

GEOLOGY 409

Pretmier

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PREMIER MINES LTD.

Introduction

The Premier Mine is located on the east side of Cascade Creek, approximately 14 miles north of Stewart. Stewart is at tide-water near the head of Portland Canal and is the nearest town. Development of this property began in 1918 and it operated continuously from 1922 until 1953. After sporadic production for several years the property was re-opened in 1959 with limited ~~production~~ mining of a high-grade ore shoot in the south wall of the old Premier glory-hole.

General Geology

The area surrounding the mine is underlain by greenstone, tuffs, and sediments of Mesozoic age. These rocks are intruded by an orthoclase porphyry of about 2 miles diameter and called the Premier porphyry. This stock sends numerous sill-like and dike-like tongues into the surrounding greenstone and sediments and is intruded in turn by a granodiorite outlier of the Coast Range complex. (See Figure 1)

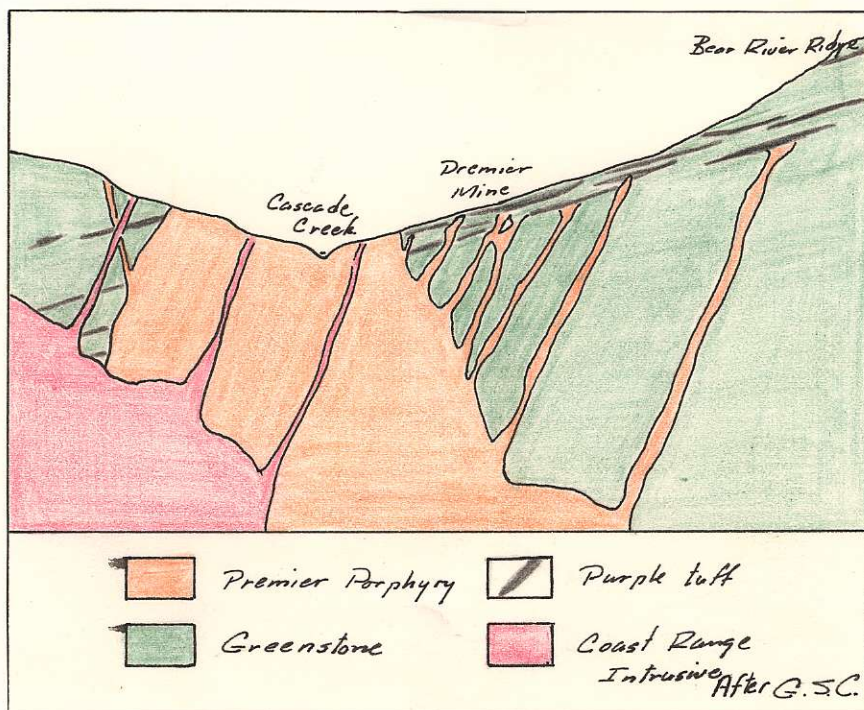


Figure 1. An Idealized X-Section of Premier Mine Area.

It is generally accepted that the Premier ore bodies owe their origin to the Coast Range intrusions.¹ A corollary of this view is that the open-fractured porphyry served as an escape avenue through the comparatively impervious volcanics for mineralizing solutions from the cooling granodiorite .

The Premier ore bodies occur along or closely parallel to the porphyry-greenstone contacts and are normally capped by the impervious purple tuffs or associated sediments. Mineralization within the ore bodies is strongly controlled by faulting and shearing.

Megascope Examination

On the basis of appearance and minerals present, the hand specimens of this suite can be divided into four groups.

1. Highly fractured volcanic tuff and quartz with mainly pyrite mineralization. The pyrite is granular to massive, and well formed cubic and pyritohedral crystals are present in many vugs and solution cavities.
2. Massive sulfide mineralization; primarily sphalerite and galena with lesser amounts of pyrite, chalcopyrite, tetrahedrite, and polybasite. Some of the samples are fresh and unaltered whereas others, apparently from a weathered zone, are coated with a covering of fine grain, black, sooty material. This sooty material is probably an alteration product of sulfides, particularly galena, tetrahedrite, and polybasite.
3. Intensely fractured quartz mineralized with chalcopyrite, polybasite, and silver. The native silver is present as thin, ~~xxx~~ irregular plates plastered on the fracture surfaces of the quartz and also along fractures in the sulfides.
4. Spongy masses of quartz, primary sulfides, and secondary alteration products. Identification of the secondary minerals by X-rays (Dr. R. M. Thompson) revealed them to be the rare minerals rosasite, langite, and linarite. Their physical properties and nature of occurrence are described below.

1. Canadian Ore Deposits, Canadian Institute of Mining and Metallurgy.

Rosasite $(\text{Cu, Zn})_2(\text{OH})_2(\text{CO}_3)$

Crystal system and class: apparently monoclinic, pseudo-orthorhombic.

Habit: in mamillary, botryoidal or warty crusts with a fibrous or spherulitic structure.

Tenacity: brittle

Hardness: $4\frac{1}{2}$

Density: 4.0-4.2

Color: green, bluish-green, and sky blue.

Luster: waxy, ~~x~~ translucent

Occurrence: A secondary mineral, rosasite is found in oxidized lead-zinc-copper ores.

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

Crystal system and class: monoclinic, 2/m

Habit: crystals elongated and often tabular, singularly or in groups as crusts and confused aggregates.

Cleavage: (100) perfect; conchoidal fracture

Hardness: $2\frac{1}{2}$; brittle

Density: 5.35

Color: deep azure-blue; vitreous and translucent

Occurrence: Linarite occurs in small amounts as a secondary mineral in the oxidized zone of copper and lead deposits. In this suite it is intimately associated with the native silver; the native silver appears to have had a precipitative effect on the linarite.

Langite $\text{Cu}_4(\text{SO}_4)(\text{OH})_6 \cdot \text{H}_2\text{O}$

Crystal system and class: orthorhombic

Habit: crystals small, equant or elongated (100).

Also as laths, scales, and fibro-lamellar crusts.

Hardness: $2\frac{1}{2}$ - 3

Density: 3.48 - 3.50

Luster: crystals vitreous, crusts somewhat silky.

Translucent

Color: fine blue to bluish-green

Occurrence: Langite is a secondary mineral which occurs in the oxidized zone of some copper deposits.

With the exception of some of the samples of massive sulfide mineralization, the majority of the samples of the suite are characterized by an abundance of vugs and solution cavities.

Microscopic Examination

Those minerals observed and identified in the polished sections are listed below along with their diagnostic properties.

1. Pyrite FeS_2
2. Sphalerite ZnS
3. Galena PbS
4. Chalcopyrite CuFeS_2
5. Gold Au
6. Polybasite $8\text{Ag}_2\text{S} \cdot \text{Sb}_2\text{S}_3$

POLISH	- excellent
COLOR	- slightly greyish white
HARDNESS	- C
STREAK	-
PLEOCHROISM	- none visible
ANISOTROPISM	- distinct; deep blue to olive green
TWINNING	- none
INT'L REFL'N	- red int'l refl'n doubtful
CLEAVAGE	- none
ETCH TESTS	- HgCl_2 tarnished irred. KOH etched slightly & tarnished irred. KCN rapidly etches black HCl neg. FeCl_3 <i>tarnished wred.</i> HNO_3 <i>fumes tarnish</i>

Minerals (cont'd)7. Native Silver Ag

POLISH	- excellent but rough in places
COLOR	- bright creamy white
HARDNESS	- B
STREAK	- bright metallic
PLEOCHROISM	- none
ANISOTROPISM	- none
TWINNING	- none observed; didn't etch specifically
INT'L REFL'N	- none for.
CLEAVAGE	- none
ETCH TESTS	- HgCl ₂ brown stain KOH neg. FeCl ₃ stains irred. KCN stains brown HCl neg. HNO ₃ effervesces

No argentite was observed in either hand specimens or in polished sections. Its presence is not unlikely, particularly in view of the presence of some wire silver.

The silver was not etched specifically to determine whether it is supergene or hypogene.

Mode

The abundance of the minerals observed is as follows:

	Pyrite FeS ₂	20%	
	Sphalerite ZnS	25%	
<i>Tetrahedrite</i>	Galena PbS	25%	< 10%
Primary	Chalcopyrite CuFeS ₂	20%	15%
	Polybasite 8Ag ₂ S · Sb ₂ S ₃	10%	5%
	Silver Ag	2%	
	Gold Au	< 1%	
	Rosasite (Cu,Zn) ₂ (OH) ₂ (CO ₃)	1%	
Secondary	Langite Cu ₄ (SO ₄)(OH) ₆ · H ₂ O	< 1%	
	Linarite PbCu(SO ₄)(OH) ₂	< 1%	
	Limonite HFeO ₂	< 1%	

Textures and Paragenesis

The earliest deposited mineral of the Premier Suite is pyrite. It is present now as euhedral to anhedral crystals, many now having been corroded and replaced by later sphalerite, galena and gangue. Figure 5 is an example of replacement of pyrite by galena.

Textures

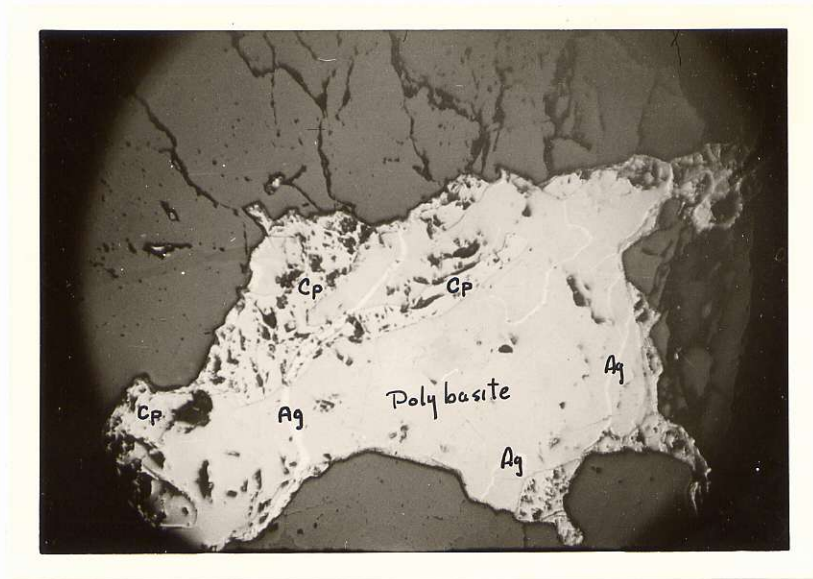


Figure 1. Replacement of polybasite and chalcopyrite by silver.

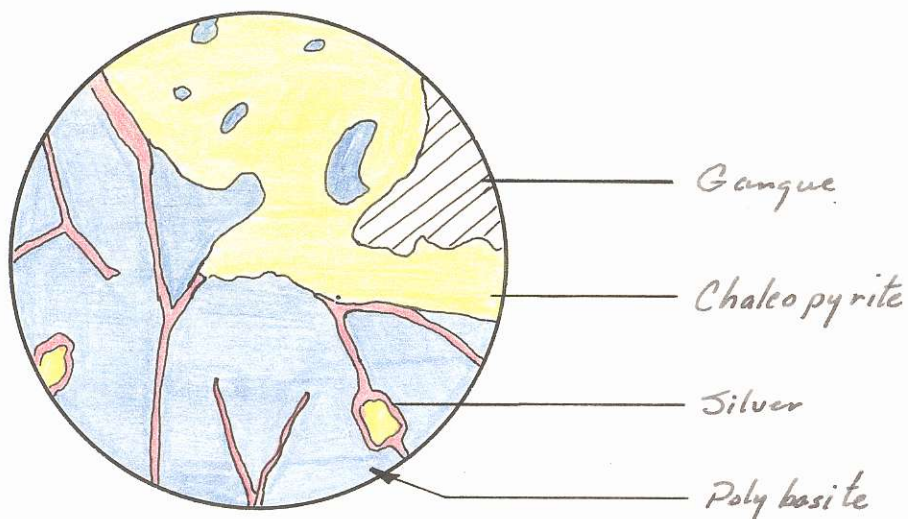


Figure 2: Replacement of chalcopyrite by polybasite and replacement of both in turn by native silver. (x 90)

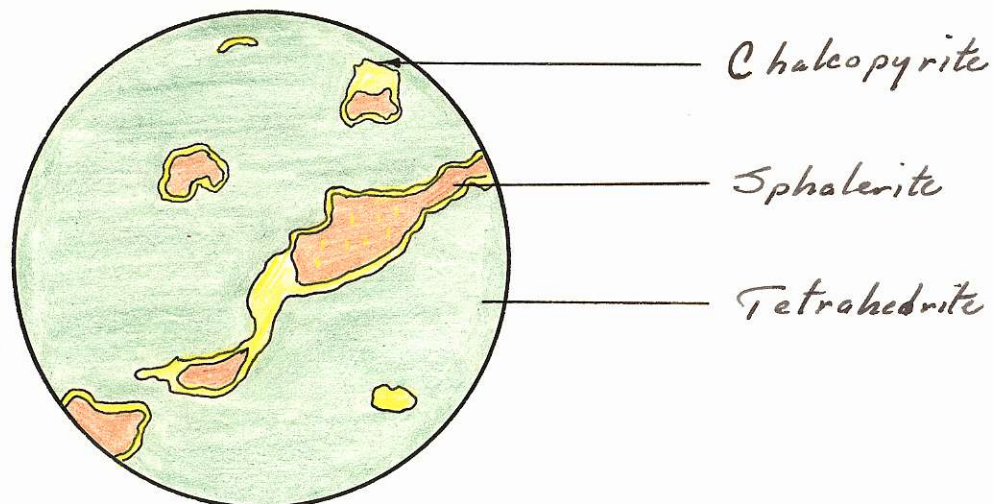
Textures

Figure 3. Rim texture of chalcopyrite bordering sphalerite. Result of unmixing of melt. (x 320)

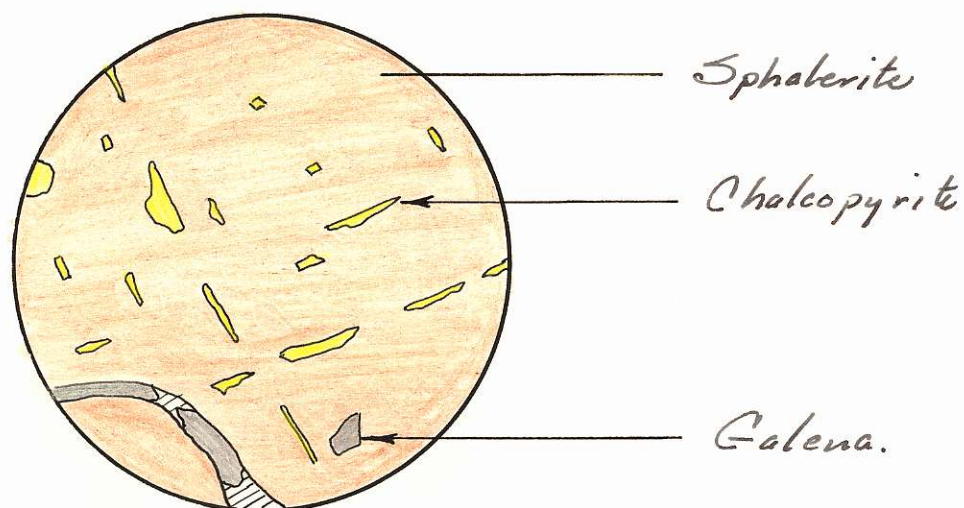


Figure 4. Emulsion texture of chalcopyrite ex-solution bodies in sphalerite. Ex-solution bodies show a seriate arrangement. Vein of galena cuts the sphalerite. (x 320)

Textures (cont'd)

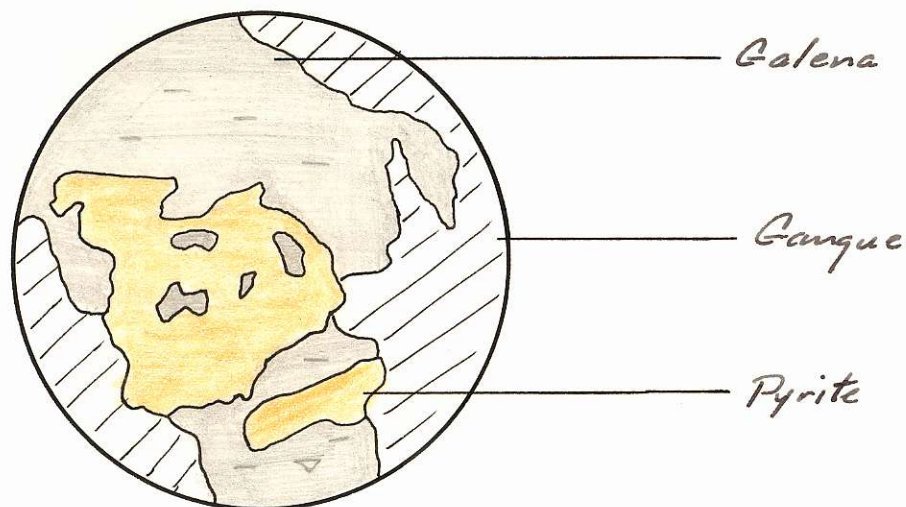


Figure 5. Replacement of pyrite
crystal by galena. (x40)

The second mineral deposited was tetrahedrite. Although it is in contact with pyrite, no boundary relationships confirming tetrahedrite's later age were observed. It is placed second in the paragenetic sequence on the basis of the fact that all later minerals are observed in replacement relation to it.

Deposition of tetrahedrite was followed by the approximately contemporaneous deposition of sphalerite, chalcopyrite, and galena. Much of the chalcopyrite was brought in ~~in~~ ~~with~~ ~~sphalerite~~ ~~and~~ ~~galena~~ ~~and~~ ~~intermixed~~ with sphalerite. Where the solutions cooled sufficiently slowly, chalcopyrite unmixed from sphalerite to form rims around the sphalerite and also free blebs. Where cooling was more rapid, chalcopyrite occurs as exsolution bodies arranged along lattice planes in the sphalerite. (See Figures 3 & 4) Galena was brought in only slightly later than sphalerite and chalcopyrite. A small fracture filling of galena ~~with~~ cutting sphalerite is present in Figure 4.

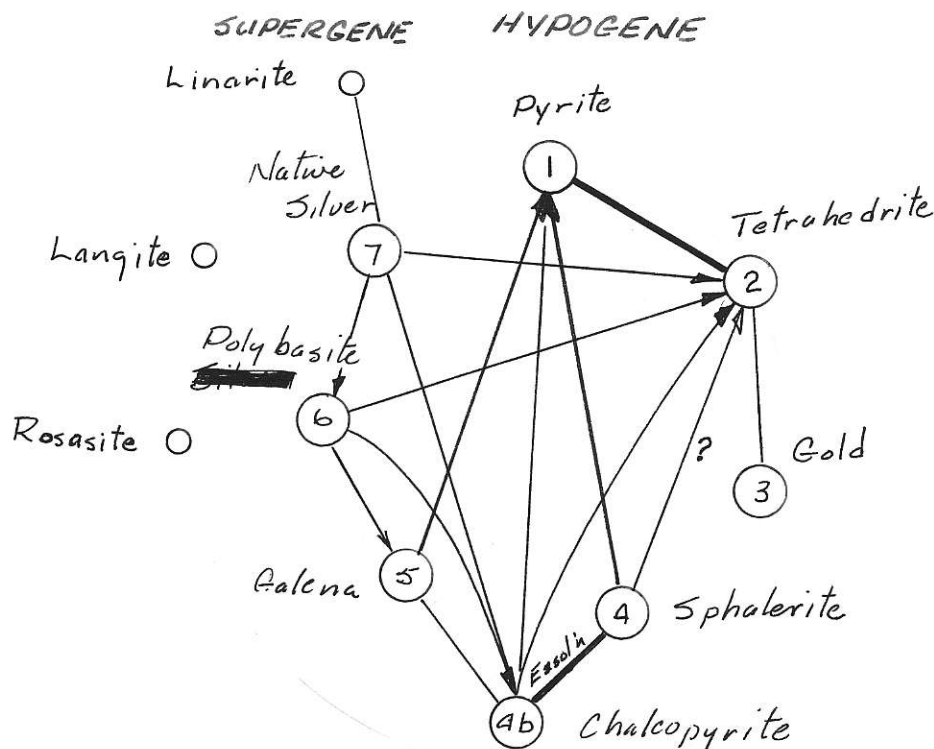
Textures and Paragenesis (cont'd)

The next mineral to be brought in was polybasite. It was observed in definite replacement relationship to tetrahedrite and in a less definite replacement relationship with chalcopyrite. In most places polybasite and chalcopyrite have a common boundary relationship, the only evidence for replacement ~~of~~ being a few unsupported nuclei of chalcopyrite within polybasite.

Late fracturing of the quartz gangue and those minerals already deposited provided access for the final phase of mineralization, native silver. The native silver is present as dendritic plates plastered on the fracture surfaces of the quartz and also along fractures in the polybasite. The low temperature at which the native silver was emplaced is evident ~~XXXXXXXXXXXX~~ by the way it is confined primarily to fractures, replacing polybasite to a very limited extent only. (Figures 1 & 2) Native silver replaces chalcopyrite only very reluctantly, and in most places allows its outline to be controlled by the chalcopyrite.

An occasional bleb of gold was observed, both intergranular in the fractured quartz gangue and in tetrahedrite. The maximum size was 0.3 mm. dia. No definite time of emplacement can be established for the gold other than that it ~~XXXXXXXXXXXX~~ was either contemporaneous with the tetrahedrite or of some later time.

The above paragenetic relationships are illustrated on the Vanderveer diagram below.



Type of Deposit

Mineralization of this deposit occurred through a temperature range of ~~xx~~ from somewhat above 550°C for deposition of pyrite to very low temperatures for deposition of native silver. On the basis of mineral assemblage, the deposit would be classified as a low to intermediate temperature hydrothermal replacement deposit.