Pretty fair grasp of things due to intimate knowledge re comp. Not too discriminating otherwise.

A Mineralographic Report of ores of the 3-D stope Silbak Premier Mine

March 21, 1959 Geology 409 B. Murphy

INTRODUCTION

Purpose of Report

This report is an investigation of the ore from the 3-D stope of Silbak Premier Mines, Limited. Premier B. C. Emphasis has been placed upon the genesis of the ore minerals encountered. In addition, a description of the Premier Mine dealing with its colorful past, its production, and general geology is included as part of the interest shown in this world famous mine, which in its early years of production was considered to be a bonanza type of gold - silver deposit.

Method of Report

Both laboratory as well as library studies were undertaken. The laboratory study consisted of microscopic methods of determining and studying the ore minerals. The geology and history of the Premier mine was obtained from library and personal references.

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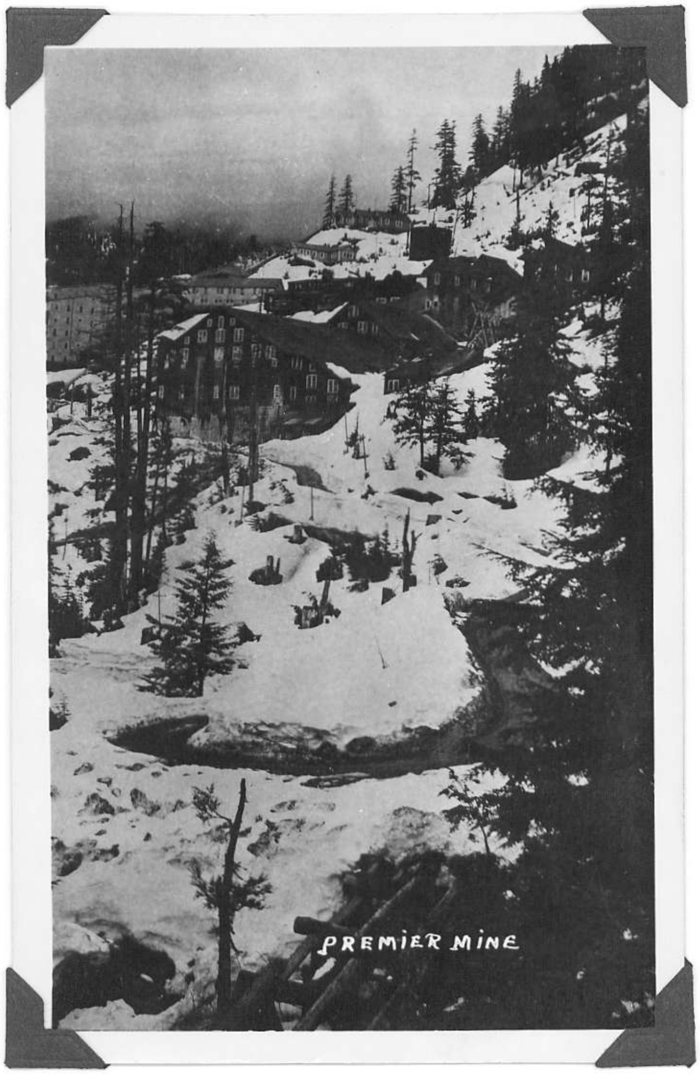


Premier Mine

Camp was constructed in 1919
and served mining operation until
1953. On Nov. 16, 1956 fire destroyed
lower buildings (mill); mine bunk houses
(left) were saved as well as mine office
and residences (top left).

CHAPTER I

PROPERTY

Silbak-Premier Mines was incorporated in 1919 as the Premier Gold Mining Company and is a reorganization of the former Salmon-Bear River Mining Company. During the years 1919-1935 the company operated under the name Premier gold mining company and had holdings consisting of 17 claims and fractions; .... present holdings now consist of 77 claims and fractions. In May 1935 an agreement was reached between the Premier interests and the Selukwe Company at that time controlling B. C. Silver Mines and Sebakew Mines adjoining the Premier holdings, (see ref. map 2, page 7) such that a new company, to be known as Silbak Premier Mines, Limited, was to jointly operate the three properties. The newly organized company operated almost continuously from 1935 until 1953, when the Premier mine now working below its sixth level and having an output largely composed of lead and zinc was forced to close because of a drastic price reduction in these base metals. Attempts have been made since that time to reopen the once famous mine, but as yet they have not been successful.

LOCATION

The property of Silbak-Premier Mines is situated ten miles north of the terminus of the Portland Canal in British Columbia. The Premier mine (56° 130° S.E.) lies within the Salmon River mining district and is situated on the western slope of Bear River ridge on the Cascade River, just north of the International boundary. (....see maps 1 and 2 next page). The mine is reached by road from Stewart, B. C., a distance of 14 miles. Stewart is served by coast steamship service from Vancouver, B. C., a distance of some 700 miles. The aerial extent of the claims held by Silbak-Premier Mines Limited in the Salmon River District is shown on page 7 . The claims consist of the original Premier Gold Mining Co's 17 claims and in addition 1935 (Premier Border and B. C. Silver Co.) claims which previous to this were held by Selukwe Gold Mining and Finance Company as previously mentioned.

HISTORY AND PRODUCTION

The Premier mine has had one of the most colorful histories related to a gold rush as any mine in the western part of North America. Its discovery goes back to the spring of 1910 when a rich gold strike was reported in the Portland Canal area of British Columbia. The story of this strike spread by wire and newspaper across the North American continent, and also to London, England. Sensational headlines read "The mountain of gold" and "The Gold Reef Twenty Miles Long", near Stewart, British Columbia. Within days a gold rush was on, and the town of Stewart grew from a townsite of tents comprising about 600 individuals to 10,000 people, over night. First rate hotels were erected, leading banks established branches, a newspaper, Stock Exchange, electric light and water system, along with telephone and telegraph service were rapidly installed. With the building boom came the building

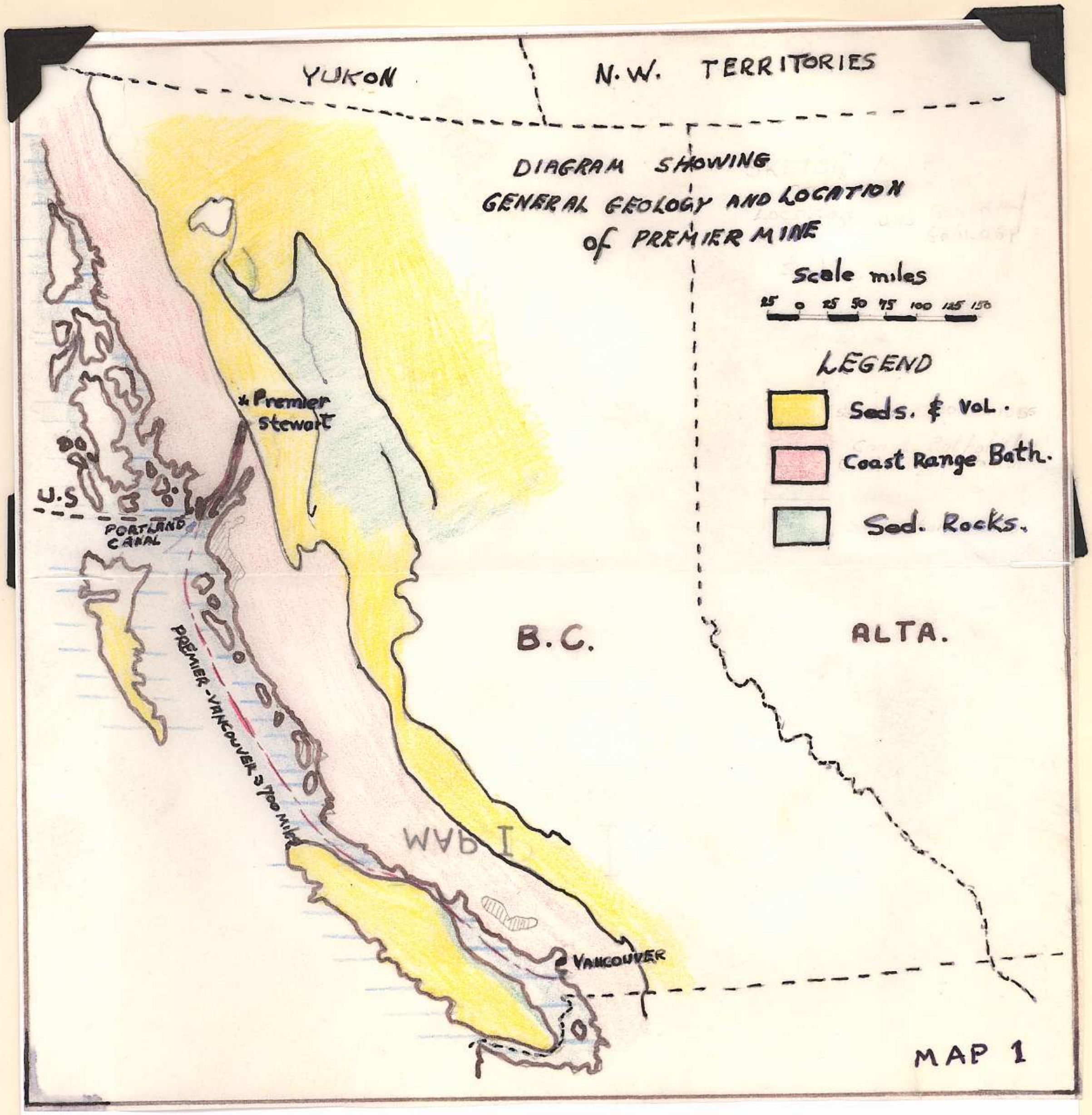
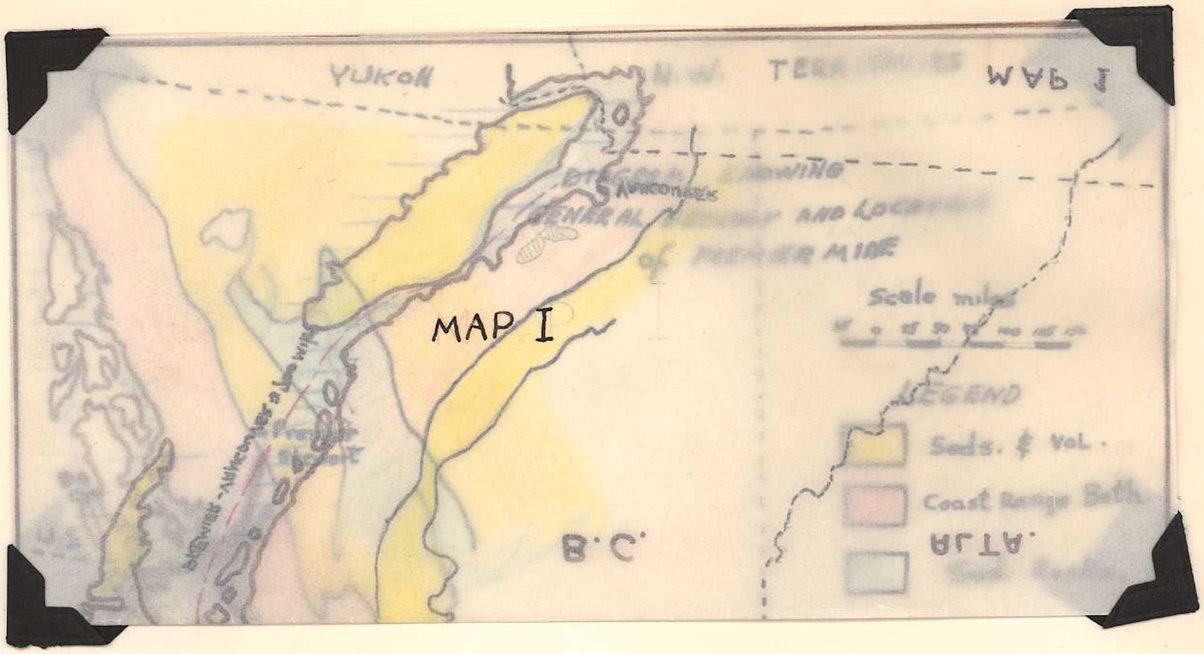


Diagram showing position of the groups of Mineral claims of Silbak-Premier Mines in Salmon River District.



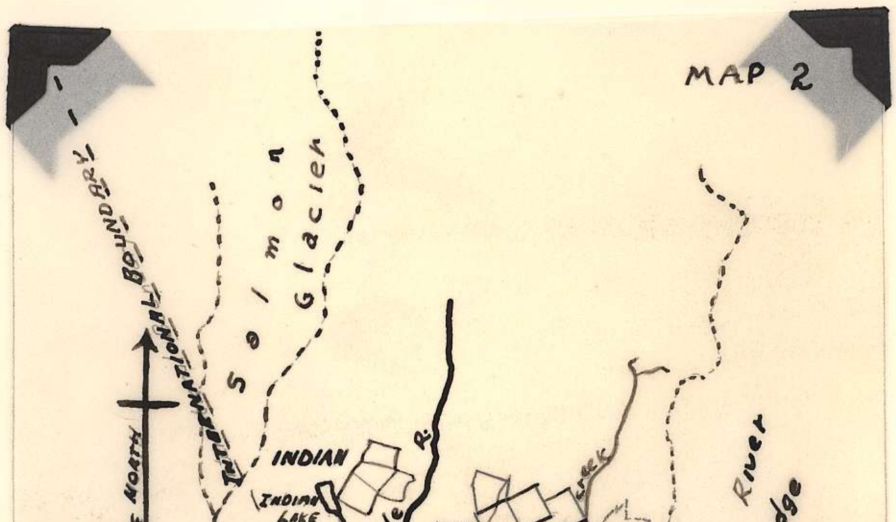
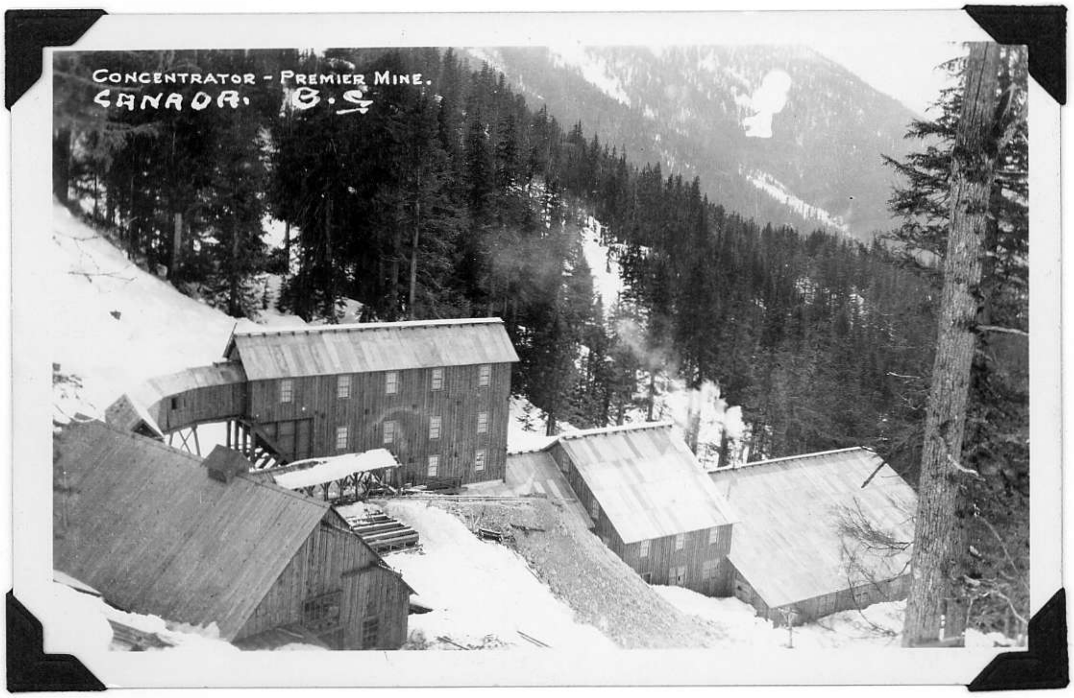


Diagram showing position of the groups of Mineral claims of Silbak-Premier Mines in Salmon River District.



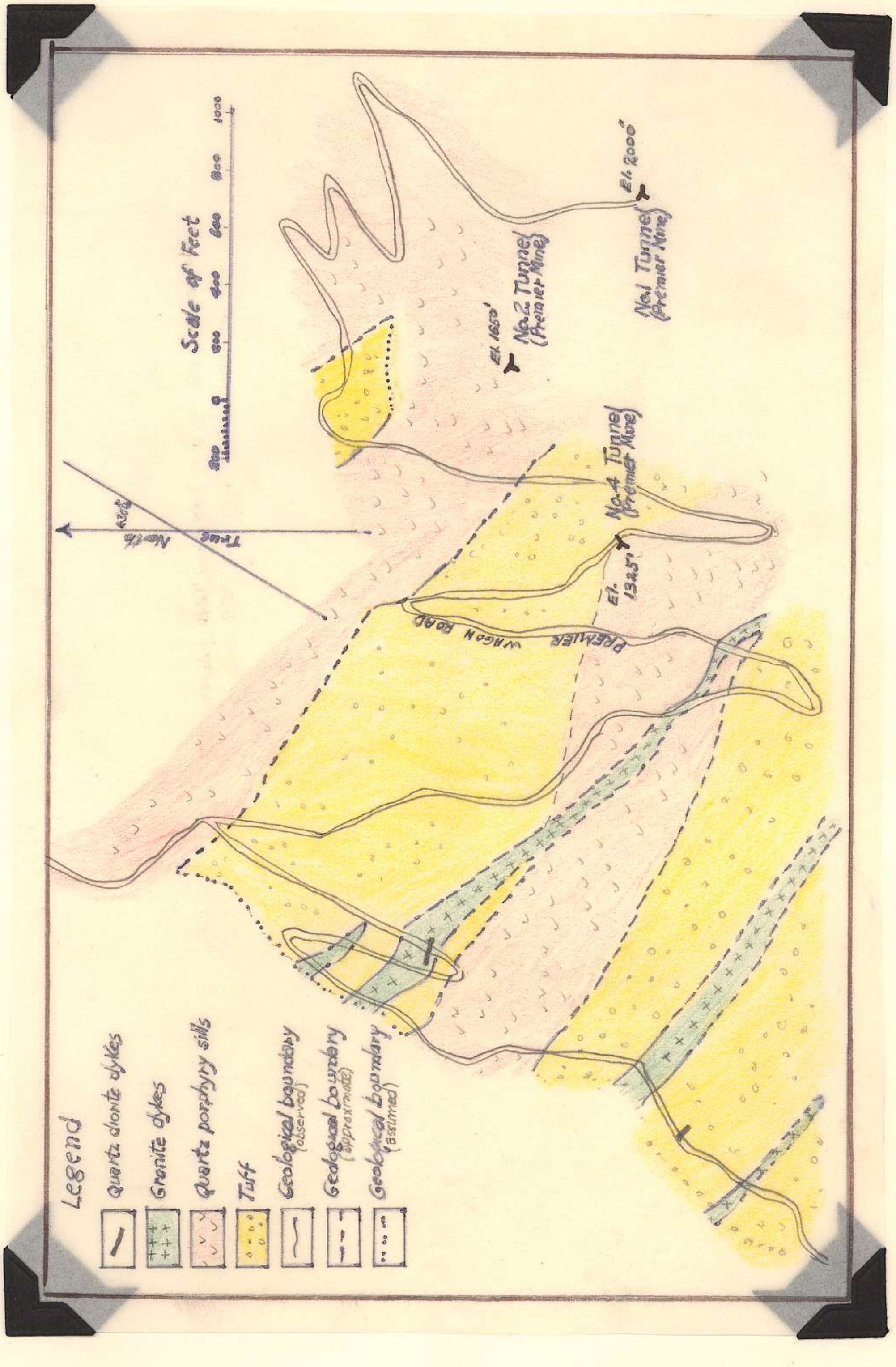
Premier Concentrator
From 1919 - 1926 cyanidation was employed in milling operations; re-designed in 1926 - 28 for flotation treatment of ore the concentrator operated until 1953. In 1956 during preparations for reopening, the concentrator was destroyed by fire.

of a railway which extended some 14 miles into the Bear River valley, and which was expected to be the Pacific port of the Canadian Northern Railway in the west. In anticipation of becoming wealthy, mining companies erected mills on these properties, as well as aerial tramways and ore loading facilities before drilling results justified such spending. Skepticism began to grow as drilling on small highgrade veins showed the ore to be shallow. Real estate values were the first to drop, in one instance an acreage on Bear River, worth $60,000 could not be sold for $600 after the belief that the ore was only a sprinkling and was finished. The railway with no future prospects, since the town was abandoned, was dissolved. With the coming of the first world war disillusionment further set in and only 17 miners and prospectors remained and continued to hand mine rich veins in the hills. One of these, an old Kootenay miner named Pat Daly believed he had finally struct it, just a small quartz vein, 6 inches wide, ...he finally interested a New York concern to look at the property but the company remained skeptic because of the first rush and finally dropped their interest in the property. Daly, still unbeaten continued to hand mine the vein and finally made a small sacked shipment of ore to the Tacoma smelter. The American smelting and Refining Company at Tacoma, interested in the high gold and silver values, made a detailed examination of the property, and through the recommendation of their engineer, D. L. Pitt (deceased) purchased the property from Daly for $20,000. Later the Guggenheim interests in New York financed a portion of the money needed for development, and united with the American Smelting and Refining Company, who were to manage the mine development. A 100 ton mill was completed in 1921 which recovered the values in part as cyanide precipitates and in part as table and flotation concentrates, however three-quarters of all the ore mined was shipped directly to the smelters because of its high grade. Development of the mine was slowed down greatly due to transportation difficulties from mine to tide-water. It was therefore decided to install an aerial tramline which, completed in 1922, had a total span of 11-1/2 miles from the No.4 level, and while operating was the longest of its kind in the world. In 1926 the mill was revised and cyanidation was abandoned. By 1933 all ore mined was milled, and the capacity of the mill was increased intermittently until in 1935 it was treating 550 tons per day, the largest portion being primarily lead and zinc concentrates. Following the merger in 1935 with the Selukwe interests the Premier workings were extended and connected with the Sebabew levels, in which a greater extent of the future workings were contained. The mine continued to operate steadily until the second world war and then through the wars years operated on a reduced basis because of the labor shortage. From 1946 to 1953 its output was largely composed of lead-zinc concentrates with minor amounts of gold, silver and copper. Up to 1953, based on current values, the Premier mine has been one of the greatest producers in B.C.'s history. Total production is in excess of $100 million dollars worth of gold, silver, lead, zinc and cadmium paying dividends of $27 million, the highest of any B. C. mining operation next to C.M. and S. Co. It has paid out a value in wages equal to $15 million, and a value of $5 million for supplies. Three and three quarter million tons of ore have been mined. This includes 1,800,000 ounces of gold; 41,800,000 ounces of silver; 23,000,000 pounds of lead; 16,000,000 pounds of zinc and 122,000 pounds of cadmium. It is interesting to note that in its initial development stages during 1919 - 1922 it had declared dividends of $3,050,000 or 63% of its capital stock and thus became the most profitable mining property in Canada. By 1924 the dividends rose to a total of $6,649,625 during which time (1919 - 1924) $15 million worth of ore had been mined.

GEOLOGY

General geology of mine area

A series of greenish to purplish tuffs, usually very fine grained underly the area, and are overlain by drift and heavy vegetation. These tuffs are intruded along their bedding planes by sills (Premier sills) of Quartz porphyry. The tuffs are the younger members of the Bear River formation. In the vicinity of the Premier mine the attitude of the tuffs is variable and ranges from N 80° to N-S with dipping to the west and southwest at angles of 45° to 70° which in turn correspond to the slope of the hillside. The rocks in the vicinity of the upper workings of the mine are highly sheared, especially at the contact of the quartz porphyry sills and the tuffs. Intruding the previously mentioned rocks are light colored dykes having the composition of quartz-diorite, these strike northwesterly and have been found cutting the primary ore bodies in the district, however, the ore bodies of the Premier as well as the quartz diorite dykes are cut by lamprophyre dykes, that are believed to be the youngest rocks in the district.



Map 3

Diagram showing surface geology in vicinity of Premier Mine.

The lamprophyre dykes are well exposed in the Premier tunnels and are usually narrow and dark in color.

MINE GEOLOGY

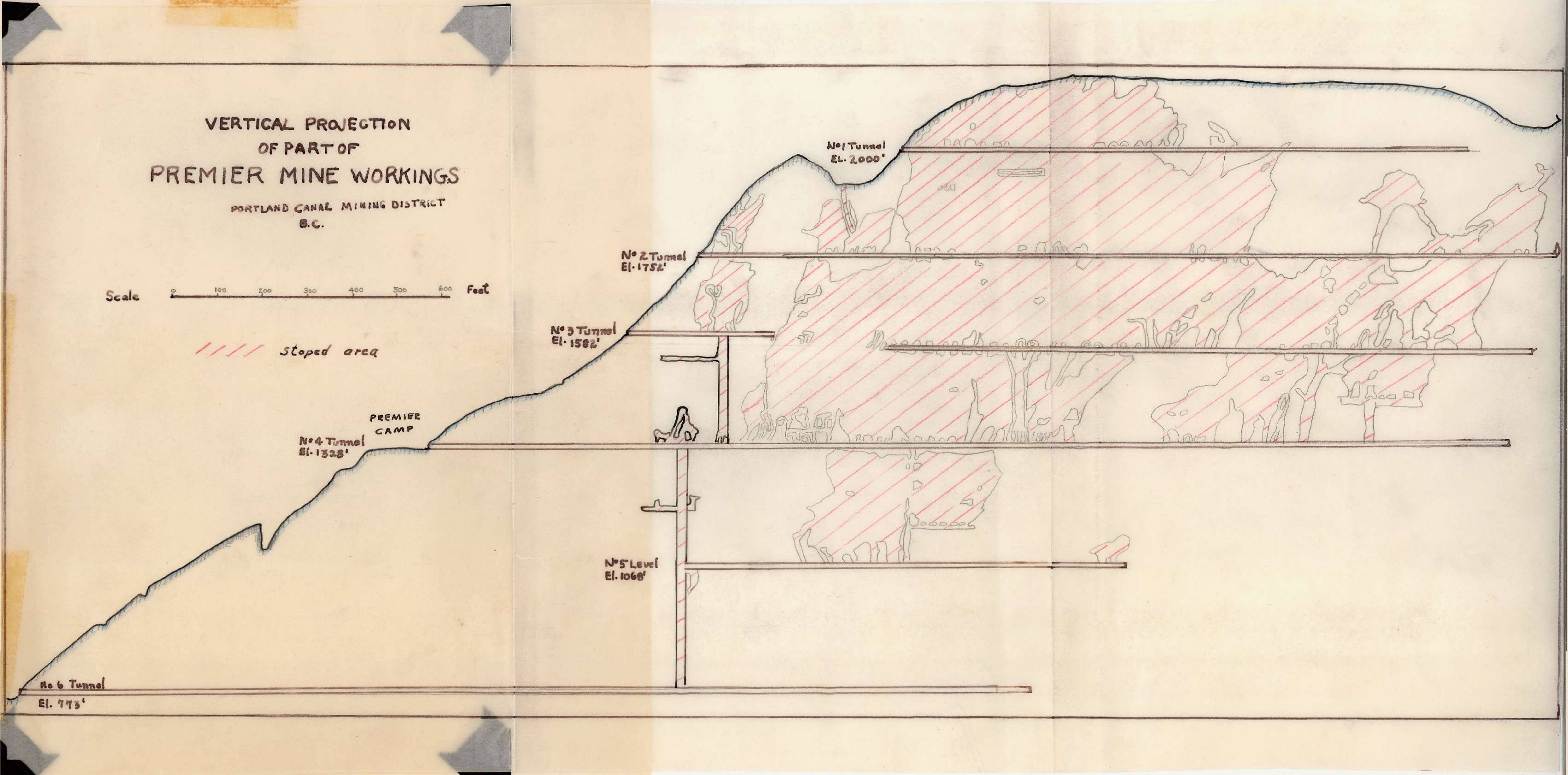
The ore bodies in general show a trend N 80°E/N80-70°W. This occurrence seems to be controlled at the contact of a quartz-porphyry sill and overlying tuffs, both highly sheared and metamorphosed around the ore bodies. Mineralization has partially replaced the wall rock on both sides of the ore bodies, and in doing so extensive silicification of the wall rock has resulted. In localization of the ore a significant fracture pattern exists such that the greatest concentration of ore lies at the intersection of the fractures. The faults in the mine are N-W fractures and lie roughly parallel with the Batholitic contact, occurring at right angles to the general fracture pattern, they are early and do not cut off the ore bodies, however they do set the mineralization off to the north-west.

GEOLOGIC SEQUENCE OF AREA

The deposit lies at the eastern contact of the coast range Batholith and the Hazelton group of rocks. The geologic legend exhibits the following occurrence:

Late	Lamprophyre	dykes
	Granodiorite	dykes
	Nass River	slates
	Mineralization	
	Coast Range Batholith	
	(Premier Porphyry - premier sills	
Hazelton Group	(Agglomorates	
U. Jurassic	(Coarsely Purple tuff	
	(Fine grained green tuffs	
	(Lavas with local volcanic breccia	

The mineralization is associated with the period of dyke intrusions, which is believed to be the closing of the Coast Range Batholithic intrusion. At the Premier, the ore bearing solutions found the sheared contact between the quartz porphry sills and tuffs the most favorable place for ore deposition. At a later time minor faulting occurred and following this, mineralization carrying high gold and silver values enriched the ore, concentrating it in the intersection of the fault fissures.



Mine Workings
Map 5.

3 D STOPE

Mineralogy

The 3D stope is located on the No. 3 (1582') level of the mine. The ore extracted from it was high grade gold-silver ore with varying amounts of lead, zinc and copper. The specimens from this stope are typical of the high grade ore which is associated mainly with the upper workings of the mine. Diagram 5 page 16 shows the earlier workings of the mine (up to 1930) during which time the ore was of the high grade type, and where the greatest dollar values of production were obtained. In general three types of ore have been known to occur in the Premier bodies:
a silver deposit primarily in the upper levels carrying high gold and silver values i.e. 200 oz. Ag/ton consisting of electrum, native silver, argentite, and some silver sulfosalts in a vuggy gangue of calcite and quartz; a polysulfide deposit largely composed of massive pyrite, argentite and electrum with varying amounts of the silver sulfosalts but no native silver in a gangve of quartz; and a low grade silicous gold deposit with varying amounts of lead, zinc and copper and small amounts of argentite. The mineralogy of the 3 D stope shows a variation in mineral assemblage but is more strongly related to the first two previously mentioned occurrences. The ore in the 3D stope is composed of approximately 25% base metal sulphides in a gangue of quartz and calcite and is an example of the typical assemblage of the minerals in the Premier ore. In decreasing order of abundance the minerals present are: pyrite, sphalerite, galena

chalcopyrite, argentite, native silver, polybasite and tetrahedrite, pyrargrite and minor traces of electrum.

Microscopic

Mineral Assemblages and Textures

Pyrite, the most abundant mineral has a massive texture and is extremely fractured. This fracturing has caused the formation of numerous channels in the pyrite which in turn are occupied by quartz, calcite, galena, chalcopyrite, sphalerite and argentite.

The replacement of pyrite by sphalerite (plate 1, page 19) is evident as the euhedral pryite shows irregular borders as well as portions of microscopic crystals completed replaced. The more granular pyrite (grains up to 2 mm. in diameter) is highly fractured and is not replaced by mineralization to the same extent as the previously mentioned massive pyrite. The fractures in the granular pyrite are filled with quartz, calcite, native silver, chalcopyrite, silver sulfosalts, galena and sphalerite, but the latter two do not always occur together.

PLATE I Sphalerite(grey) replacing chalcopyrite lower left; Pyrite crystal above this(diam. .5mm.) also partially replaced by sphalerite as well as containing sphalerite inclusions.

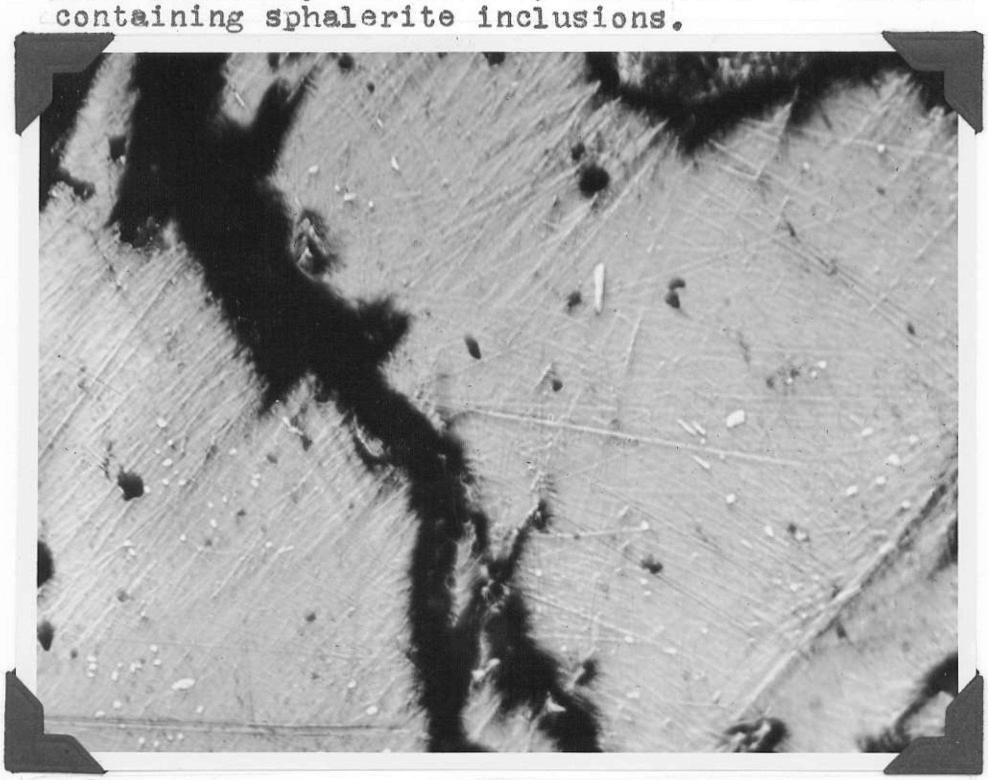


PLATE 2 Sphalerite(grey) contains minute inclusions of chalcopyrite(white) .001 mm. in dia. Chalcopyrite is not uniformly distributed in sphalerite, occurring only when the two are in contact and is an example of replacement of chalcopyrite by sphalerite.

SPHALERITE

Sphalerite, the second most abundant mineral, is associated with pyrite. (In plate 2, page 19) sphalerite has partially replaced the early pyrite. Sphalerite occurs filling the irregular fractures in the pyrite and partially replacing the latter mineral. Some minor inclusions of sphalerite in pyrite crystals occur (plate 1, page 19). The inclusions of sphalerite do not contain any chalcopyrite intergrowths and suggest that the inclusions are contemporaneous with the pyrite. However, if the sphalerite inclusions are considered to be unsupported nuclei, then there is not conclusive evidence in support of either minerals having first formed.

CHALCOPYRITE

The chalcopyrite is found associated with the sphalerite, quartz and pyrite. It occurs in quartz as minute blebs and in fractured quartz filling fractures (plate 3, page 21). Chalcopyrite is also found filling the inlet like fractures in pyrite and to a lesser degree than sphalerite replacing pyrite crystals. Supergene covellite is present as a fine scale covering the surface of the chalcopyrite occupying narrow fractures in quartz, it is not present in the massive sulphides.

Plate 3. Mag.23x

Fracture filling (.36 mm. Dia) consisting of pyrite (yellow) crystals partially replaced by chalco pyrite with supergene covellite (blue) present as well as poly basite (grey). The polybasite is later than the chalcopyrite and earlier than the native silver (white) which occurs in threadlike blebs (.1 mm. Dia.)

Plate 4.

Pyrite (white) has long inlets developed from fracturing in which electrum occurs as minute blebs (avg. 1 micron Dia.) partially filling the exterior rim of an inlet and seems to be localized by a fracture dia. of 1 micron, and thus does not occur in a fracture smaller in dia. than this. Associated with electrum is argentite (grey), chalcopyrite, supergene covellite and sphalerite.

GALENA AND TETRAHEDRITE

Galena which is more abundant than chalcopyrite is associated with sphalerite, quartz, and calcite. Tetrahedrite occurs as exsolution intergrowths in galena both when the galena is coarsely massive..plate 5 page 22. Also massive plate 6 page 22. Tetrahedrite is not a common constituent of the ores, it is found only as intergrowths in galena. Its presence is not noted in the lower workings of the mine and thus it seems to lie within a zoning which is related to the later period of mineralization of native silver, galena, and silver sulfosalts thus restricting its occurrence in the more early massive sulphides at depth.

Plate 5 Mag. 23x

Coarse massive galena (white) with abundant triangular pits developed on surface. Galena occurs chiefly in gangue of calcite and quartz and is associated with native silver and silver minerals in later enrichment of primary mineralization.

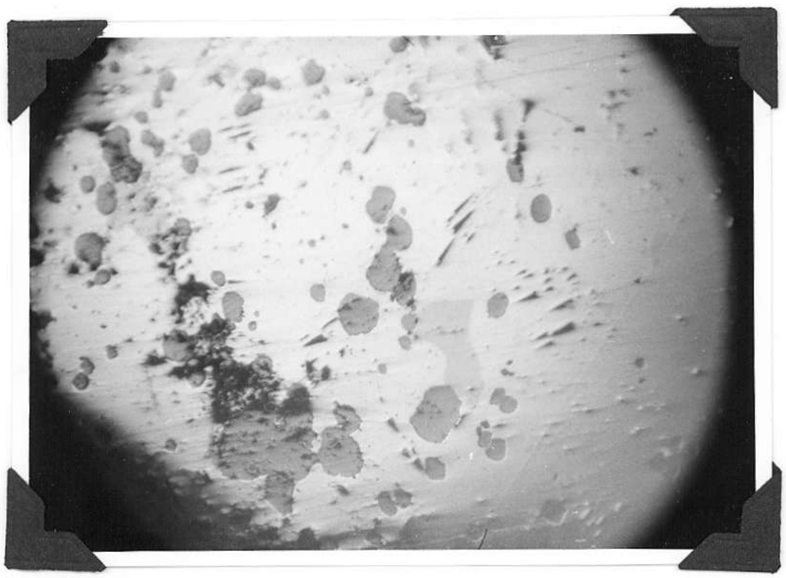


Plate 6 Mag. 23x

Fine grained massive galena showing minor triangular pits (black); dark grey mineral is sphalerite, light grey ore tetrahedrite. Galena occurs in a siliceous gangue (not shown) associated with pyrite. (Sphalerite - (galena-tetrahehrite) exhibit contemporaneous deposition and have an equigranular texture. Minor blade like rods of tetrahedrite occur in galena and are distinguished only by etching the galena with HNO_3. The tetrahedrite is non-silver bearing. Minerals shown are related to second generation of mineralization.

SILVER MINERALS AND NATIVE SILVER

Argentite is the most abundant silver mineral in the ore. It is found chiefly in filling fractures in quartz and pyrite and to a lesser degree with sphalerite and galena. Argentite is also associated with native silver ... (see Plate 3, page 21) as small veinlets.

Polybasite and Pyrargyrite occur with the native silver previously mentioned under argentite. These sulfo-salts are also associated with the sphalerite and galena which in turn occurs with massive pyrite. Pyrargyrite is found only in minor amounts as extremely small blebs (10 microns) within the poly basite.

Native silver is restricted to veinlets in fractured quartz in which it is associated with argentite, and the silver sulfosalts. Minor grainlike specs of native silver also occur with galena in a gangue of calcite.

ie none at all?

It is note worthy to mention here that the galena (previously) discussed under tetrahedrite is non-silver bearing. The fact that the galena does not carry any silver has had an important influence on the value of the ores extracted from the lower levels in the mine, nearly all of which is composed of massive sulphides.

Electrum

A very minor amount of electrum is present. It is distinguished from chalcopyrite by its pale yellow color and sectility.

Because so little of the electrum is present it is difficult to establish a complete mode of occurrence for it; hence its occurrence may vary in another stope. In the 3-D ore examined it is found in the fractures developed in pyrite . . . average (width of 4 microns) and is associated with sphalerite and galena.

Native gold

No native gold was found in any of the sections examined. A thorough examination of minerals present was done, as well as a close study of solid pyrite crystals and unfractured quartz was carried out but no native gold was found to be present. This does not rule out the possibility of its being present however, since the sections examined were only a limited number. It is sufficient to say that native gold, if present, is restricted in occurrence, and more likely to occur as inclusions in unfractured original quartz.

Gangue Minerals

The chief gangue minerals are quartz and calcite, minor amounts of chlorite are also present. Quartz, the commonest gangue mineral is found with all the ore minerals. It is present as unfractured silica containing minute inclusions at chalco pyrite and argentite, as fractured silica in which the principal ore minerals occur, as well as pyrite; and as fractured silica occurring with secondary calcite.

Calcite

The occurrence of calcite is restricted to the later sulphides and native silver and to a lesser extent fractures in pyrite in which other sulphides are also present. The calcite is typically vuggy in appearance having numerous large cavity-like openings, highly irregular in form.

FORMATION OF MINERALIZED ZONES

The mineral bearing solutions that are responsible for the ore zones at the Premier mine are believed to be derived from the last stage of the Coast Range Batholithic intrusion. This stage is represented by lamprophyre dyke intrusions and contemporary deposition of the ore minerals. Prior to the formation of siliceaus zones, a stage of pre-mineral fracturing took place which provided channels for siliceous emanations. The silica replaced portions of the wall rock along the fractures, consequently there is an irregular deposit of silica within the fractures. Minor amounts of chalcopyrite and possibly gold ore disseminated as minute inclusions $<$ 1 micron in width and blebs in the unfractured quartz. Following the initial stage of pre-mineralization, primary fracturing of the siliceous zones occurred which provided routes for the mineralizing solutions of chalcopyrite, pyrite and possibly gold.

Successive fracturing occurred followed by the deposition of chalcopyrite, sphalerite, galena and argentite, polybasite, pyragyrite and electrum. The last stage of mineralization saw the deposition of calcite, argentite, polybasite and native silver.

Significant Replacement and Paragenesis

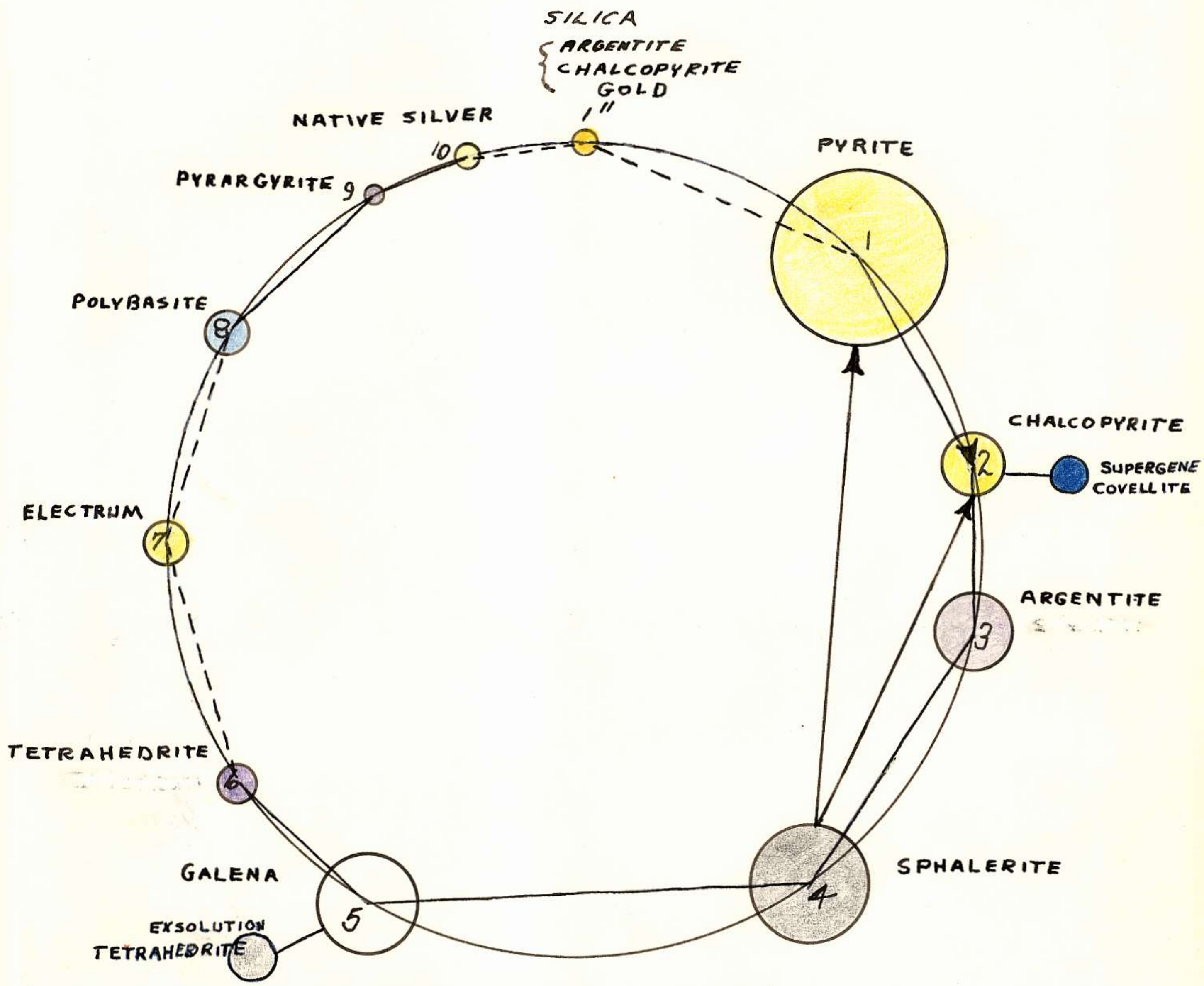
The replacement properties exhibited by the various minerals are illustrated in plates 1 - 6 . . . see ref. page 19 - 22.

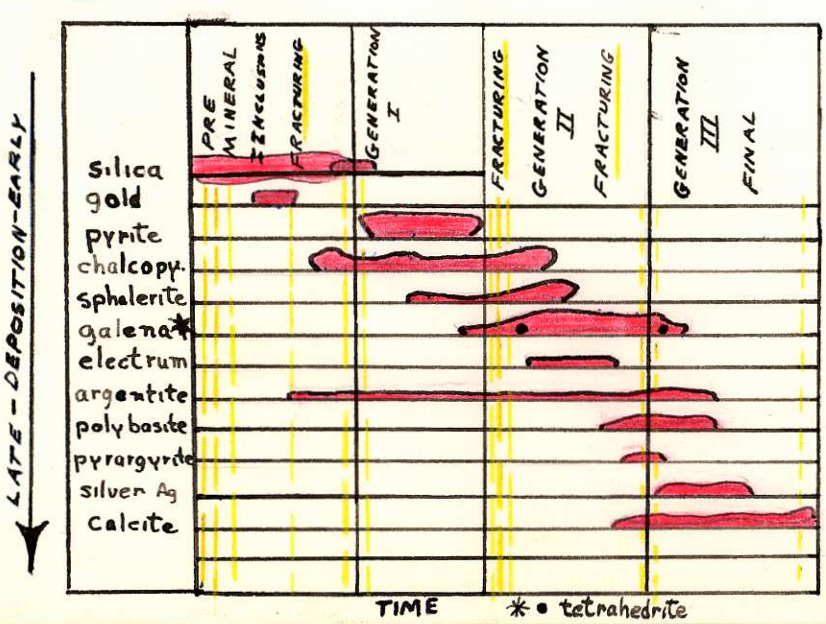
Significant replacement of chalcopyrite and pyrite by sphalerite occurs more frequently at an open contact of these three minerals. However, sphalerite is also found replacing pyrite along inlets developed from fracturing as well as replacing the inner core of a small number of pyrite crystals. Segregated minute inclusions (5 microns in Dia.) of chalcopyrite occur in the sphalerite sporadically and thus are not an indication of exsolution. Since the Chalcopyrite occurs as inclusions in (sphalerite-chalcopyrite) and not in the massive sphalerite, it is probable that the chalcopyrite is a result of the previously mentioned replacement of chalcopyrite by sphalerite. Minor inclusions of chalcopyrite in pyrite were observed. It was first thought that these were deposited contemporaneously with the pyrite. Similar inclusions of chalcopyrite in unfractured quartz plus the fact that only a limited number of pyrite crystals contain minute inclusions of chalcopyrite close to a chalcopyrite contact leads to the contention that pyrite replaced a portion of the earlier chalcopyrite inclusions which were fractured along with the silica, whereas the inclusions of early chalcopyrite in unfractured silica were not replaced, and this deposition was not contemporaneous. The inclusions of sphalerite in pyrite would suggest that the pyrite crystals must be permeable since the pyrite is earlier than the sphalerite. The pyrite crystals show no features to support this; however, a more practical derivation for the iron is from the contents of sphalerite. It is probable to contend that the iron passed from the sphalerite and began to grow around a small core of sphalerite forming smaller pyrite crystals thus making the few crystals formed in this manner later than the primary pyrite. No replacement of galena by sphalerite is evident in the ore. Sphalerite appears to be associated with an earlier period of mineralization. The occurrence of argentite filling fractures in pyrite suggests that the argentite is primary, similar evidence supports the origin of the native silver it is found filling fractures in quartz as a single constituent and also associated with galena, argentite and sphalerite.

PARAGENESIS

From the previous discussion of the 3 - D ore minerals and their respective properties, the writer believes the ore minerals to be derived from hypogene solutions. In particular, the massive sulphides present are definitely of this origin. The silver minerals and native silver are possibly the only minerals that would be considered questionable by some, if also considered hypogene. Nevertheless, there is no evidence to contend a supergene origin. The textures exhibited by the silverminerals undoubtedly suggest their being hypogene. Still, in a deposit of this type, it is possible that some of the native silver and silver minerals have a supergene origin in restricted areas of the workings, but this would account

PARAGENESIS





for only a minor amount of the silver content of the ores. Covellite is the only mineral showing evidence of being supergene as it infrequently occurs as a fine scale on chalcopyrite associated with narrow fractures in quartz.

CONCLUSION AS TO TEMPERATURE TYPE OF DEPOSIT

Deposition of the Premier ore minerals is confined to a temperature range of $<250^{\circ}C - 500^{\circ}C$. At least three generations of deposition took place. The first one essentially the pre-mineralization stage, saw the deposition of minor amounts of chalcopyrite, native gold and argentite which are found as minor inclusions in the unfractured quartz and have a temperature range of $250^{\circ}C - 500^{\circ}C$. Slightly later than this came the deposition of pyrite $\approx 500^{\circ}C$. The second generation of mineralization which can be considered as the primary stage had a probable temperature control of $175^{\circ} - 300^{\circ}C$ - in which chalcopyrite, sphalerite, galena, tetrahedrite, argentite and electrum were deposited. The deposition of the last generation of mineralization was governed by a temperature of $<250 > 180^{\circ}$ and argentite, polybasite, pyrargyrite and native silver were deposited. As previously discussed the ore occurring in the 3 - D stope as well as a large portion of the Premier ore is a result of fissure filling with the consequent replacement of the wall rock in siliceaus zones and is considered to be a mesothermal type of deposit. Closely associated to this, is the concept that the mineralization is a result of hypogene solutions and in particular the native silver occurrence as a later hypogene enrichment of the ore minerals is definitely established by the coarse recrystallization texture of the silver, thus placing a lower temperature of deposition $\approx 200^{\circ}$; thus there is an overlapping between epithermal and mesothermal deposition.

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POLISH	Sphalerite good	galena good	tetrahedrite good	chalcopyrite good	pyrite good - fair	electrum good	polybasite good	argentite fair	pyrargrite fair	native silver poor
COLOR in reflected light	ISOMETRIC grey	ISOMETRIC galena white	ISOMETRIC grey	TETRAGONAL yellow brassy + blue Indigo (covellite)	ISOMETRIC yellow (pale)	ISOMETRIC pale yellow	MONOCLINIC grey	ISOMETRIC grey	HEXAGONAL grey	ISOMETRIC white
HARDNESS	C-	B	D	Supergene covellite C	* F	B	C	* A	C	B
TEXTURE	massive	massive fine grained	massive fine grained	massive fine grained	massive fine grained	fine grained	fine grained massive	surface finely scratched on polishing	massive	coarsely crystalline
ANISOTROPISM	isotropic	isotropic	isotropic	weakly anisotropic	isotropic	isotropic	strongly blue-grey violet-green	isotropic	grey to brown	isotropic
TWINNING	—	—	—	—	—	—	—	—	—	—
INTERNAL REFLECTION	yellowish brown	—	—	—	—	—	red	—	ruby red	—
CLEAVAGE	—	cubic cl. Δ pits	—	—	—	—	—	—	—	—
ETCH TESTS $HgCl_2$	—	—	—	—	—	irredesent	stains black	quickly irridescent	slowly stains brown	brown to irr.
KOH	—	—	—	—	—	—	—	—	irridescent	—
KCN	—	—	—	—	—	stains dark	brown stain etches surface	brown to black stain	stains brown to black	—
$FeCl_3$	—	irredescent	—	—	—	—	—	grey to black stain	—	irridesent
HCL	tarnish ±	irridesent	—	—	—	—	—	tarnishes leaving halo	tarnishes	tarnishes
HNO_3	tarnish	blackens	tarnish	—	tarnish	efferves. + tarnish	tarnish	—	grey to brown	effervesces white leaves coating
Aqua Regia	eff. brown stain	not done * —	not done	tarnish brown						
MICROCHEMICAL TESTS	not done	not done	non silver bearing							
REMARKS			* greenish tint where tetrahedrite contacts galena metallic powder	gives powder when scratched by needle	* color and hardness are significant identifying properties	* sectile	* red internal reflection	* sectile surface finely scratched	Internal reflection * + grey-blue color diagnostic	* sectile