Dolly Varden Mine Samples

Myron Osatenko.

THE DOLLY VARDEN MINE

The Dolly Varden Mine is situated in the Kitsault River valley, eighteen miles from the head of Alice Arm, in the Portland Canal mining division of British Columbia.

During 1919 - 1921 the mine was operated by Taylor Engineering Company, Limited, and produced 1.3 million ounces of silver from about 36,000 tons of ore.

General Geology

The Dolly Varden mine is in the northern half of a complex of intrusive, extrusive, and fragmental rocks known as the 'Kitsault igneous body'. The igneous body is surrounded by sedimentary rocks of the Hazelton group. The precise age of the Hazelton group is not known, but they are definitely older than the Coast Range complex, which intruded during Upper Jurassic or Cretaceous times.

The ore deposit is a vein, which follows a fault fracture in the flows, and fragmental rocks.

Vein Structure

The Dolly Varden vein represents a replacement of the rock which, for the most part, form the footwall of a fault fracture. It varies from an inch up to 25' in width, has a strike of N55°E, and a dip of 45° - 60° to the northwest.

Economic Geology

All the ore in this mine originated in one vein, and silver was the only metal recovered. Two types of ore were noted in the hand specimens.

Type A : The matrix of "type A" is composed of black quartz, and white fine grained calcite. Argentite, ruby silver, and native silver are found along minute, branching fractures. The black color of the quartz is apparently due to minute veinlets of argentite and pyrargyrite. In several specimens argentite was observed to exhibit a cubic crystal form. In all cases argentite is found with a black coating. The native silver is found in frond-like, and dendritic masses. Euhedral to subhedral pyrite is present in minor amounts.

Type B : The matrix of "type B" is composed of white quartz. Euhedral pyrite is not associated with any fracture system, and is therefore thought to have been deposited at the same time as quartz. Galena and sphalerite are common in some fractures. Minor amounts of argentite, ruby silver and chalcopyrite are present. Limonite is occasionally found on the surface of some specimens.

The outcrop of the vein consists of a barren, oxidized capping which is eight to ten feet deep. At the base of the capping the material abruptly changes to an unoxidized vein matter. Native silver is found immediately below the capping.

A. Mineralogy

The following minerals have been identified in the Dolly Varden mine: pyrite, sphalerite, galena, chalcopyrite, tetrahedrite, argyrodite, argentite, pyrargyrite, native silver, quartz, barite, calcite, jasper, and limonite.

1. Pyrite: FeS_2: pale yellow color; hardness E; isotropic; euhedral to subhedral crystals - minor veined pyrite; fair - good polish.

2. Sphalerite: (Zn,Fe)S: light grey color; hardness C to C^+; isotropic; triangular pits; good polish; positive microchemistry test for Zn.

   Etch tests: Aqua regia - stains brown.

   Forms less than 2% of the vein. Is found replacing pyrite.

3. Galena: PbS: galena white color; hardness B; isotropic; good cubic cleavage with numerous triangular pits; good polish; positive microchemistry test for Pb.

Etch tests: HNO_3 (1:1) - black stain
HCl - brown stain

Two periods of galena mineralization:

(a) Pre silver mineralization - this is indicated by the replacement of galena by argentite and pyrargyrite.

(b) Contemporaneous with silver minerals - indicated by mutual boundaries between argentite, pyrargyrite, and galena.

4. Chalcopyrite: $Cu_2 S \cdot Fe_2 S_3$: brass yellow; hardness C; weakly anisotropic. Found ensolving out of sphalerite.

5. Tetrahedrite: $5Cu_2 S \cdot 2(Cu,Fe)S \; 2Sb_2S$: pale greenish grey; hardness C^+; isotropic.

Etch tests: HNO_3 - negative
KCN - brown stain

Seems to be contemporaneous with the silver minerals.

6. Argyrodite: $4Ag_2S \cdot GeS_2$: pinkish grey color; hardness C; isotropic.

Etch tests: HNO_3 - negative
HCl - negative
KCN - brown scratches?
$FeCl_3$ - negative
KOH - negative

Was identified in only one polish section.

7. Argentite: Ag_2S: greenish grey color; hardness A; sectile; isotropic; Ag test positive.

Etch tests: HCl - yellow brown aureole which doesn't wear or wash off.

KCN - stains brown to black.

$FeCl_3$- stains black.

HNO_3 - granular texture.

Mode of occurrence:

(a) interstitial mineral, filling the spaces between brecciated quartz grains.

(b) as veinlets with galena and native silver.

8. Pyrargyrite: $Ag_3 SbS_3$: bluish grey color; hardness B; moderate anisotropism; red internal reflection; Ag and Sb test positive.

Etch tests: HNO - negative
HCl - tarnish
KCN - stains brown to black
$HgCl_2$ - brown

9. Native silver: Ag: bright yellowish orange; moderate anistropism; hardness B; sectile; Ag test positive.

Etch tests: HNO_3 - white coating
KCN - brown stain
$HgCl_2$ - stains brown

All native silver gave a good Ag test; however some samples gave Ag plus Au tests. This may indicate minor amounts of electrum.

10. Quartz: SiO_2: Quartz is the most abundant gangue mineral; it comprises from 70 - 85% of the vein. Thin section and polish section study shows that the quartz and pyrite were deposited first. The quartz was then fractured, and impregnated with argentite and pyrargyrite.

11. Barite: $BaSO_4$: prismatic crystals which may make up as high as 60% of the gangue. Only found in the lower levels of the mine.

12. Calcite: $CaCO_3$: contemporaneous with argentite?

13. Jasper: $SiO_2(Fe)$: red color; hardness E; rare.

14. Limonite: $HFeO_2$: yellow brown stain.

B. Paragenetic Sequence

Stage I : Pyrite
Jasper
Quartz

Stage II : Sphalerite
Chalcopyrite

Stage III: Galena

Stage IV : Argentite
Pyrargyrite
Argyrodite
Galena
Calcite

Stage V : Native silver

Mineral percentages:

(a) Pyrite - 10%

(b) Sphalerite - 4%

(c) Galena - 1%

(d) Chalcopyrite - ≪ 1%

(e) Tetrahedrite - < 1%

(f) Argyrodite - ≪ 1/4%

(g) Argentite - < 1%

(h) Pyrargyrite - < 2%

(i) Native silver - ≪ 1%

(j) Gangue - 80% - Quartz
- Barite
- Jasper

(k) Limonite - 1%

Hypogene or supergene?

Supergene enrichment was the first proposed origin of the silver ores of Dolly Varden. Early investigators felt that the argentite, pyrargyrite, and native silver were derived from argentiferous galena and tetrahedrite by supergene enrichment.

From field evidence it appears likely that the native silver is of supergene origin as it is found immediately below a barren oxidized zone. It generally occurs as frond-like or dendritic masses which are filling fractures.

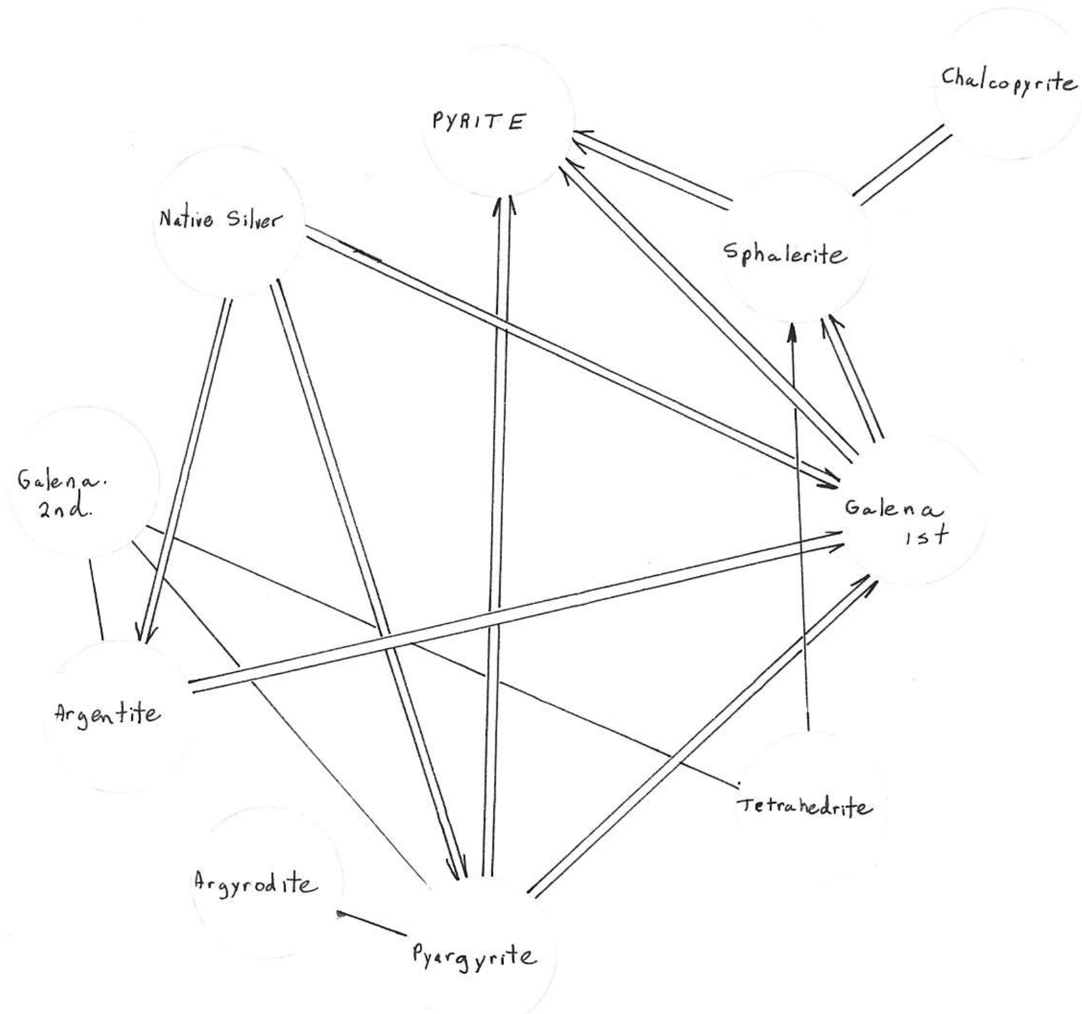
This horizon provided the richest silver ore. Below this horizon the high grade silver values decrease rapidly.

The derivation of argentite and pyrargyrite from argentiferous galena and tetrahedrite is untenable as both these minerals are contemporaneous with the silver minerals (Warren, 1942). This conclusion is based on mutual boundary relationships.

There is a possibility that some of the galena may have been dissolved, and redeposited with the silver minerals. This is indicated by the two galena stages. If this is the case then very minor amounts of argentite could be of supergene origin.

If the silver minerals were derived by supergene enrichment of argentiferous galena and tetrahedrite then minerals such as anglesite, covellite, and chalcocite should be present - they are not.

It appears that the native silver is of supergene origin while argentite, pyrargyrite and argyrodite are hypogene.


PYRITE
Chalcopyrite
Native Silver
Sphalerite
Galena 2nd.
Galena 1st
Argentite
Tetrahedrite
Argyrodite
Pyargyrite

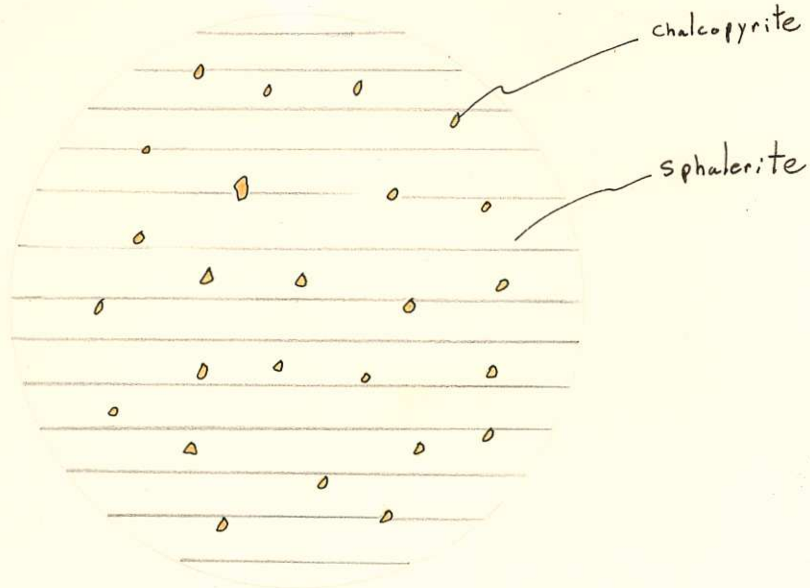


Figure 1. Chalcopyrite ensolving out of
sphalerite.

Scale?

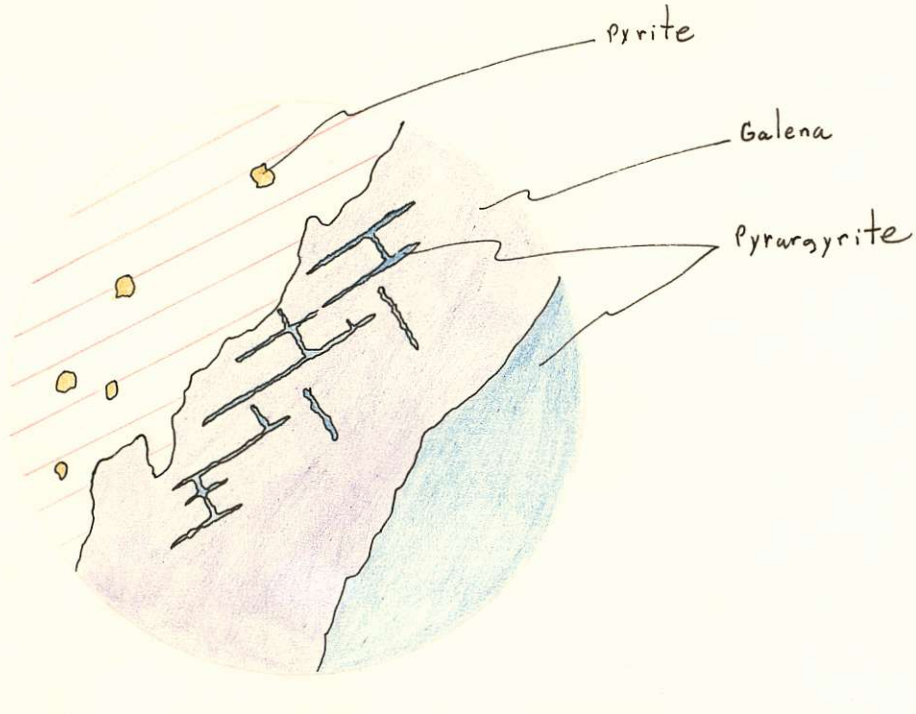


Figure 2. Pyrargyrite replacing galena along
cubic cleavages.

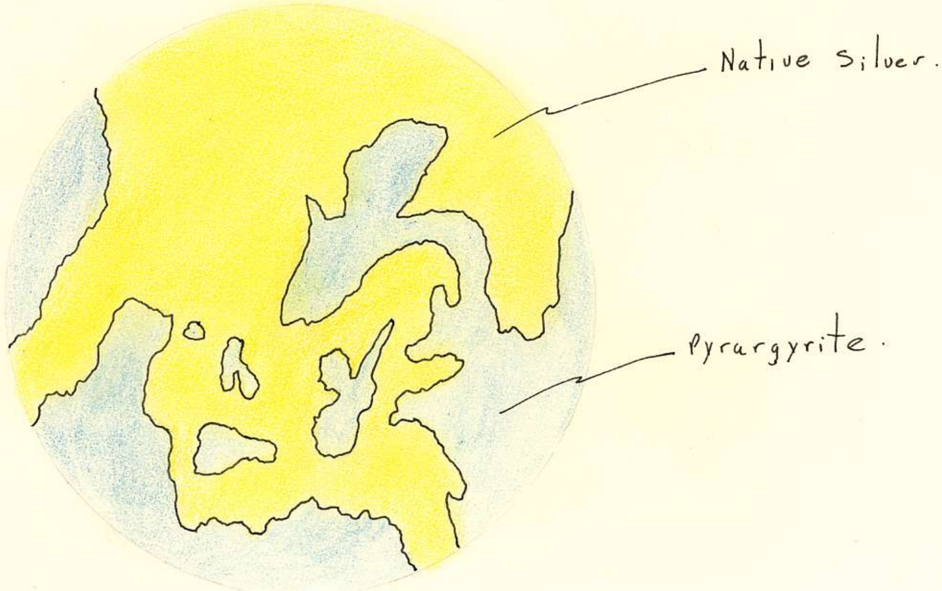


Figure 3. Native silver replacing pyrargyrite.

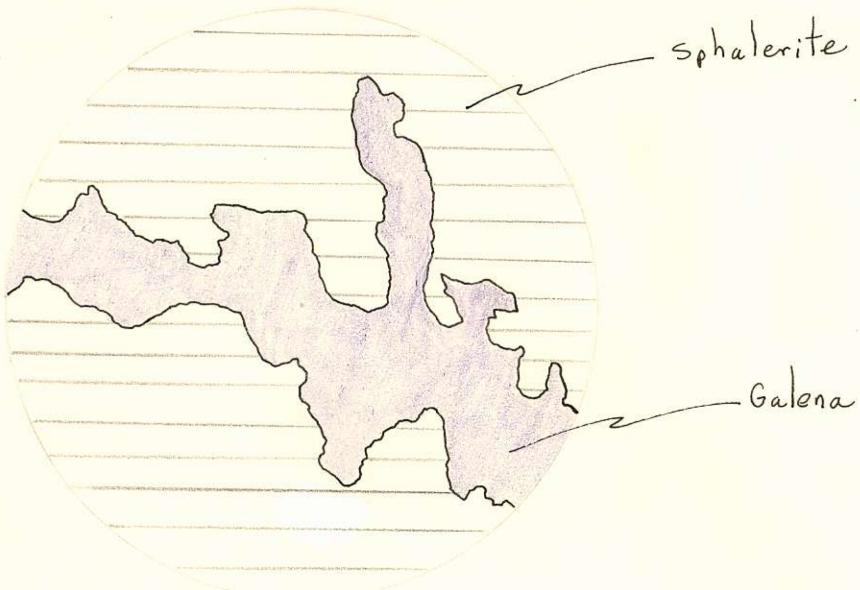


Figure 4. Galena replacing sphalerite

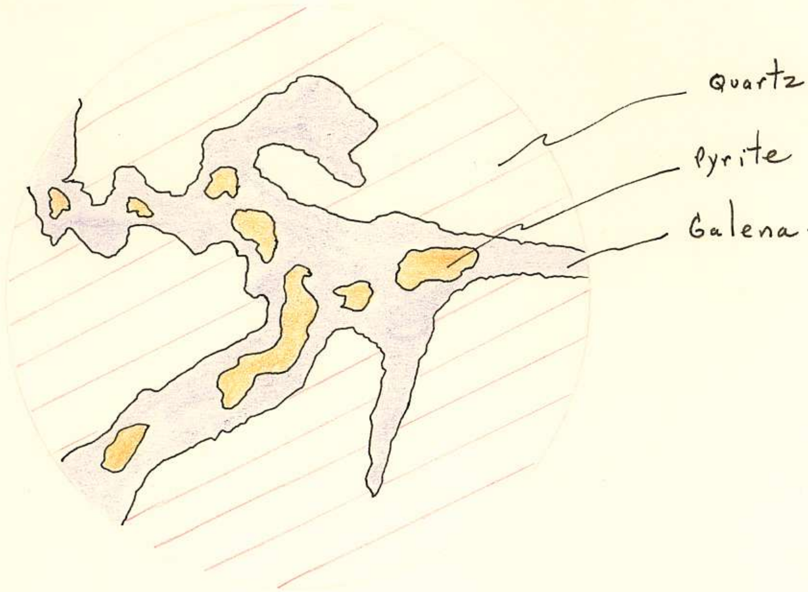


Figure 5. Galena replacing pyrite.

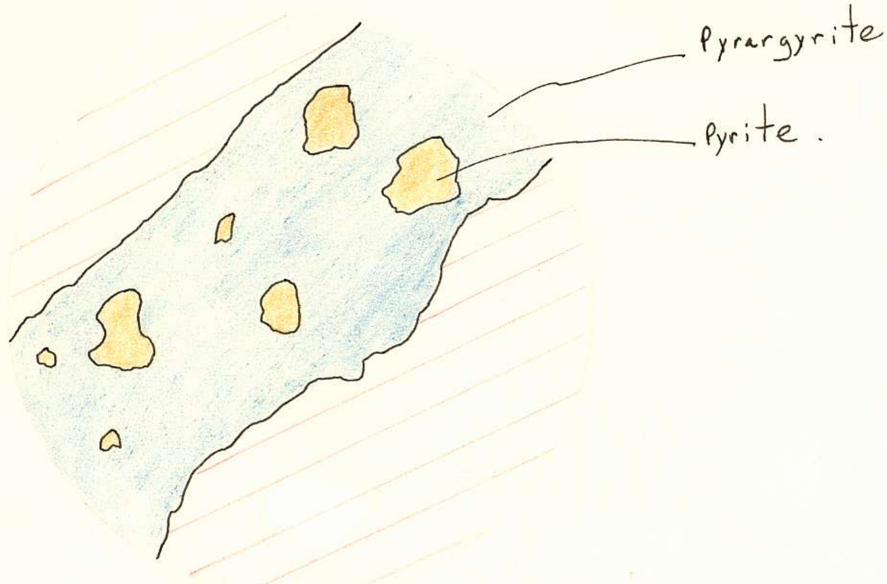


Figure 6. Pyrargyrite replacing pyrite.

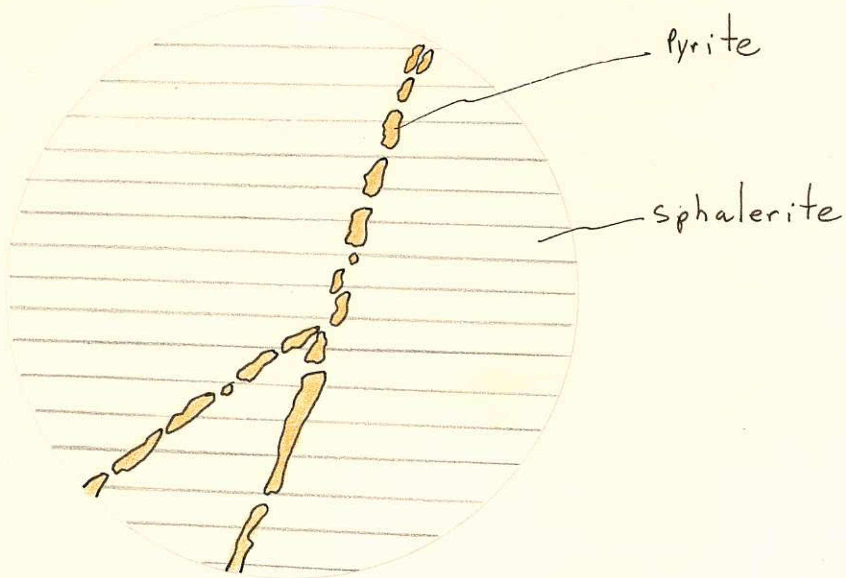


Figure 7. Sphalerite replacing veined pyrite.

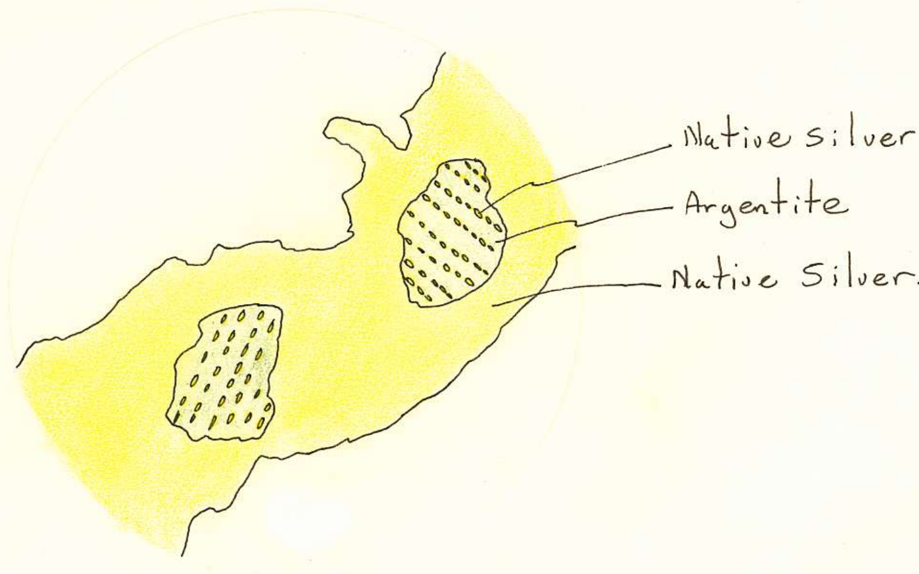


Figure 8. Native silver replacing argentite along cleavages.

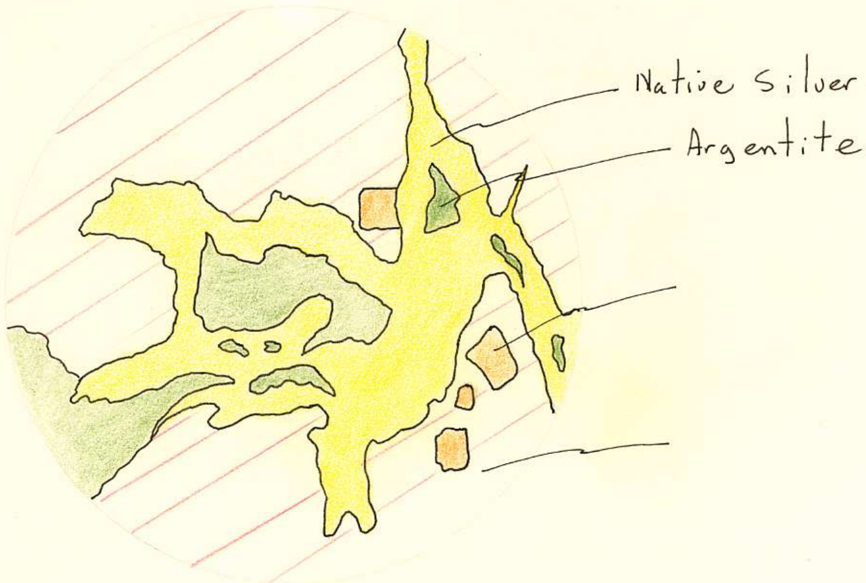


Figure 9. Native silver replacing argentite.

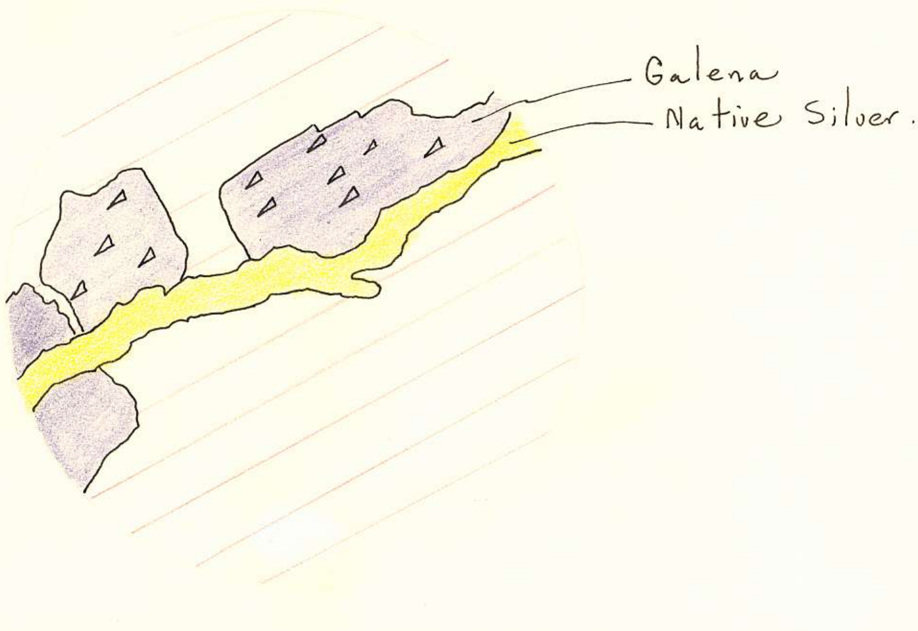


Figure 10. Native silver replacing galena.

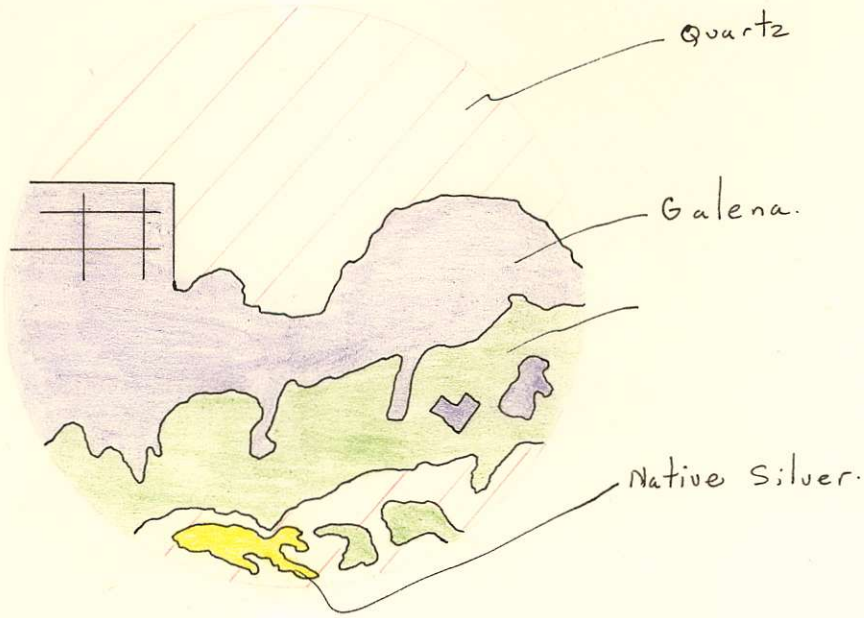


Figure 11. Argentite replacing galena.

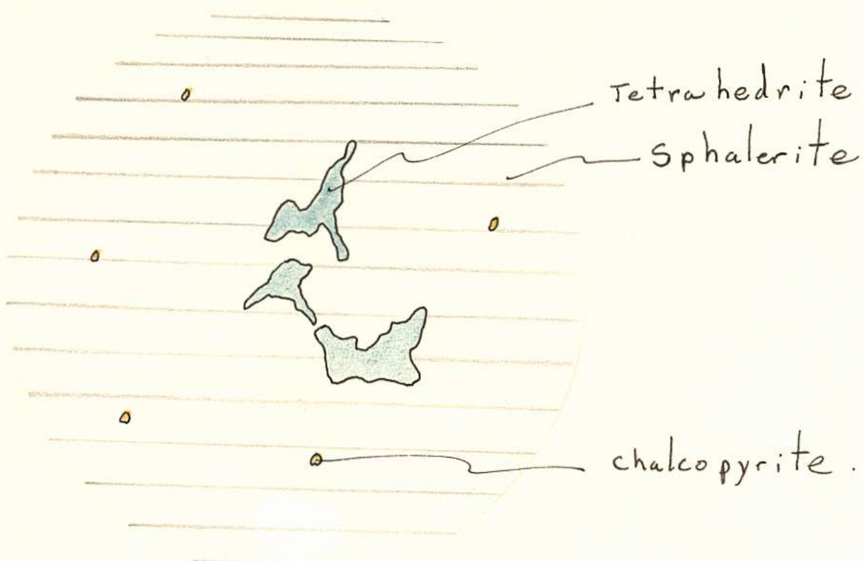


Figure 12. Tetrahedrite replacing sphalerite? Minor chalcopyrite ensolving from sphalerite.

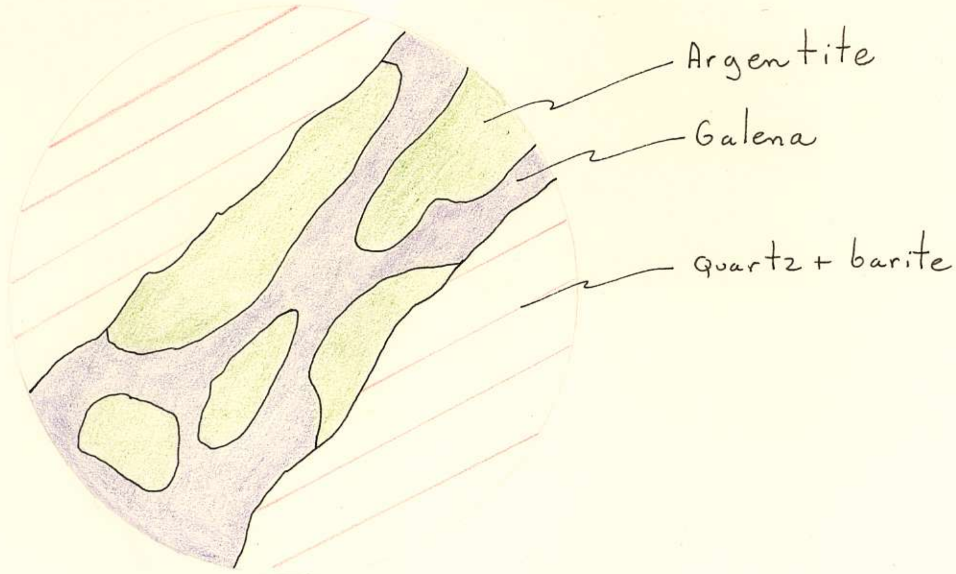


Figure 13. Contemporaneous galena and argentite.

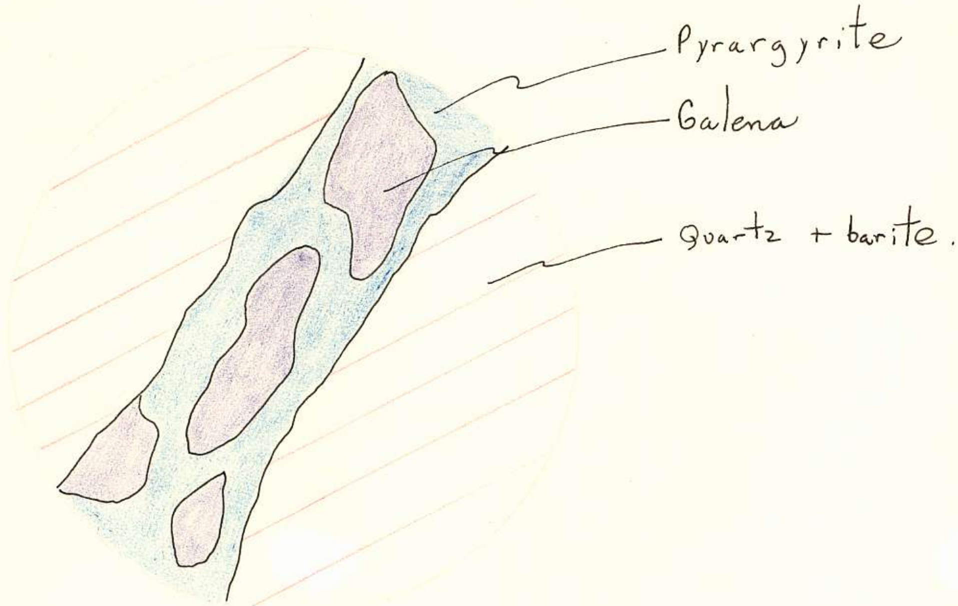


Figure 14. Contemporaneous galena and pyrargyrite.

BIBLIOGRAPHY.

(1.) Warren, H.V ; Gordon Brown C.E. 1942 - "The Dolly Varden Mineralization: Hypogene or Supergene?" The Miner, Oct. 1942 page 26.