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MINERALOGRAPHIC REPORT ON
ORE SPECIMENS FROM
SILBACK PREMIER MINE

by

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Respectfully submitted

L London

Silback Premier Mine

History and Introduction

Silback Premier Mine is located about 16 miles northwest of Stewart B.C. in the Portland Canal, Salmon River mining district. Gold and silver mineralization was discovered in 1910 and work started the following year. Production increased steadily until 1935. In 1921 a 100 ton per day mill was constructed and later increased to 550 tons per day in 1931. Prior to 1935 it was believed that the ore bottomed on the 1350 level into low grade barren pyritic zones, and work was expanded above the 1350 level. In 1935 Silback Premier Mines was formed to continue exploration below the 1350 foot level, and large reserves were discovered between the 790 and 1350 levels. In 1953 the mine closed down due to low prices. Work began again in 1956 but only weeks later the mill was destroyed by fire.

In 1958, Bermah Mines Limited, consisting of T.J. McQuillan and his two partners leased portions of the mine from Silback Premier Mines Limited. In 1959 they discovered a high-grade ore shoot in the south wall of the old Premier glory-hole, and in that year shipped 62 tons of high-grade ore containing 650 ounces of gold and 16,829 ounces of silver. During 1960 Bermah Mines Limited shipped 1,239 tons of high-grade averaging 6.2 ounces per ton of gold and 176 ounces per ton of silver, until their lease expired on November 1, 1960.

After Bermah Mine's lease expired; Silback Premier Mines Limited continued mining and exploration of the high-grade ore-shoot. In 1961 and 1962 a total of 1296 tons were shipped to the smelter at Montana.

This (^{report} mineralographic, which follows,) is confined to ore specimens collected from the high-grade oreshoot discovered in 1959 in the old Premier glory-hole. It is not believed that these samples however are completely representative of the oreshoot.

General Geology

The main rock types are volcanic rocks of the Bear River Formation and bodies of quartz sanidine porphyry/called the Premier Porphyry. Overlying rocks include the conglomerate and argillite of the Salmon River Formation, and the argillite and slate of the Nass Formation. All rocks are Jurassic in Age and form the Hazelton group.

The rocks associated with the ore deposits form the north-east limb of a large open syncline which trends northwest and plunges gently towards the northwest. The Premier Porphyry is intruded into the volcanic rocks as sills and appears spatially related to the ore. The Purple tuffs overly the ~~syn~~cline conformably as a broad anticline on the flank of the syncline. It is believed that these tuffs limit the ore and cause a strong zoning effect on some of the mineralization.

MINERALOGY

Megascopic Description

Examination of specimens from the high-grade oreshoot of the Premier glory-hole suggests a low temperature vein filling deposit with extensive replacement in places. Most of the mineralization is concentrated in fractures and vugs within massive quartz veins and highly altered rocks. Most of the samples contained from 75 percent to 90 percent metallic mineral with much alteration. Some secondary silicification was observed. The alteration

minerals were studied in the hand specimens. The following is a description of them.

1. Rosasite $[(\text{CuZn})_2(\text{OH})_2(\text{CO}_3)]$

- forms light green botryoidal crusts of radiating fibrous crystals; cleavage is excellent in two directions. Mineral appears similar to smithsonite in form but gives a good positive Cu and Zn microchemical test. Rosasite is formed from the alteration of tetrahedrite, chalcopyrite and sphalerite.

2. Smithsonite $[\text{ZnCO}_3]$

- indistinguishable from rosasite without microchemical investigation; it forms a cruddy greenish cream crust.

3. Cerrusite $[\text{PbCO}_3]$

- forms brownish orthorhombic crystals, both tubular and prismatic in habit. Crystals are very brittle and give a good microchemical test for lead. Cerrusite is formed from the alteration of galena.

4. Goethite $[\text{HFeO}_2]$

- forms as a botryoidal to cruddy dark yellowish brown crust along fractures in the quartz; commonly associated with cerrusite. Goethite forms from the alteration of pyrite and other iron sulfide minerals.

5. Calcite and Aragonite $[\text{CaCO}_3]$

- forms as white to clear radiating sprays of prismatic crystals lining vugs. Both calcite and aragonite appear to be present, the latter forms orthorhombic crystals.

6. Manganiferous calcite

- occurs as cruddy black to brown masses in fractures and vugs.

7. Azurite $[\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2]$

- occurs only as a medium bluish stain with the calcite in vugs. Azurite is not common in the hand specimens and is indistinguishable from langite.

8. Langite $[\text{Cu}_4(\text{SO}_4)(\text{OH})_4\text{H}_2\text{O}]$

- langite is a light blue hydrated copper sulfate which is indistinguishable from azurite unless distinct forms are observable. It was observed on selected hand specimens as radiating prisms directly associated with native silver. It is a relatively rare mineral.

9. Linarite $\text{PbCu}(\text{SO}_4)(\text{OH})_2$

- linarite was not observed but has been noted in rare occurrences from Premier Mine. It forms as deep blue prismatic crystals from the alteration of copper and lead minerals

The primary minerals found in the polished sections were observed in the hand specimens and are best described in the section, "Microscopic Investigation". Electrum appears to be more abundant in the hand specimens than the polished sections indicate. It forms dense coatings along fractures and as filiform textures. Native silver was not observed in polished sections, but was in hand specimens as thin black coatings and wires lining vugs and fractures. Silver is closely associated with argentite.

Microscopic Examination of Polished Sections

The minerals observed in order of decreasing abundance include:

Quartz	-	50%
Sphalerite	-	25%
Pyrite	-	10%
Tetrahedrite	-	5%
Chalcopyrite	}	- 5%
Galena		
Polybasite	}	- 5%
Electrum		
Pyrrargyrite		
Argentite		

Native gold and silver, and pyrrhotite were not observed, but are believed to be present.

Descriptions

1. Quartz $[\text{SiO}_2]$

- there are two ages of quartz present. The ground mass for the mineralization is milky white fractured quartz which has been strongly replaced by sulfides. Some has a distinct hexagonal crystal form. Much of the silica is clear secondary quartz which has replaced the primary sulfides.

2. Pyrite $[\text{FeS}_2]$

- recognizable by the F hardness, pale yellow color, rough polish, high relief and isotropism. It occurs disseminated throughout the quartz or segregated into masses. The texture is generally clastic with some replacement by later sulfides.

3. Chalcopyrite $[\text{CuFeS}_2]$

- recognizable by brassy yellow color, good polish, C hardness, brittleness and weak anisotropism. It occurs as massive replacements and as an ex-solution product of sphalerite.

4. Polybasite $[\text{Ag}_{18}\text{Sb}_2\text{S}_{12}]$

- light greenish grey mineral with strong anisotropism. It has a hardness of C, good polish and may show moderate internal reflection. Etch tests: KCN-stains black; FeCl_3 tarnishes iridescent to dark brown.

Polybasite is associated with tetrahedrite and is distinguishable from tetrahedrite by its relative negative relief, greenish color and reaction with KCN. It is distinguished from pyrargyrite by the greenish color.

5. Pyrargyrite $[\text{Ag}_3\text{SbS}_3]$

- similar to polybasite but the color is distinctly more bluish. FeCl_3 etch, forms a black residue on pyrargyrite which will not wash off.

6. Tetrahedrite $[(\text{CuFe})_{12}\text{Sb}_4\text{S}_{13}]$ or Friebergite

- grey isotropic mineral with good polish and hardness of D. Characteristic etch tests include: HNO_3 - stains brown to iridescent; aqua regia - stains brown to iridescent. Microchemical tests were positive for Cu and Sb. Tetrahedrite forms along fractures and as massive replacements. It commonly replaces the polybasite, although the polybasite may be an exsolution product.

7. Sphalerite $(\text{Zn}_1\text{Fe})\text{S}$

- recognizable by its darker grey color, isotropism, good internal reflection and streak. The mineral is easily identified by a Zn microchemical test. It occurs as massive replacements and is in contact with most of the other minerals. Usually sphalerite contains small ex-solution blebs.

8. Galena PbS

- the triangular cleavage pits, white color and good polish are characteristic of galena. The mineral is not too abundant and has been strongly replaced by sphalerite and secondary silica.

9. Electrum (Au-Ag)

Electrum is the most abundant of the ore minerals in the

suite. It is distinguished by the light yellow color, hardness of A, sectility and isotropism. The KCN etch test varies according to the silver-gold ratio (high silver ratio does not stain as readily as low silver ratios). It commonly occurs in veinlets associated with argentite, electrum, etc.

10. Argentite $[\text{Ag}_2\text{S}]$

- Argentite has a good polish, grey color, hardness A and is isotropic. Etch tests include: KCN - stains black, HCl - negative, FeCl_3 - stains black, HNO_3 - stains very slightly, KOH - stains brown, HgCl_2 - stains iridescent.

Significant Textures

Significant textures are important if formulating a proposed sequence of mineralization. These textures are best illustrated by the accompanying photomicrographs. (Figures 1-15)

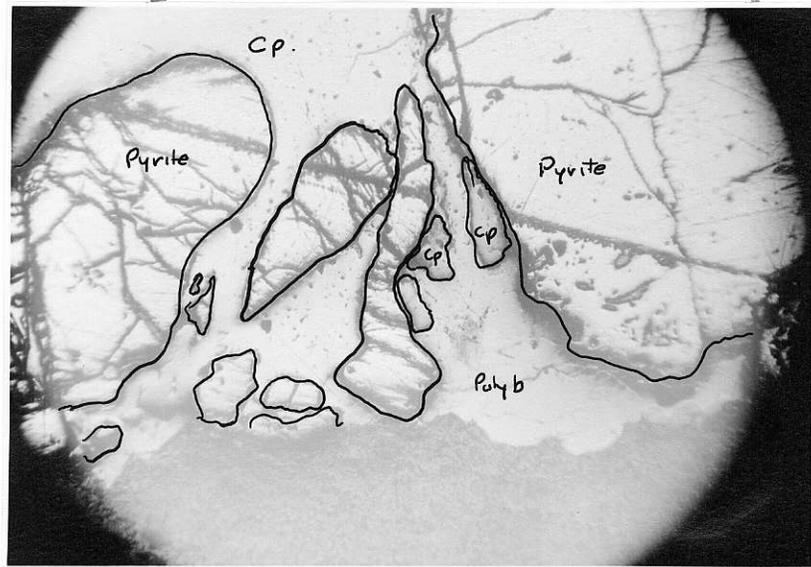


FIGURE 1 - Replacement of pyrite by chalcopyrite, and replacement of chalcopyrite by polybasite.
(x30)

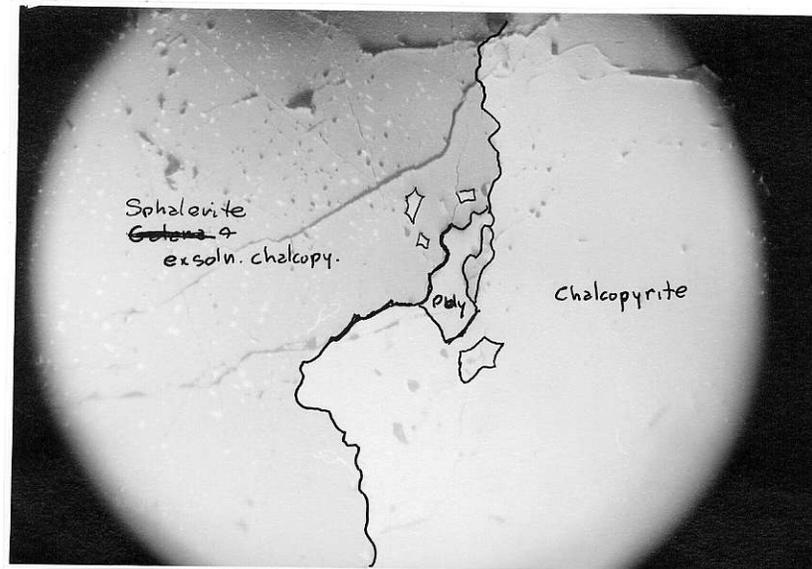


FIGURE 2 - Replacement of chalcopyrite and polybasite by sphalerite, with emulsion blebs of chalcopyrite in the sphalerite
(x80)

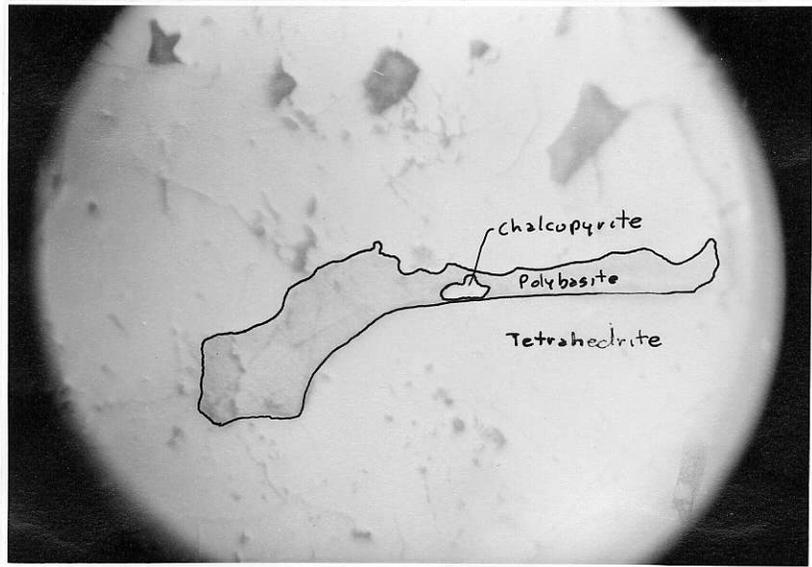


FIGURE 3 - Polybasite replaced by tetrahedrite (X200)

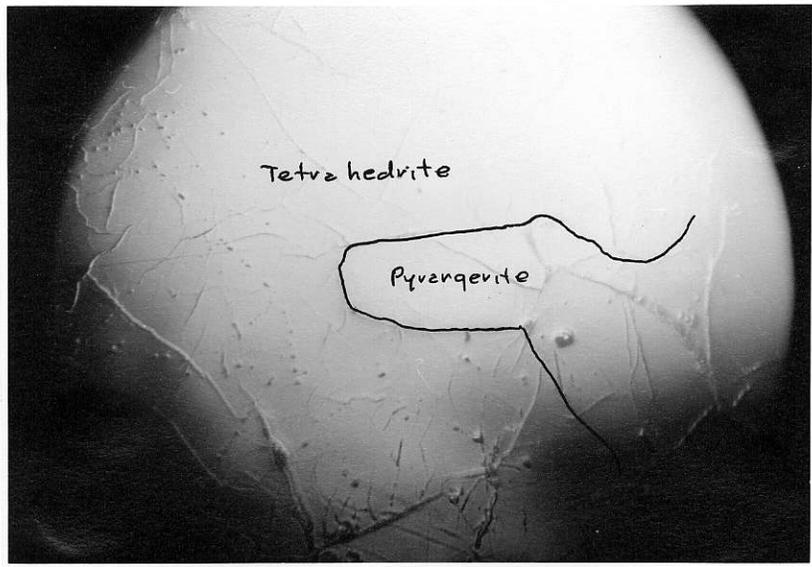


FIGURE 4 - Tetrahedrite replacing pyrrhotite. (X80)

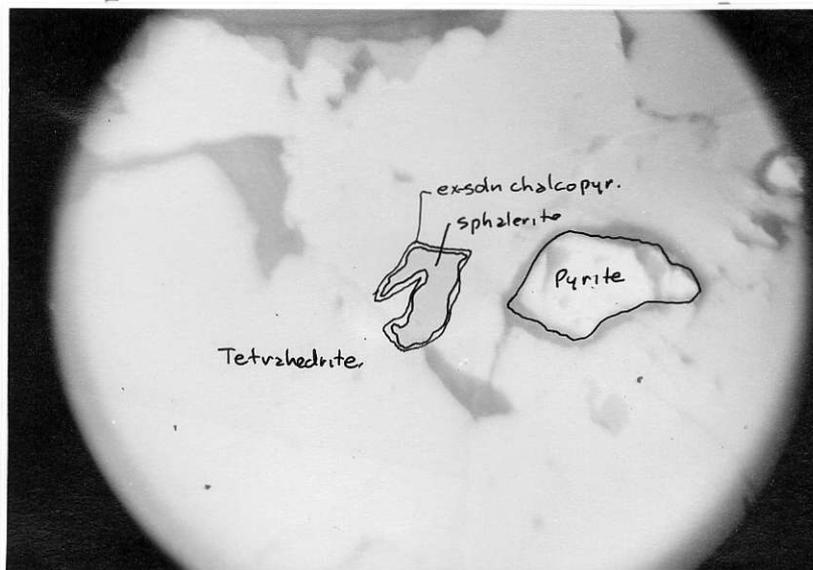


FIGURE 5 - Sphalerite with an ex-solved rim of chalcopyrite. Host mineral is tetrahedrite. Pyrite replaced by tetrahedrite
Temp. of exsolution - 350 - 400 °C.
(x200)

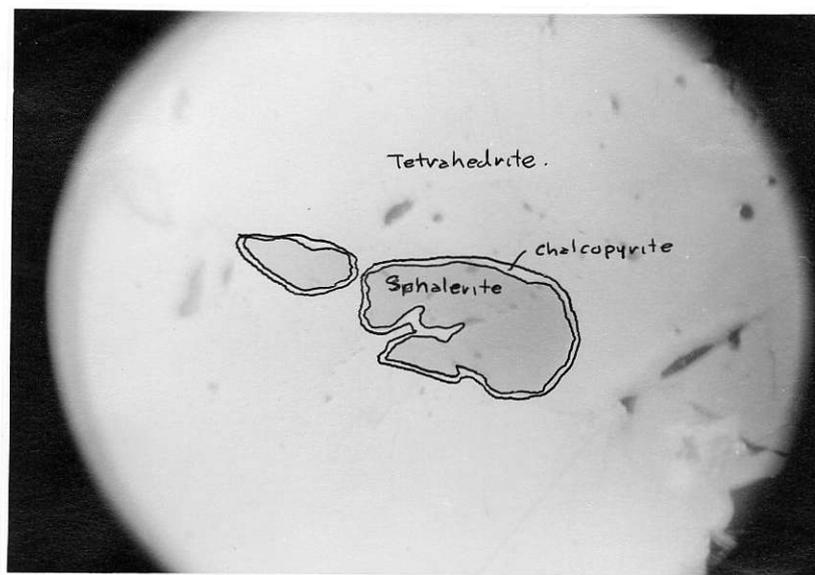


FIGURE 6 - Exsolution rim of chalcopyrite around Sphalerite.
(x200)

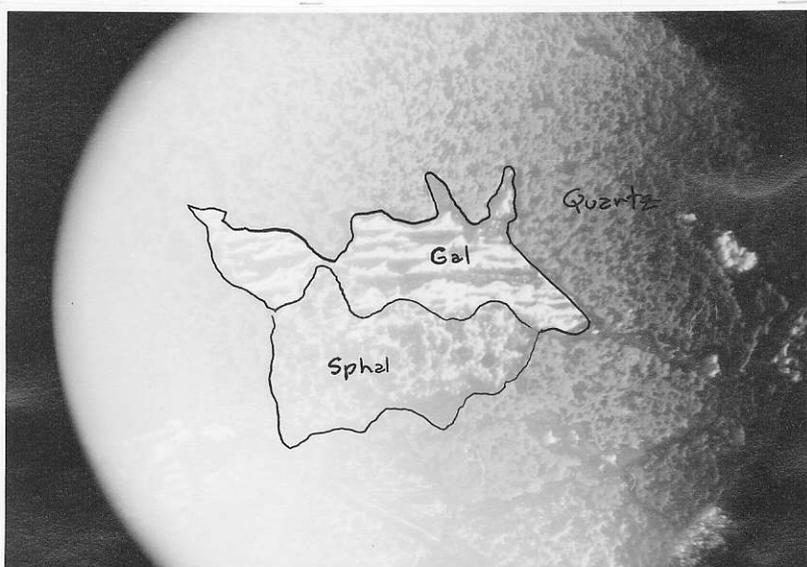


FIGURE 7 - Sphalerite replacing galena, carries texture. Quartz is replacing both sulfides.
(x 80)

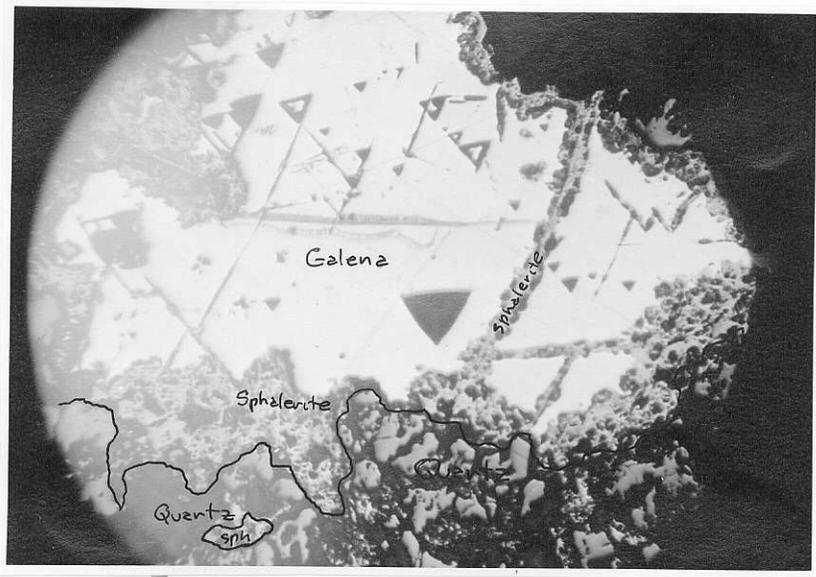


FIGURE 8 - Sphalerite replacing galena and quartz replacing sphalerite, carries texture. Note replacement along galena cleavage.
(x 80)

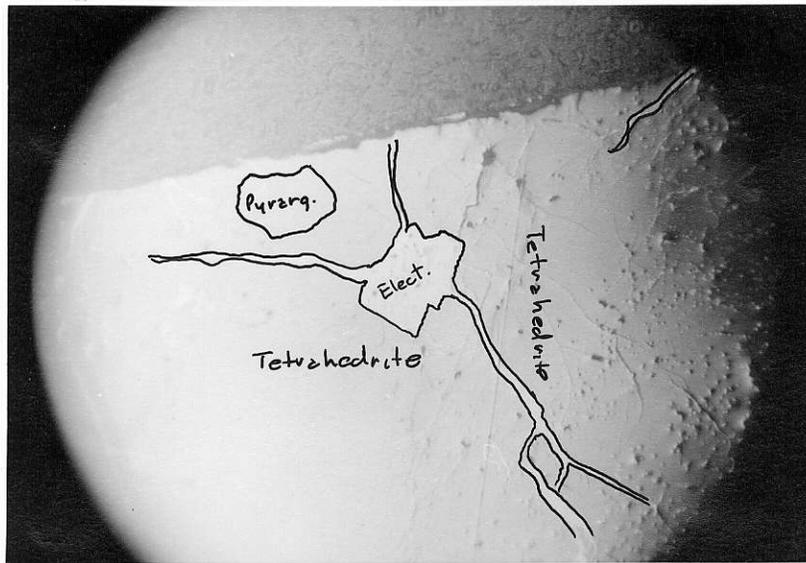


FIGURE 9 - Electrum filled fractures in tetrahedrite with some replacement. Tetrahedrite has also replaced pyrrhotite.

(x80)



FIGURE 10 - Electrum replacing tetrahedrite, & electrum filled fractures in tetrahedrite.

(x80)

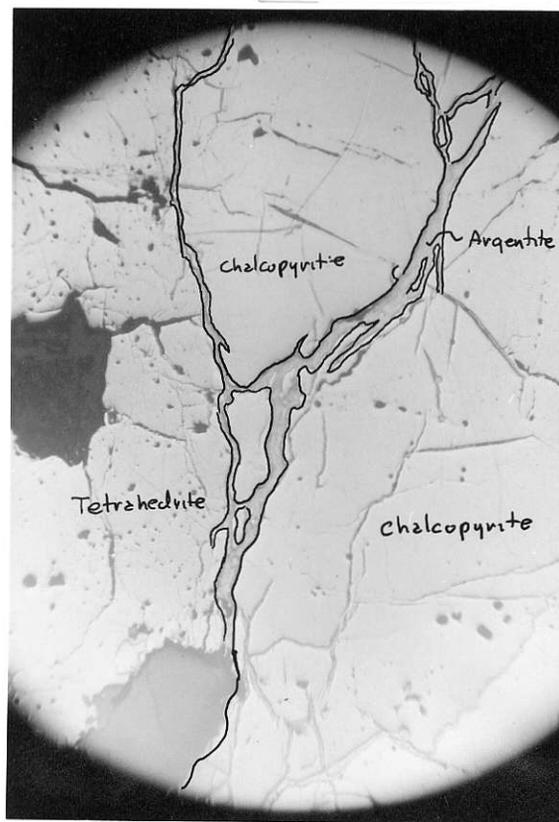


FIGURE 11 - Argentite filled fractures in chalcopyrite and tetrahedrite. (X80)

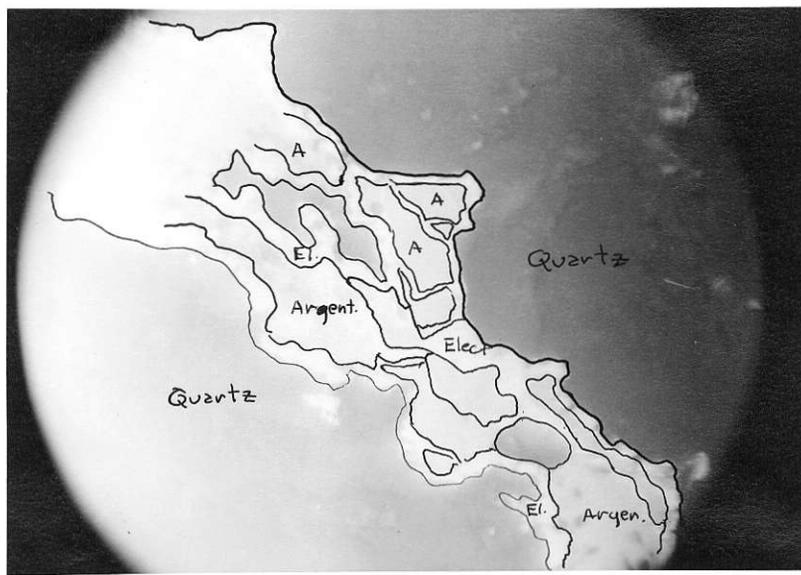


FIGURE 12 - Argentite and Ag-rich electrum filling quartz fracture. Electrum is very high in silver & probably formed by breakdown of argentite at low temperature. Electrum is later than argentite. (X200)

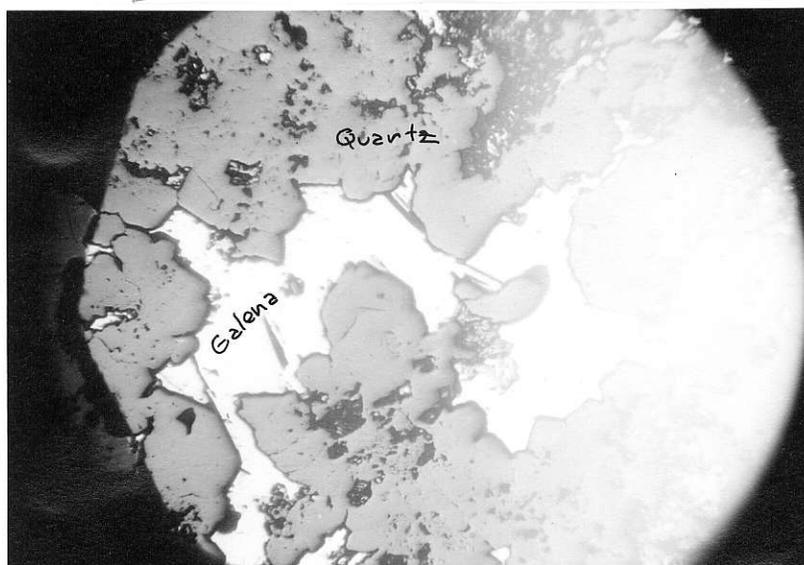


FIGURE 13 - Replacement of galena by quartz
with carrier textures.
(X 30)

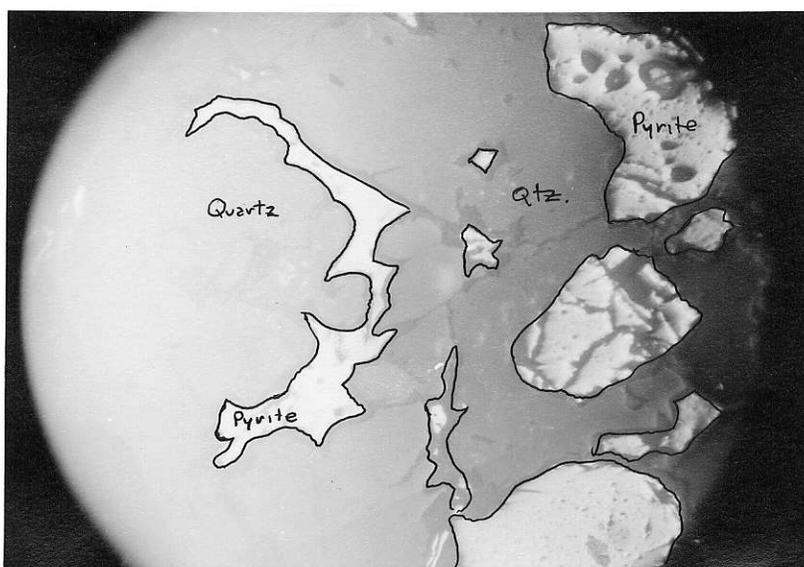


FIGURE 14 - Replacement of pyrite by secondary
quartz or jasperoid, carrier texture.
(X 80)

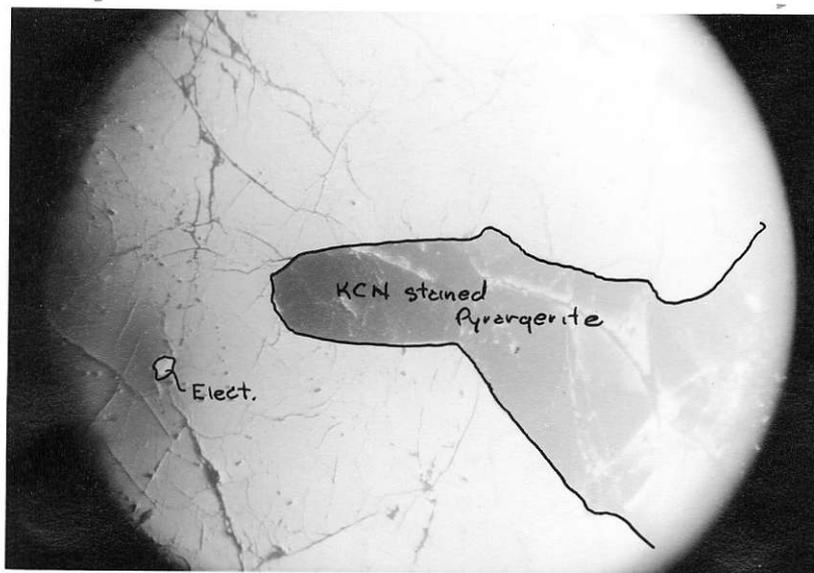


FIGURE 15- Identification of ruby silvers or silver-sulfosalts from tetrahedrite by KCN etch test. KCN stains pyrrhotite black.

(X80)

PARAGENETIC SEQUENCE

Vandeven Diagram (Figure 16)

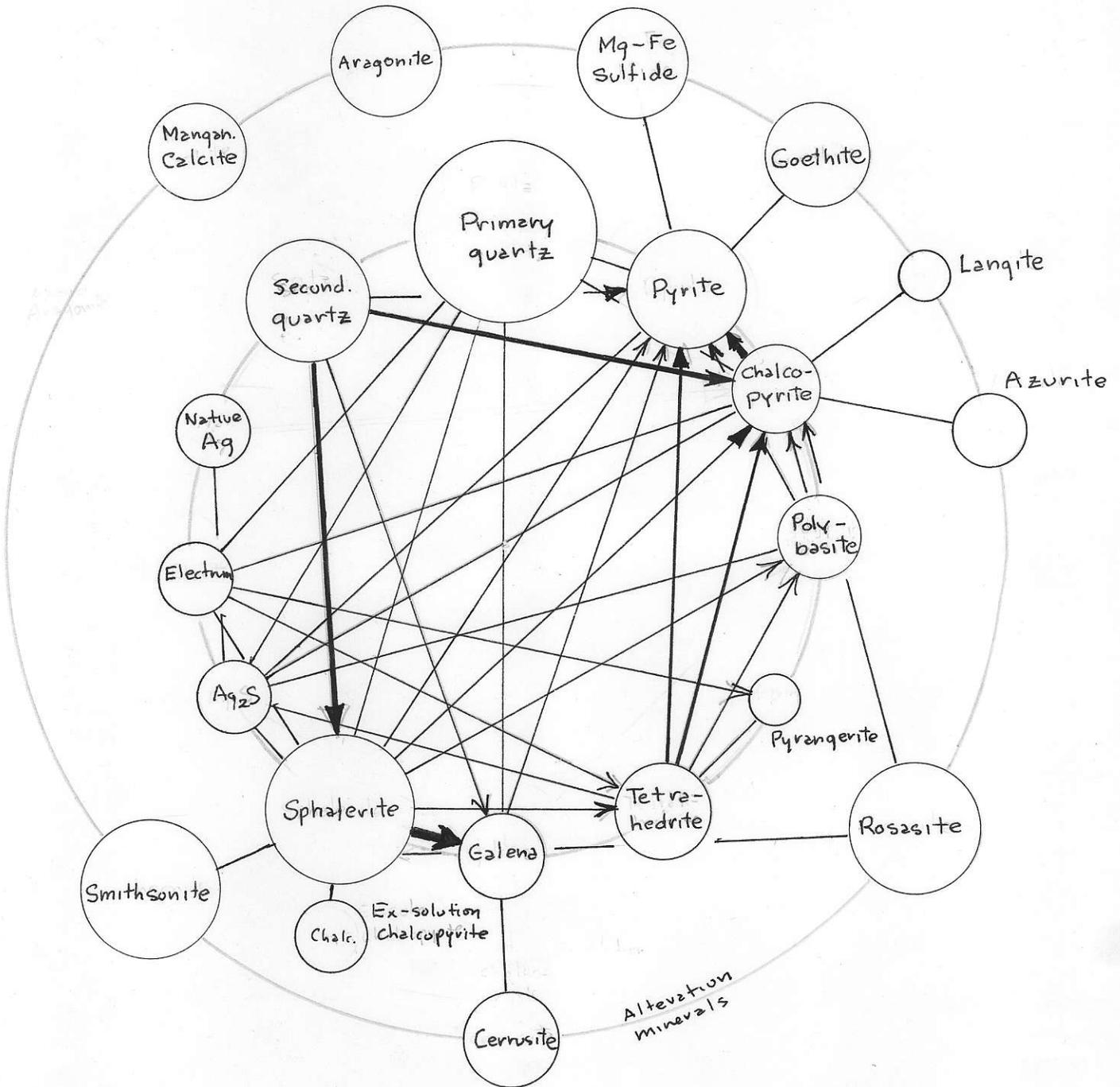


Figure 16.

Paragenesis

The paragenetic sequence is illustrated by the Vanderveer diagram. (Figure 16) The sequence appears to have formed in stages which may overlap one another to some extent. The following is a summary of the stages of mineralization.

Stage 1 - Formation of the main shear zone followed by extensive silicification along the zone to form the quartz veins.

Stage 2 - Fracturing of the silicified rock and deposition and replacement of pyrite, chalcopyrite, and possibly other minerals including gold.

Stage 3 - Re-fracturing and deposition of the silver sulfo-salts, tetrahedrite (friebergite), galena, sphalerite, argentite, electrum and native silver, accompanied by replacement of preceding minerals. Sphalerite precipitated ex-solution chalcopyrite and has strongly replaced other sulfide minerals.

Stage 4 - Further silicification and replacement of sphalerite, pyrite and chalcopyrite by clear quartz.

Stage 5 - Alteration of primary sulfides to goethite, langite, azurite, linarite, rasasite, cerrusite and smithsonite.

Classification of Ore Deposit

The deposit is best classified as a leptothermal deposit, having been formed at depths and temperatures between those of epithermal and mesothermal deposits. This is suggested by zoning characteristics which occur in regions of the mine. No zoning was evident in the specimens observed. Temperature of formation has been estimated to be between 300°C and 500°C and at a minimum depth of 4000 feet. (Edwards) The temperature below which the sphalerite-chalcopyrite solid solution will unmix has been determined as between 350°C and 400°C. (Buerger 1934)

WORKS CONSULTED

- (1) Minister of Mines and Petroleum Resources, Annual Reports for 1937, 1959, 1960.
- (2) Texture of Ore Minerals, A.B. Edwards
Published by The Australasian Institute of Mining and Metallurgy.