. Tetrahedrite and polybasite together with some chalcopyrite are the replacing minerals.

The microscopic study of the Silver Island suite show the prevailing order of deposition among the hypogene minerals was:

1. Sphalerite.
2. Chalcopyrite.
3. Galena.
4. Tetrahedrite (chalcopyrite).
5. Polybasite.
6. Argentite.
7. Native silver.
8. Malachite and azurite - probably derived from tetrahedrite.

<u>Van de Veer diagram.</u>



# REFERENCES.

B.C. Mines Report - 1924 pp.B101, 113.

1925 pp.A142 - 143.

G.S.C. Summary Report - 1925 Part A pp.62A - 91A.

Phemister - G.S.C. Summary Report - 1928 - Pa t A p.50A.

Hansen G. - G.S.C. Summary Report - 1924 Part A.pp.19A - 37A.

Armstrong - G.S.C. Memoir 252.