REPORT ON A MICROSCOPIC EXAMINATION OF ORE FROM THE SILVER HORDE GROUP OF MINERAL CLAIMS, MONASHEE DISTRICT, BRITISH COLUMBIA.

Geology 409 Report

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Submitted by A.C. Taplin, 4th Year Arts

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ABSTRACT

This mineralogical investigation was carried out primarily to determine the minerals contributing the high silver and gold values indicated by assay reports. Although native silver had been reported previously, none was noted in the preliminary megascopic examination; neither were there any indications of free gold. As a result of microscopic examination and the performance of specific etch and microchemical tests, the writer concludes that native silver, polybasite and tetrahedrite are the mineral constitutents giving high silver values, and that no gold mineralization is evident in specimens examined.

INTRODUCTION

Mineral specimens examined were derived from the Silver Horde Mineral Claim, which is one of a group composed of the Silver Belle, Silver Moon, and Silver Horde claims. These claims are situated on Bromide Mountain, between the north and south forks of Cherry Creek. The general area lies some 47 miles east of Vernon, in southern Central British Columbia.

ACKNOWLEDGEMENTS

The writer wishes to express his sincere appreciation of the advice and instructive criticism received from all the members of the Department of Mineralogy at the University of British Columbia. In particular, the writer is indebted to Dr. R. M. Thompson for his prevailing cooperative

attitude. X-Ray powder pattern photographs taken by Dr. Thompson positively identified two of the constituent minerals. The writer is also grateful to Mr. J. Donnan, technician, for his expert instructions on the preparation of bakelite mounts and their subsequent polishing by the "Multi-mount Superpolisher". Of 14 polished sections examined, 8 were previously prepared by J. Donnan.

GENERAL GEOLOGY

The silver-lead deposits of Cherry Creek and vicinity have been known since the latter part of the 19th Century. The claims comprising the Silver Horde Group were at that time investigated by the Hidden Treasure Mining Company. It is only under this name that any reports on the local geology may be obtained.

Dawson (1877-78) reports this area, including the length of Cherry Creek and the lower part of the North Fork, to be underlain by closely folded slaty and schistose rocks. These rocks, having a general East-West strike, vary from soft graphitic slates to hard silvery grey schists. Dawson noted that granitic material, often gneissic, appeared to be contemporaneous with the slates in age. In 1898 Dawson proposed the name of Shuswap Series to cover this type of gneisses, schists and other metamorphosed rocks, found from Shuswap Lake south to the International Boundary. Dawson considered the "Shuswap type" to represent an ancient sedimentary series, Precambrian in age, now highly metamorphosed and inseparable from the associated gneissic granitic rocks. Recent work (Rice and Jones, 1948) has shown the "Shuswap type" may be developed from both Precambrian and Paleozoic sediments by magmatic action or granitization.

At the claims of the Hidden Treasure Mining Company, Dawson (1887-88) reports the country rock as blackish shales or slates. Quartz veins, in general conforming to the strike of the slates, carried galena, sphalerite and possibly tetrahedrite. An average specimen obtained by Dawson assayed some 658 oz. of silver per ton. Later reports by the British Columbia Minister ef Mines (1914) indicate the vein on the Silver Horde varies from a few inches to 6 feet in width. Gold values are reported at this later date, whereas the earlier reports of assays by G. M. Dawson showed only a trace of gold.

Only minor development work, such as surface stripping and short adits, has been undertaken to date. The present base metal prices have caused a revival of interest in this property, as the Vancouver office of the British Columbia Department of Mines shows several claims held by location only, surrounding the older crown-granted properties. An old-time prospector of the Monashee district, Mr. Frank Burton, has disclosed to the writer that a pack-train load of high grade silver ore was taken from the Hidden Treasure Mining Company's property prior to 1900, and shipped via Vancouver to San Francisco.

MINERALOGY

A. Megascopic

The following minerals were identified in hand specimens:-

1. Galena - finely crystalline, often with secondary anglesite, occasionally with covellite stain also. The galena occurs as irregular stringers and masses in the quartz vein.
2. Pyrite - in characteristic cubes, minor amounts only.
3. Weathered quartz showing malachite, azurite and covellite stain, also some anglesite, limonite and possibly other secondary minerals.
4. Covellite and malachite, associated with a dark mineral observed only in minute veinlets cutting the quartz.
5. Chalcopyrite.

No sphalerite was observed in the hand specimens.

All of the mineralization is present in vein quartz, rusty coloured usually, often showing black streaks throughout. Small vugs within the quartz contain well formed comb structures of quartz, possibly indicating some fissure filling.

B. Microscopic

1. Galena (PbS). This was the most abundant mineral noted. It is found in all sections, associated with all of the other minerals, but only veining tetrahedrite as in figure 1. The galena occurs in minute fractures only 200 microns in width and in more massive stringers one inch or

more in width, but very discontinuous and branching.

Identification as follows:-

Galena white colour
Hardness B.
Isotropic under polarized light.
Presence of triangular cleavage pits.
Positive etch reactions to HNO_3, HCl, $FeCl_3$, and occasionally to $HgCl_2$ in some areas.

One microchemical test of two performed was positive for silver. There is probably some silver contained in the galena, which according to Guild (1917), also Nissen and Hoyt (1915), can be up to 0.1% silver before precipitation of definite silver minerals occurs.

Secondary anglesite and cerussite form irregular bands or rims around most of the more massive galena. In the case of narrow veinlets of galena, most of the material has been reduced to a mixture of anglesite and limonite, presumably by descending meteoric waters. Occasionally a purplish covellite stain forms on this oxidized material, so that one may conclude that some copper salts have been added as well.

2. Chalcopyrite ($CuFeS_2$). Next to galena, the second most abundant mineral is chalcopyrite. This mineral occurs in two different forms.

(a) As rounded blebs and masses in galena. In this case the chalcopyrite is always brassy yellow in colour, and 300 microns to 1 mm. in grain size.

(b) As residuals in small stringers less than 100.0 wide, often surrounded by limonite and intersected by covellite veinlets. In this latter case the chalcopyrite is occasionally noted in the same stringer in the quartz that is occupied by native silver at a different elevation. Such chalcopyrite is brassy yellow after polishing, but within a few hours tarnishes from pink to light purple.

Both types of chalcopyrite give the same etch and microchemical tests. That the one type has been more accessible to attacking solutions would probably account for its tarnishing so readily.

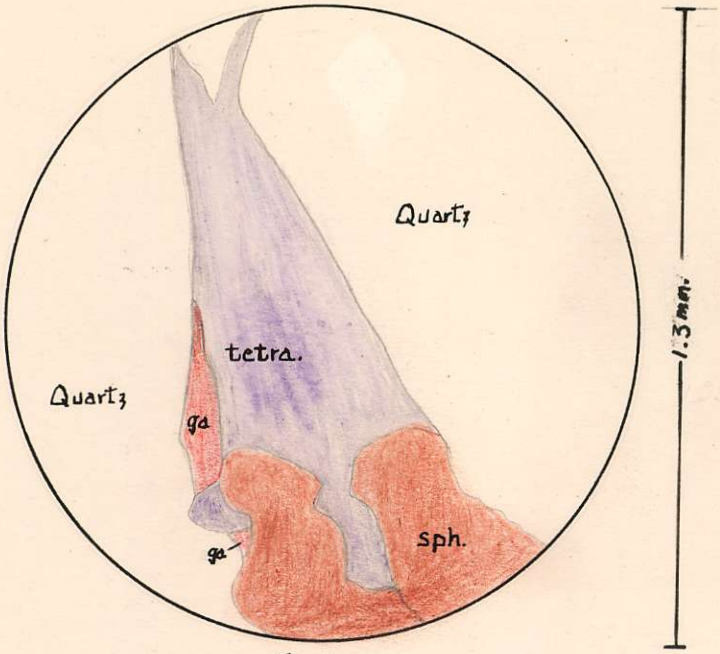
Identification of chalcopyrite:-

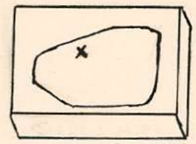
	Brass yellow colour
	Hardness C.
Gives microchemical	Weakly anisotropic
test for Cu, Fe.	Positive only to aqua regia.
	Brittle

Chalcopyrite definitely is later than galena as shown in fig. 3. Also a possible example of core replacement of polybasite by chalcopyrite is illustrated in figure 4A. Such a replacement would explain the shape of the chalcopyrite bodies shown in figure 4.

3. <u>Tetrahedrite</u> $5Cu_2S \cdot 2(Cu,Fe)S \cdot 2Sb_2S_3$.

This mineral occurs only in one section (No. 6) where it is in quite large masses from 350 microns to 1.25 mm. Covellite is characteristically associated with it. Tetrahedrite also fills a fracture in sphalerite as in figure 1. Galena is also seen to be later than the tetrahedrite in figure 2.





No. 6.

Fig. 1
Tetrahedrite filling a fracture in sphalerite.
Galena (ga) adjacent to the gangue.

Both these illustrations (figures 1 and 2) from adjacent areas of section no. 6.

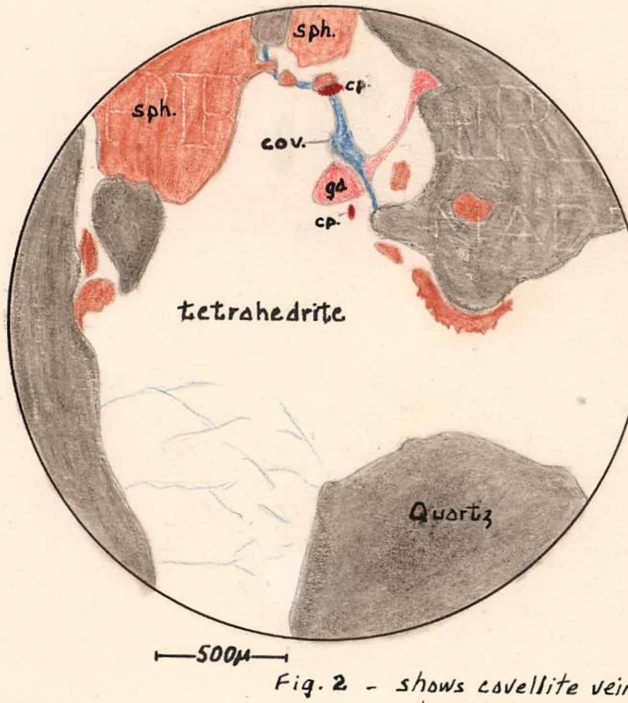


Fig. 2 - shows covellite veinlets cutting tetrahedrite, also galena replacing tetrahedrite. Some residual sphalerite, also two minute grains of chalcopyrite (cp.)

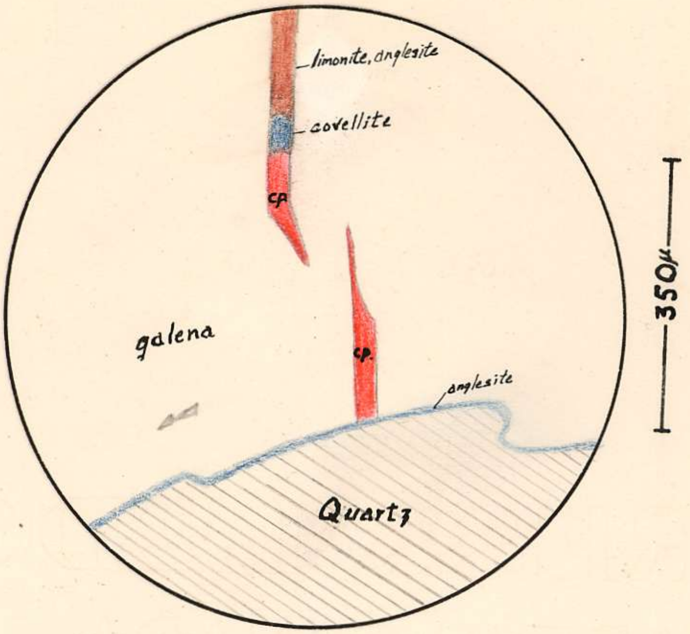


Fig. 3.
chalcopyrite filling small shear fracture in galena.
secondary anglesite. limonite. covellite.
section no. 7.

That the composition of this mineral approaches that of freibergite, the argentiferous variety, is quite possible although the etch tests do not indicate this.

Preliminary Identification:

Microchemical tests for Cu positive; for Sb, As, negative. No internal reflection.	Brownish gray colour. Isotropic Hardness C. Positive relief with galena. Definitely positive only to HNO_3, but also slightly to KOH, $HgCl_2$ (this does not agree with Short).

Tetrahedrite was considered, but a positive test for Sb could not be obtained. Dr. R. M. Thompson removed a particle for X-Ray photographic examination. The powder pattern definitely showed this mineral to be tetrahedrite. Perhaps the failure of the microchemical tests for antimony may be explained by adulterated reagents or the presence of copper in the mineral.

4. <u>Sphalerite</u> (ZnS). This mineral occurs only in limited amounts in a few sections. It has previously been indicated that it was deposited prior to the tetrahedrite and galena. It may have been largely replaced by the galena.

Identification of sphalerite as follows:

Gives microchemical test for Zn.	Gray colour. Isotropic under polarized light. Hardness C. Resinous internal reflection. Contains minute inclusions of chalcopyrite. Negative to all etch reagents but aqua regia.

The largest grains of sphalerite observed were approximately 1 mm. in size, many small residual grains are only 150 microns in size.

The paucity of sphalerite in specimens examined, indicates that the type of mineralization is not that found in the "wet" ores of the Slocan district, where an ankerite gangue and predominant sphalerite are characteristic.

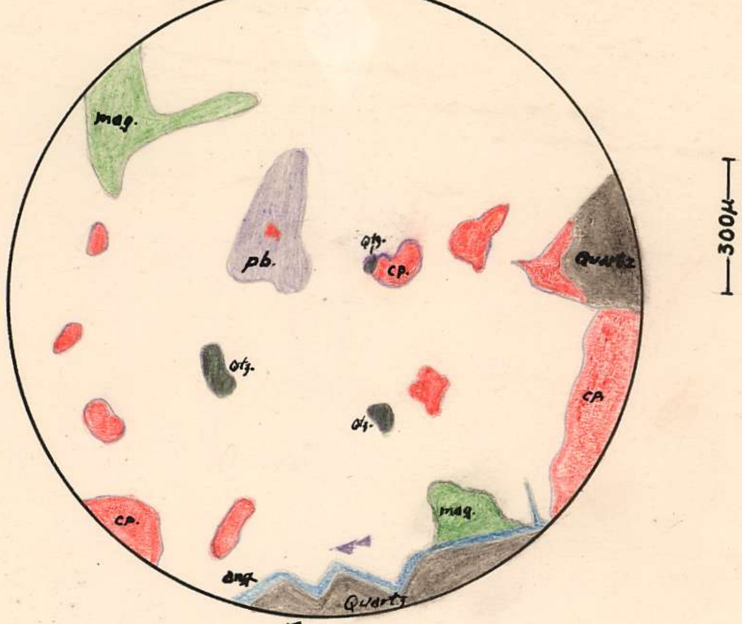
5. Polybasite ($8\ Ag_2S.Sb_2S_3$). Polybasite occurs as small irregular bodies displaying sub-graphic texture in the galena. These irregular bodies are either along cleavage planes of galena or near the grain boundaries (fig. 7). Some larger rounded bodies 300 microns in size are found in the galena, as in figure 4.

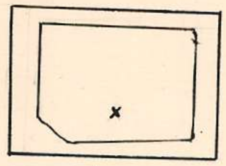
Identification of polybasite as follows:

	Greenish gray colour.
	Strongly Anisotropic Colours
	Slight relief with galena
Microchemical test for Ag.	Hardness C
No other tests performed.	Positive to $HgCl_2$, $FeCl_3$, KCN.
	Negative to HCl, HNO_3.
	Black powder when scratched.
	Red internal reflection on rough surface.

Polybasite was suspected as a result of these tests. A grain of this mineral was removed by Dr. R. M. Thompson and photographed by the X-Ray powder pattern method. Identification as polybasite was thus made conclusive.

Polybasite is observed in figure 4a, apparently being centrally replaced by chalcopyrite. The gangue indi-





No. 12

Fig. 4

Round smooth borders of polybasite and chalcopyrite replacing certain areas of galena.
Magnetite also as rounded bodies, but only near the borders.
Secondary anglesite bordering galena.
Main ground-mass is galena.

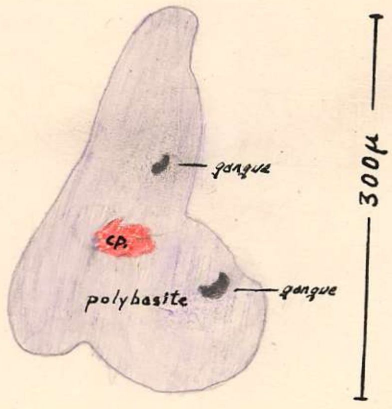
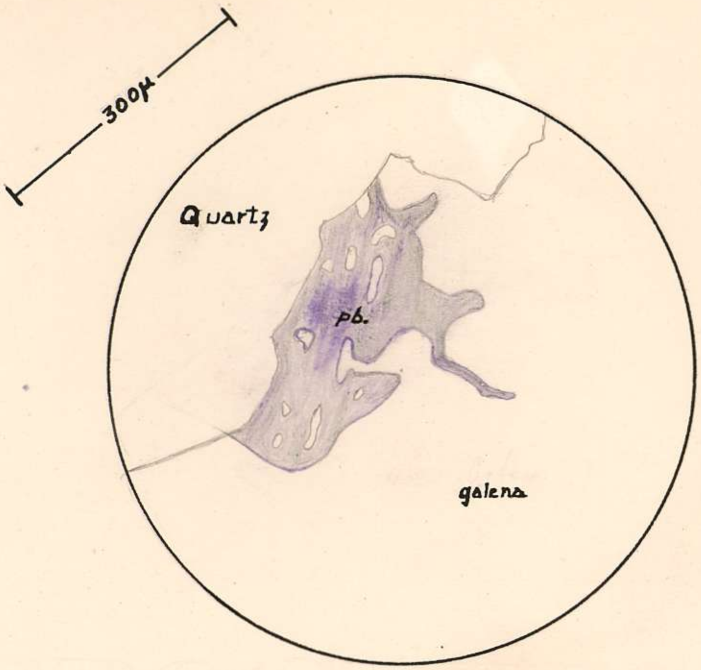
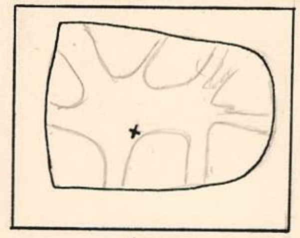


Fig. 4 a.

chalcopyrite centrally replacing polybasite?





No. 2.

Fig. 7
sub-graphic texture resulting from replacement of galena by polybasite (pb.), near the boundaries of the former.

Other minute blebs of polybasite in the galena have the shape described as zig-zag.

< 100μ long.

cated here is unknown, it is neither quartz or calcite.

Polybasite can be observed in sections nos. 2, 12, 7 and possibly as sub-microscopic rods in the rest of the sections containing galena.

6. Native Silver. Native silver is associated only with chalcopyrite. It occurs completely filling narrow fractures in quartz and in minute vugs showing well terminated quartz crystals. Some of these thin fillings are 1 or 2 mm. in length but only 150 microns in width.

Identification as follows:

	Silvery white colour when newly polished.
Microchemical tests -	Yellow-brown tarnish.
Ag positive.	Hardness A.
Sb, Bi negative.	Very Sectile.
	Positive to all reagents but KOH.

Because of its lack of inter-relationships with the hypogene minerals and because of the abundant evidence in the specimens of enrichment conditions, this silver has been considered as supergene. It is quite easily seen in several of the sections, associated with residual chalcopyrite and the various secondary copper and lead minerals.

The native silver is observed in sections nos. 3, 5, 10, 11 and 12.

7. Pyrite was noted only in one section, no. 8 as illustrated in figure 6. Its euhedral form, rough surface and hardness serve to identify it. The pyrite has been

fractured and some of these fractures filled with minute amounts of chalcopyrite and still later galena. The apparently unsupported quartz grains are really projections from the inner walls of vuggy structures in the quartz.

8. Magnetite was determined in section 12 only, as shown in figure 4. Negative etch reactions, isotropic character under polarized light, hardness and magnetism were the means of identification. It occurs only in this one local area and along the edge of the galena, and adjacent to the quartz. Its rounded form suggests the possibility that it was formed by leaching and oxidation of the chalcopyrite, rather than as a hypogene mineral deposited with the first surge of the mineralizing solutions. However, as there is no evidence for this, the magnetite has been instead delegated as the first primary mineral formed before the medium temperature sulphides.

Secondary Minerals. Anglesite coats most of the galena around the boundaries as shown in figures 3 and 4. In some areas there is a replacement by anglesite along the cleavage planes of galena. In some of the sections two layers of secondary minerals coat the galena. The inner band is considered to be anglesite, the outer band effervesces with acid and is probably cerussite.

Covellite and another mineral also form alternating rhythmic bands around partially replaced chalcopyrite.

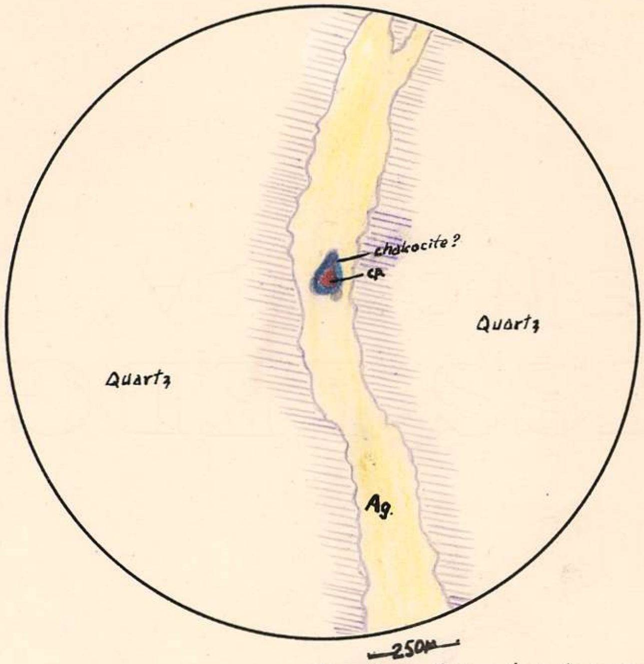


Fig. 5. - native silver in narrow veinlet, some residual chalcopyrite (cp) and supergene chalcocite?
From Section no. 11.

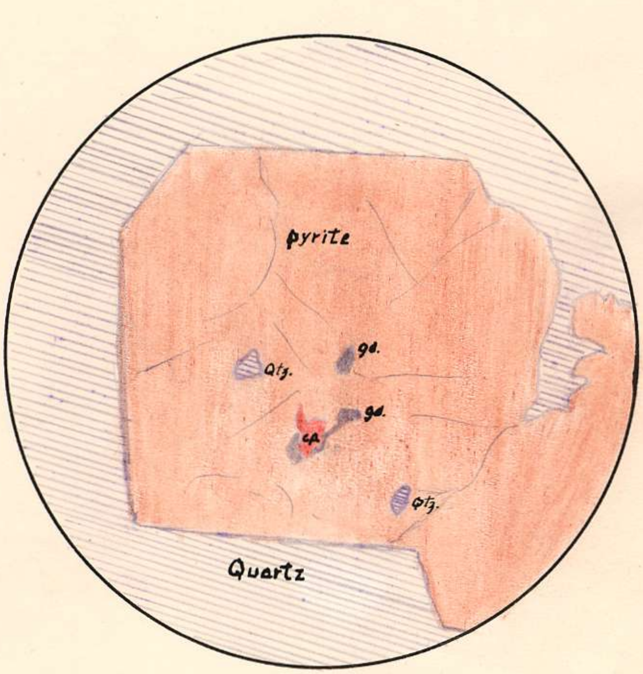


Fig. 6 - Shattered pyrite with later galena and chalcopyrite
Unsupported Residual Nuclei of Quartz?
From section no. 8.

Several generations of finely crenulated and concentric bands are thus formed. Minor amounts of bluish gray chalcocite were identified associated with the chalcopyrite in some areas where no covellite was present. The colour difference between this chalcocite and the covellite is very slight. However in some places the bluish mineral replacing chalcopyrite was shown to be isotropic and the etch reactions definitely indicated chalcocite. With the presence of supergene native silver in the qnarts veins, the added presence of supergene chalcocite is not unlikely. The association is shown in figure 5. No drawing wae made of the rhythmic banding because of the complexity and the fact that the writer was unable to determine with certainty that it was the chalcocite which participated with covellite in the banding. An example of this banding is to be found in sections nos 10, 11.

CONCLUSIONS

1. That the mineralization is within the mesothermal range.
2. That fissure filling and replacement were the methods of primary mineralization.
3. That supergene enrichment has been prevalent in the veins, and has caused the deposition of native silver and probably some chalcocite.
4. That sphalerite is present only in minor amounts and thus the mineralization can be classed as of a silver-lead type rather than a silver-lead-zinc type.

5. That primary polybasite and tetrahedrite plus supergene native silver give high silver values to the "ore".

6. No free gold was noted in any specimens although the weathered portions of the veins were examined with particular care.

PARAGENESIS

The determined order of mineralization is as follows:-

Magnetite
Pyrite
Sphalerite
Tetrahedrite
Galena
Polybasite
Chalcopyrite
Secondary native silver, chalcocite
Also anglesite, cerussite, covellite and limonite.

<u>Note</u>. Only a few minute inclusions of chalcopyrite were noted in the sphalerite and in the tetrahedrite. This chalcopyrite may have been formed by ex-solution on cooling, but as some small blebs were also noted in the galena, only one generation of chalcopyrite has been proposed. The apparent anomalous association of both rounded masses and yet adjacent transecting veinlets of chalcopyrite in the galena, can be related directly to the presence of suitable cross fractures in the galena.

The sub-graphic texture of one sulphide mineral in another has been much debated, as to origin and interpretation. Some of the features here fit criteria for ex-solution textures, others seem more applicable to a true eutectic mixture. The presence of the rounded blebs of polybasite separate from the intergrowth exclude ex-solution along crystallographic planes of the galena. Some preferred orientation of the zig-zag rods was noted. There is no marked similarity in the chemical or physical structure of the two minerals, polybasite and galena. Most investigators have concluded that the graphic or sub-graphic textures are indicative of replacement (Lindgren, 1930), some have proposed the intergrowths as being secondary and resulting from downward supergene enrichment (Whitehead, 1916). An illustration of an intergrowth of pearceite and galena is found in Whitehead's article. This illustration greatly ressembles the intergrowths found in sections of the ores under discussion.

After coneiceratinn of all of these declarations, the writer has concluded that the polybasite was deposited later than the galena. Where deformation had sufficiently opened the galena lattices, the polybasite was deposited as zig-zag rods and blebe. In the same areas of the galena where chalcopyrite replaces the former as rounded blebs, the polybasite has the same form. The sub-graphic or "pseudo-eutectic" textures observed near the grain boundaries have been formed by intersecting and coalescing veinlets of polybasite in particularly vulnerable areas, adjacent to the gangue.

BIBLIOGRAPHY

A. MINERALOGY

(1947): Edwards, A. B., "Textures of the Ore Minerals and Their Significance, Australasian Institute of Mining and Metallurgy, Melbourne.

(1917): Guild, F. N., "A Microscopic Study of the Silver Ores and their Associated Minerals", Economic Geology, vol. 12, pp. 297-340.

(1930): Lindgren, W., "Pseudo-Eutectic Textures", Economic Geology, vol. 25, pp. 1-13.

(1915): Nissen, A.E. and Hoyt, S. L., "On the occurrence of silver in argentiferous galena", Economic Geology, vol. 10, pp. 172-179.

(1931): Schwartz, G. M., "Textures due to unmixing of solid solutions", Economic Geology, vol. 26, pp. 730-763.

(1948): Short, M. N., "Microscopic Determination of the Ore Minerals", Bulletin 914, U.S.G.S.

(1916): Whitehead, J., "The Paragenesis of certain Sulphide Intergrowths", Economic Geology, vol. II, p. 1.

B. GEOLOGICAL BACKGROUND

1914 British Columbia Minister of Mines, Annual Report 1914, p. 360

1933 British Columbia Minister of Mines, Annual Report 1933, pp. 197

1877 Geological Survey of Canada, Annual Report, pp. 50G, 68R, 161B

1887 Geological Survey of Canada, Annual Report, p. 104B, 68R.

(1948): Rice, H.M.A., and Jones, A.G., Salmon Arm Map-Area, G.S.C. paper 48-4.