

*Careful study.
One or two thin section
photos needed.*

600305

A MINERALOGRAPHIC REPORT ON A SILVER-SULFO SALT DEPOSIT
ON THE SILVER ISLAND PROPERTY
BABINE LAKE DISTRICT, B.C.

A report submitted in partial
fulfillment of the Geology 409 course
at the University of British Columbia

by

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ABSTRACT

This report concerns the results of a mineralographic examination of specimens from a silver-vein deposit from the Burns Lake district of the Omineca mining division in British Columbia.

Evidence is put forward to substantiate the classification of this deposit as mesothermal-vein or breccia filling from solutions of unknown origin.

INTRODUCTION

This report includes the study of mineralized specimens from a group of eight claims which were owned by the Silver Island Mining Co. All workings were confined to the Silver Island claims which covered Silver Island, an area of approximately twenty-two acres. No evidence of work on the property since 1925 has been found.

Location

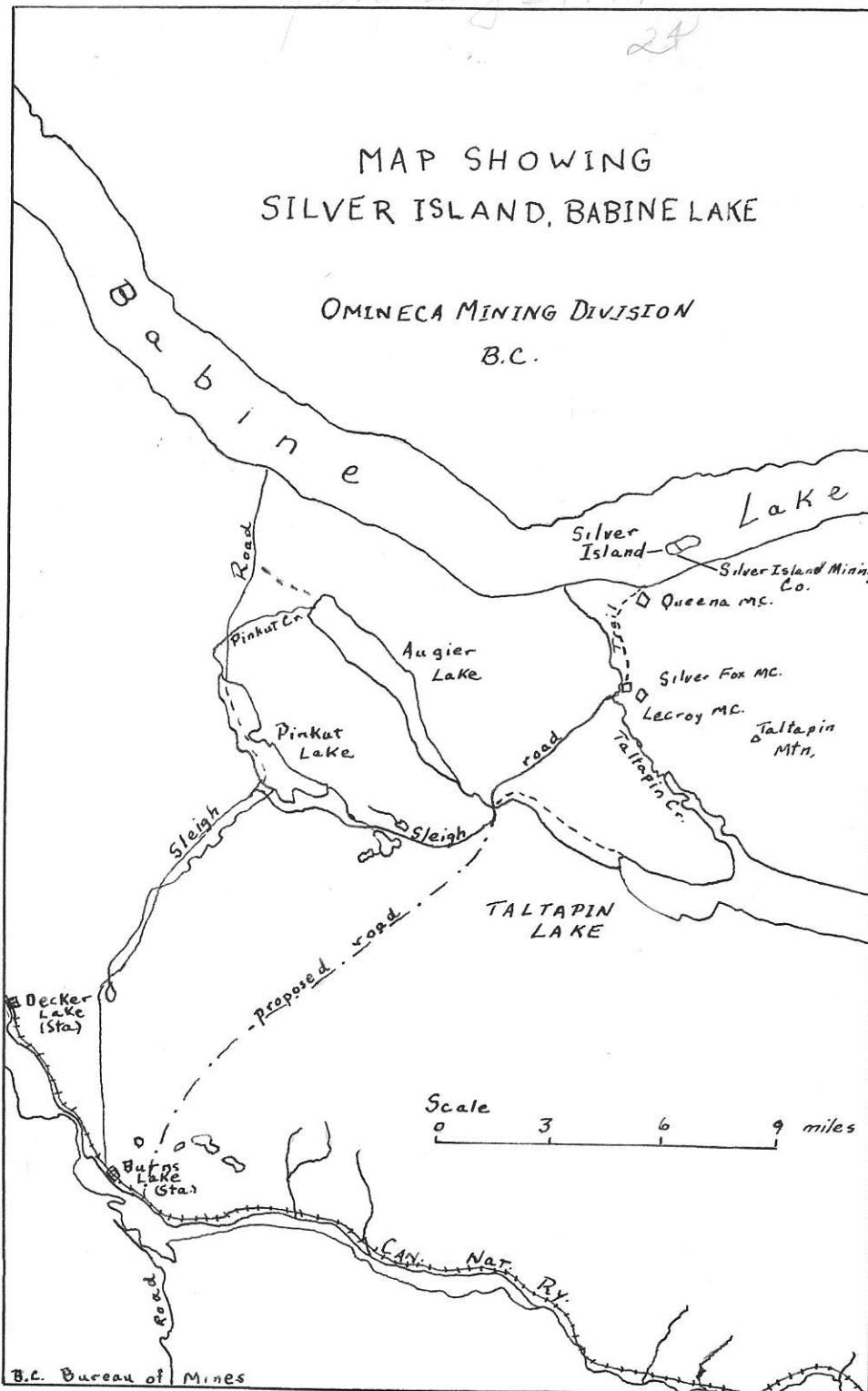
The property is situated in central British Columbia, on Babine Lake which is 28 miles from Burns Lake, a station on the Canadian National Railway. Burns Lake is 317 miles east of Prince Rupert, British Columbia, or approximately 280 miles west of Prince George. From Burns Lake station a rough sleigh, or wagon road runs north and northeast to the Taltapin

January 3, 1971

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MAP SHOWING SILVER ISLAND, BABINE LAKE

OMINECA MINING DIVISION
B.C.



B.C. Bureau of Mines

B.C. Rept. of Minister of Mines.
1924 - pp B-102

property, and the last few miles to Babine Lake and the Silver Island property is covered by a trail.

Silver Island is situated on Babine Lake, some 3000 feet from its south shore. The Island is about 1300 feet long, and 750 feet wide, is elliptical in shape, and its highest point rises about 135 feet above the lake. The surface of the lake is fairly flat and is well timbered.

how about that!

Physical Features

The general area has an undulating topography with no mountains in the near vicinity rising over 2500 feet above the general elevation of 2500 feet. Babine Lake lies at an elevation of 2222 feet, the waters of which eventually flow by means of the Babine river to the Skeena, and thence to the Pacific.

Babine Lake lies near the north end of the Nechako Plateau, which is a rolling hilly country. Here, a general gradation to the higher Babine and Bulkley mountains to the northwest, and the Omenica mounts to the northeast is observed.

Glacial erosion has played a part in shaping many of the creek valleys, but it is not thought that the area was abraded by a continental ice sheet.

General Geology

No geological survey has been made in the immediate area, but from information gleaned from reports of surrounding

areas^{*}, a general picture can be presented.

The area appears to be principally underlain by volcanic rocks, presumably of Jurassic age, and correlatable to the Hazelton group (as described by Leach). In several places in the surrounding vicinity are found relatively small intrusions of granitic rock, isolated basins of Cretaceous sedimentary rocks, and areas of sedimentary and volcanic rocks of Tertiary age. It is not known if, or how, these rocks are represented in the Babine Lake area.

Mention is made in the 1925 B.C. Report of Minister of Mines that Silver Island itself is one-half covered by a dark green diorite, and the other half of rhyolite, with the line of contact running diagonally across the island. Since this was reported from shore line investigation the correlation is not known, but it is suspected that the rhyolite would be part of the Jurassic Hazelton series, while the diorite would be a part of one of the "relatively small isolated intrusive rocks."

This area is still in the general mineral province constituting the eastern contact zone of the Coast Range batholith - but the mineralization in the area is not associated with it.

* Hanson G. G.S.C. Summ. Rept. 1924, Pt. A. pp. 19A-37A.

Hanson G., Phemister, T.C. G.S.C. Summ Rept. 1928 Pt. A. pp. 50A - 77A.

Lang, A.H., G.S.C. Summ. Rept. 1929, Part A, pp. 62A -91A

Results of Examination

(1) Megascope Examination

Eighteen to twenty hand specimens, most with polished sections, were examined for this report. Although all specimens are of the vein type, or breccia vein type, three different "classes" of specimens can be described.

All specimens of the first "class" show a breccia vein filling, and an open space fissure vein filling. The breccia fragments are a very light green color, are very soft and highly altered. These are probably altered diorite(?) fragments. The material filling the spaces between the breccia fragments is both clear calcite and quartz. The ore minerals are in this breccia zone as small clumps of minerals - including tetrahedrite and chalcopryrite. It is expected that the solutions carrying the silica and carbonate also carried the ore as post brecciation filling.

A second period of fracturing (no brecciation) and open space filling has occurred at the edges of the breccia zone. This fracture has been filled with clear, barren quartz, approximately 1/2 inch wide. This quartz shows a comb texture. In one specimen a third fracture system is noted, again at the edge of the breccia zone. This quartz filled fracture is also barren of mineralization.

The second "class" of vein is essentially similar to the first, except that at least two periods of brecciation have occurred, and the filling material is mainly a carbonate

rather than silica. In these specimens the badly altered, sheared, and brecciated country rock is abundant as fragments. The material filling the spaces between the fragments is mainly carbonate - both calcite and dolomite. The sequence of events, as suggested by hand specimen and thin section examination includes:

1. Intense shearing and brecciation of country rock
2. Infilling by mainly calcite
3. A second period of shearing and slight brecciation along a zone of weakness within the first breccia zone.
4. Introduction of dolomite, silica, and ore minerals along this zone of weakness.

As corroborated by thin section study, the ore is definitely ~~past~~ brecciation (2nd period) and is the last material to come out of solution. The channelway for the ore is at the zone of weakness of the second shear phase - and the penetration of the ore solutions weakens away from this zone of weakness.

This "class" of vein is found to contain the greatest abundance of ore minerals.

The third class of specimens is primarily made up of calcite and dolomite gangue. Very little country rock is noted as breccia fragments, although one specimen shows large, altered fragments of country rock with dolomite gangue filling the spaces, between them.

Also noted, in thin section study, is the fact that

the ore mineral, (mainly sphalerite) is also brecciated to some degree. The sequence here may be:

1. Open space filling of a single fracture by calcite, dolomite and Fe-poor sphalerite.
2. Refracturing, and brecciation of the original vein and the country rock.
3. Final filling of the breccia zone by dolomite - no minerals carried in this phase.

Further fracturing and open space filling is also noted. At the edge of the breccia zone, along a line of weakness, at least two, and possibly three periods of fracturing took place with calcite and dolomite filling the open space. Comb texture is noted on these fractures.

In none of the classes was a direct relationship of the amount of ore minerals to the degree of alteration of the breccia fragments noted.

The ore minerals which could be identified by megascopic examination includes:

1. Tetrahedrite
2. Chalcopyrite
3. Galena
4. Sphalerite
 - (a) Honey yellow - associated only with class three type specimens
 - (b) Gray sphalerite - associated with class one and two type specimens
5. Malachite alteration

(2.) Mineralogy

General Statement

For this report seven thin sections and eighteen polished sections were studied. Although the mineral assemblage is typically mesothermal, deposited from hydrothermal solutions, the sequence of ore and gangue deposition in the vein deposits is a complicated one. In this report an attempt is made to show a logical sequence of deposition, and the paragenetic relations of the ore minerals.

Thin Section Investigation

Examples of two of the vein "classes" were represented by the seven thin sections studied. The results of the examination of two of the representative specimens will be presented.

Thin Section 409-B

Mode: 1. Silica

Mosaic texture - due to recrystallization(?). Occurs in lenticular pods and irregular masses. It is suspected that this is part of the original fracture filling material.

2. Calcite

Microcrystalline to coarse grained occurs in ground-mass surrounding breccia fragments, and also as breccia fragments.

3. Altered Country Rock

Makes up a few of the breccia fragments. Composed of both calcite and altered material.

4. Dolomite

Occurs as twinned rhombs. Often fractured and separated.

5. Barite

Occurs as infilling between breccia fragments. Associated with calcite and quartz.

6. Opaques

By cleavage, much of this is identified as sphalerite. Occurs as blebs in groundmass, but shows definite evidence of brecciation.

Sequence in slide:

1. Coarse grained carbonates
2. Irregular contact, microcrystalline carbonate
3. Irregular contact, coarse grained carbonate
4. Irregular contact, microcrystalline carbonates with some interstitial, mosaic quartz.
5. Sharp, irregular contact - brecciated ore minerals, breccia fragments of altered country rock, and calcite. Infilling of dolomite, calcite and barite.

History:

In the breccia zone, the broken up appearance of the sphalerite suggests that brecciation took place after the ore mineral and calcite gangue were emplaced. This implies that a period of brecciation of a vein containing calcite and ore took place. Subsequent infilling of calcite dolomite and barite.

Slight brecciation of the dolomite occurred. This probably happened at the time of shearing and filling of shear fractures by barren carbonates (after the main period of brecciation).

Possibly another, later period of shearing, or fracturing took place, as evidenced by the parallel bands having comb texture (hand specimen).

This is an example of the "class" three type of vein.
Thin Section 409-B₂

Mode: 1. Breccia Fragments

Much altered. Sericite, chlorite, crysto-crystalline quartz and some carbonates can be distinguished in these. No indication of original composition from thin section.

2. Carbonate

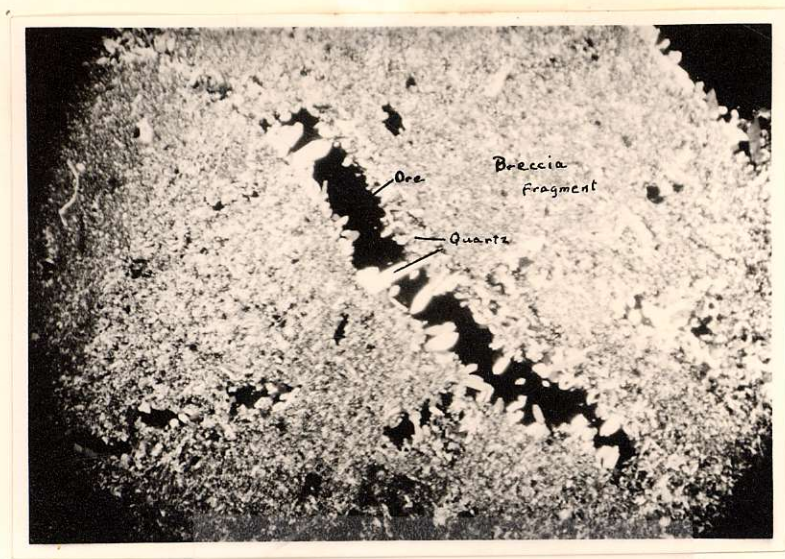
Both calcite and dolomite. Occurs as breccia filling material between the breccia fragments.

3. Quartz

This is the main mineral filling the spaces between the breccia fragments. Often elongate parallel to 'C' crystallographic and perpendicular to the walls between the fragments (see Plate 1)

4. Opaques

Ore minerals - tetrahedrite, galena, chalcopyrite. These fill up the last spaces. Can usually be shown to be later than the quartz. (see Plate 1)



X 29

Plate 1. Breccia filling by Quartz (early) and
ore mineral (late)
"Class" 2 Vein

The sequence of events, i.e. - fracturing and brecciation, for this rock were given in the megascopic description of the "class" two type of vein.

Polished Section Investigation

General description of properties of Mineral Assemblage:

1. Tetrahedrite: $Cu_{12} Sb_4 S_{13}$

The mineral takes a good polish, has a gray color, a hardness of C plus, and is isotropic.

Etch Reactions: The mineral is negative to all reagents.

Stains slightly(?) with HNO_3 . Microchemical test for Cu - positive. Yields a reddish powder.

2. Chalcopyrite: CuFeS_2

The mineral takes a good polish, has a yellow color, a hardness of C, and is very slightly Anisotropic. Color and lack of sectility were the criteria used in identification.

3. Galena: PbS

The mineral takes an excellent polish, has a silver white color, a hardness of B, and is isotropic.

Etch Reactions: Negative to HCl , KOH , and KCN . Positive to FeCl_3 - stains iridescent to brown; HCl stains brown to iridescent; HNO_3 stains black immediately.

In many cases this mineral, intergrown with Polybasite, could not be identified by the characteristic cubic cleavage, and was difficult to distinguish from polybasite in plain light.

4. Sphalerite: ZnS

The mineral takes a good polish, has a gray color (light to dark), a hardness of C and is isotropic. Light gray sphalerite from "class" three vein had golden yellow internal reflection. Dark gray sphalerite from "class" one and two vein had no internal reflection.

5. Covellite: CuS

The mineral takes a good polish, has a deep blue color, a hardness of B, and is strongly anisotropic, with polarization colors of white to fiery red. Mineral was identified by color and anisotropism.

6. Polybasite: $8\text{Ag}_2\text{S Sb}_2\text{S}_3$

The mineral takes an excellent polish, is gray white in color (somewhat lighter than tetrahedrite), has a hardness of B and is strongly anisotropic with polarization colors of blue green, to violet, to brown.

Etch reactions: HgCl_2 stains irridescent, KCN instantly stains black; FeCl_3 stains irridescent, HNO_3 stains irridescent. KOH, HCl - negative.

7. Pyrargyrite: $3\text{Ag}_2\text{S Sb}_2\text{S}_3$

The mineral takes a good polish, has a gray color with a bluish tint, a hardness of C, and is slightly anisotropic with polarization colors of dark gray brown to dark blue gray.

Etch Reactions: HgCl_2 , KOH - slowly stain brown to dark brown; KCN immediately stains black; FeCl_3 , HCl, HNO_3 - negative.

8. Argentite: Ag_2S

The mineral takes a fair polish (larger grains scratch easily), is gray white in color with a definite green tint, has a hardness of A and is isotropic.

Etch Reactions: HgCl_2 stains brown, KCN stains black; FeCl_3 stains black immediately, KOH, HCl, HNO_3 - negative.

9. Native Silver:

Some indication, but no definite identification of this mineral was established. *Such as*

Mineralographic Relations

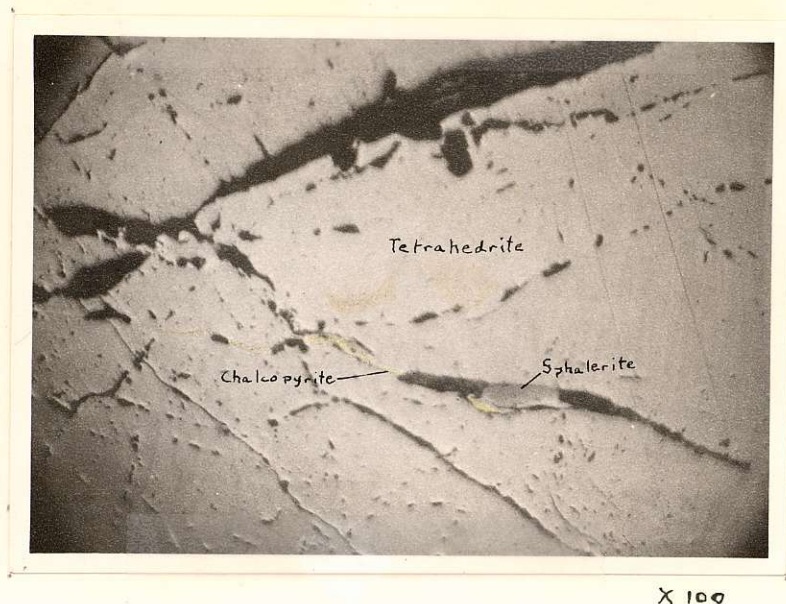


Plate 2. Chalcopyrite, sphalerite (dark) veining tetrahedrite.

Tetrahedrite:

size?

Tetrahedrite is the main metallic mineral present in the specimens, forming close to 75% of the sulphide mineralization. All other minerals are associated in some way with the tetrahedrite, as exsolution products, as veins, or as replacement(?) & exsolution(?) rims.

Chalcopyrite:

The chalcopyrite occurs to some extent in all the specimens. It is found as minute, irregular veins through the tetrahedrite (Plate 2), as blobs with mutual boundaries, or caries textures, and as irregular rims around the tetrahedrite. (Plate 3).

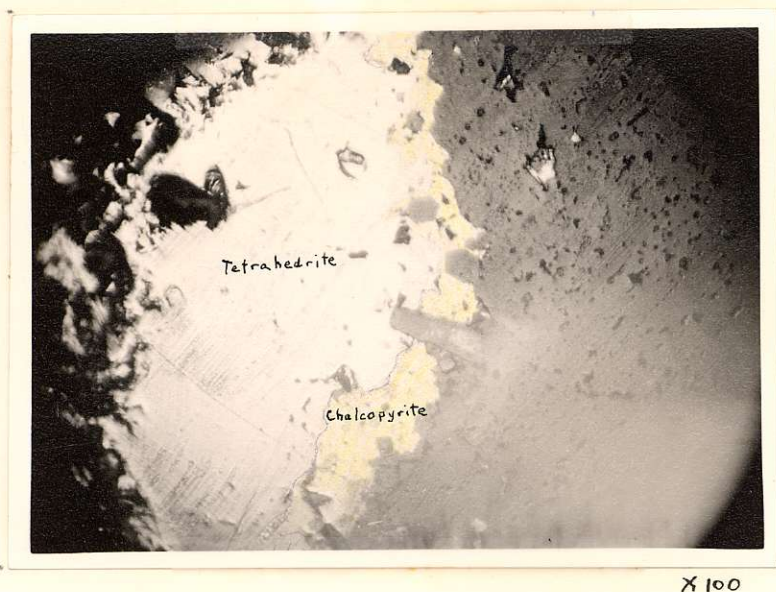


Plate 3. Exsolution(?) or replacement(?) rim of Chalcopyrite at edge of Tetrahedrite grain.

In this relation the chalcopyrite shows a definite segregation to the boundaries of the massive tetrahedrite. This would indicate that the chalcopyrite has unmixed from the tetrahedrite and migrated to the edges of the grains.

A very close relationship between the chalcopyrite and sphalerite also occurs. Plate 4 shows islands of chalcopyrite in the sphalerite. This is possibly due to unmixing of the chalcopyrite from the sphalerite. The two minerals are also often found together in the small veins (Plate 2). A mutual boundary relation indicating simultaneous deposition from solution is the most common between the two minerals.

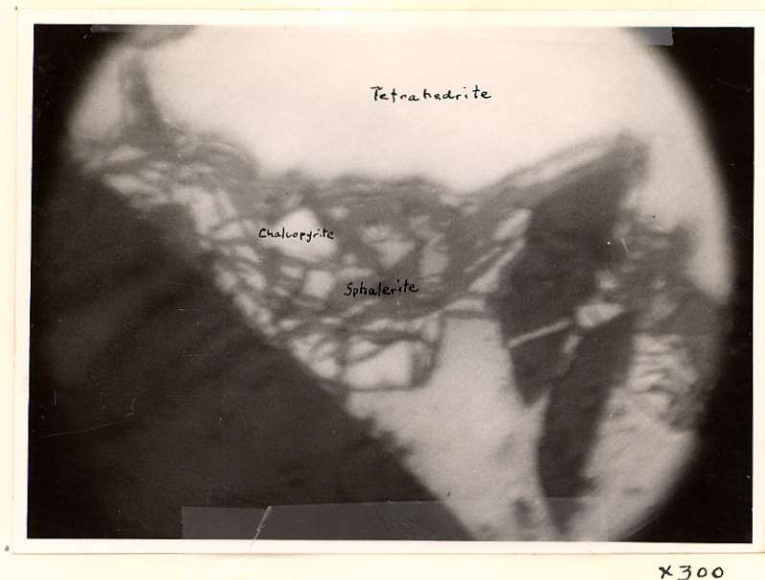


Plate 4. Unmixing texture - Islands of Chalcopyrite in Sphalerite

Chalcopyrite also occurs as minute core, or atoll structures in the silver sulfosalts, either Polybasite or Argentite (Plates 9 and 10).

Sphalerite:

As previously mentioned, the mineral most often occurs as a same generation mineral with chalcopyrite (Plate 4). It is also often associated with the Polybasite - in the same irregular veinlet, or as a coating around the edge of the exsolution blobs.

The light gray sphalerite appears to occur alone in the "class" three veins. This appears to be an earlier stage of mineralization than the rest of the sulphides.



X 100

Plate 5. Covellite replacing Argentite, an exsolution product of Tetrahedrite

Covellite:

Covellite is nearly always found as very small irregular bodies, as replacement of a silver sulfo salt. (Plate 5). In nearly every case the silver mineral was found to be only very slightly anisotropic. The numerous etch tests suggested that the associated mineral was argentite. Depending on the stage of replacement the covellite formed either a solid mass on the argentite, or occurred as an intricate network of tiny veinlets in the argentite. From this it is suspected that the covellite is a replacement product of the argentite.

Galena:

Galena was found in three distinct relationships which



Plate 6. Galena, showing cubic cleavage as rim at edge of Tetrahedrite grain.

do not seem to give any idea of its paragenetic relationship to the other minerals. Often it is found, along with chalcopyrite, as a rim around the edge of a tetrahedrite grain, usually corroded, but showing cubic cleavage (Plate 6). This would indicate either that galena occurs as an exsolution rim from tetrahedrite, or that tetrahedrite has almost completely replaced the galena.

Secondly, the galena occurs with the polybasite in the irregular, elongated vein like blobs of polybasite. Since it is suspected that polybasite is a product of unmixing from the tetrahedrite, it could, in this case, be assumed that the galena is also a product of unmixing from the tetrahedrite.

Thirdly, the galena is found in some sections as small, irregular blobs sitting alone in the gangue material. Typical cubic cleavage pits are exhibited by these grains.



Plate 7. Polybasite (etched) in tetrahedrite

Polybasite, Argentite, Pyrrhotite

All these minerals do not occur out of the tetrahedrite in which they are embedded. They are all unmixing, or exsolution products occurring as irregularly shaped blobs and masses (Plate 7), or as irregular, elongated vein like bodies in the tetrahedrite (Plate 8). Replacement of Argentite and polybasite by covellite is common (Plate 5).

Staggered unmixing is also a common phenomena of these minerals. Plate 9 shows this relationship to the best advantage, where the argentite (exsolution from chalcopyrite) forms an atoll in the chalcopyrite, and chalcopyrite (exsolution from

polybasite) forms an atoll in the polybasite.

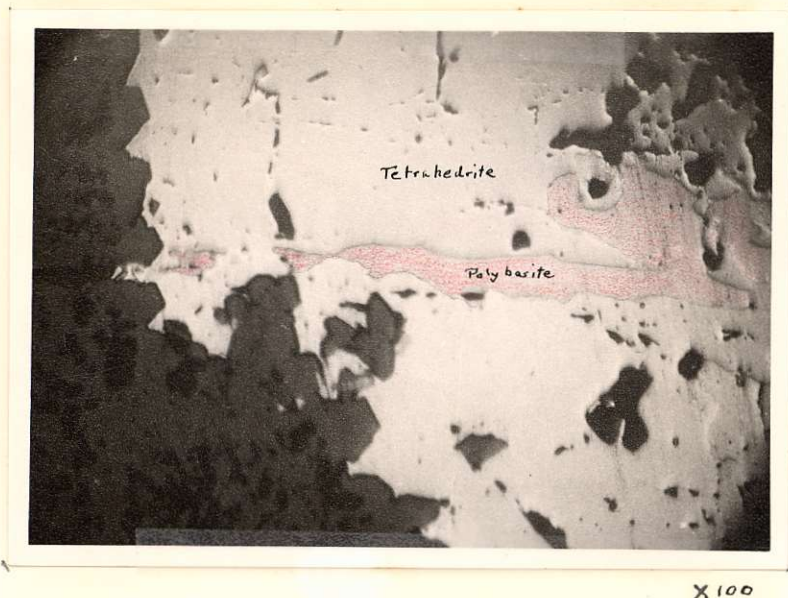
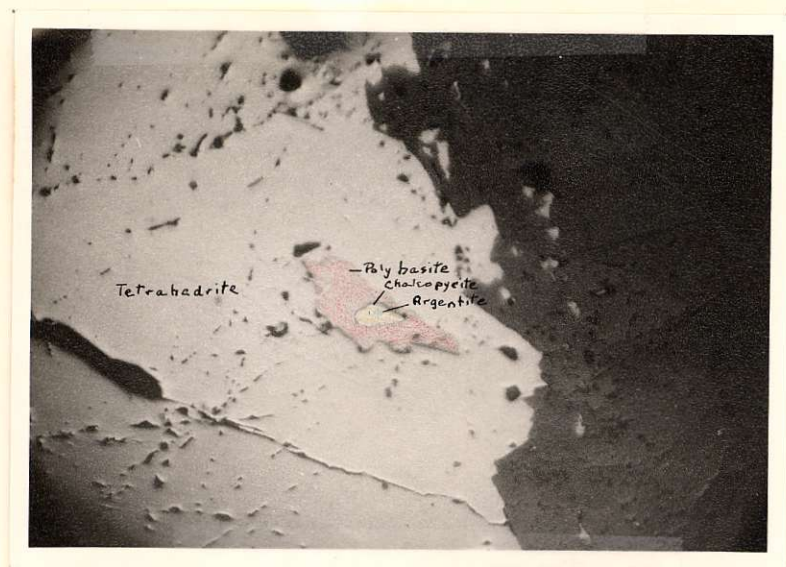


Plate 8. Irregular, vein-like exsolution of polybasite from tetrahedrite.

Plate 7 and 8 show the usual relation between polybasite and tetrahedrite to the best advantage.

By far the commonest of these silver sulfo salts is the polybasite, which is found in nearly every grain of the tetrahedrite in varying amounts. The argentite, which scratches easily and shows a greenish tint is not too common, but can usually be found in association with covellite and/or chalcopyrite (Plate 10).



X100

Plate 9. "Staggered" exsolution : Argentite from Chalcopyrite from polybasite from tetrahedrite.



X100

Plate 10. Exsolution of Chalcopyrite from Argentite, from tetrahedrite

Relative Abundance of the minerals:

Tetrahedrite	75%
Sphalerite	8%
Chalcopyrite	7%
Polybasite	5%
Galena	3%
Argentite	1%
Pyramgyrite	1%
Covellite	1%
Native Silver	?

Paragenesis:

Thin section and megascopic examination has shown that two possible periods of brecciation took place, and that two or possibly three stages of later fracturing and open space filling from hydrothermal solution occurred.

The period of ore genesis is mainly related to the second period of brecciation - when hydrothermal solutions of unknown origin carried in and deposited the primary sulphide mineralization.

It is possible that there were two periods of mineralization as evidenced by the small veining by chalcopyrite and sphalerite of the tetrahedrite, but it would appear that rather than two separate periods, one single period of overlapping deposition occurred.

Whether the galena and chalcopyrite rims around the grains of tetrahedrite are exsolution rims is debateable, but possible (Plate 3, 6). This also may be due to overlapping deposition around the grains of tetrahedrite rather than unmixing.

The silver sulfo salts with their irregular grain boundaries are almost certainly exsolution products from the tetrahedrite. The temperature at which this would occur has not been determined experimentally, but it is expected that this would occur in the temperature range of 350-400° C. It has been found that galena is capable to some degree of solid solution at fairly high temperatures, and as evidenced by the association in some places of polybasite and galena, some of the silver minerals may have unmixed from the galena rather than from the tetrahedrite. Again the temperature of unmixing would be above 350° C.

Plate 9 shows a relationship which is found quite commonly. Argentite, in chalcopyrite, in polybasite, in tetrahedrite. The polybasite is an exsolution product from tetrahedrite in this case still carrying some of the copper ions - which in turn unmixed to form chalcopyrite. This has been carried one step further to form the argentite by unmixing from the chalcopyrite.

A similar relationship occurs, as shown in plate 10, where argentite, an unmixing product from tetrahedrite, in turn unmixes leaving a grain of chalcopyrite in the centre.

These processes of "staggered" unmixing would appear possible since it is known that the polybasite and argentite can carry copper ions, and the chalcopyrite so formed may hold a few silver ions as unmixing from the polybasite or argentite.

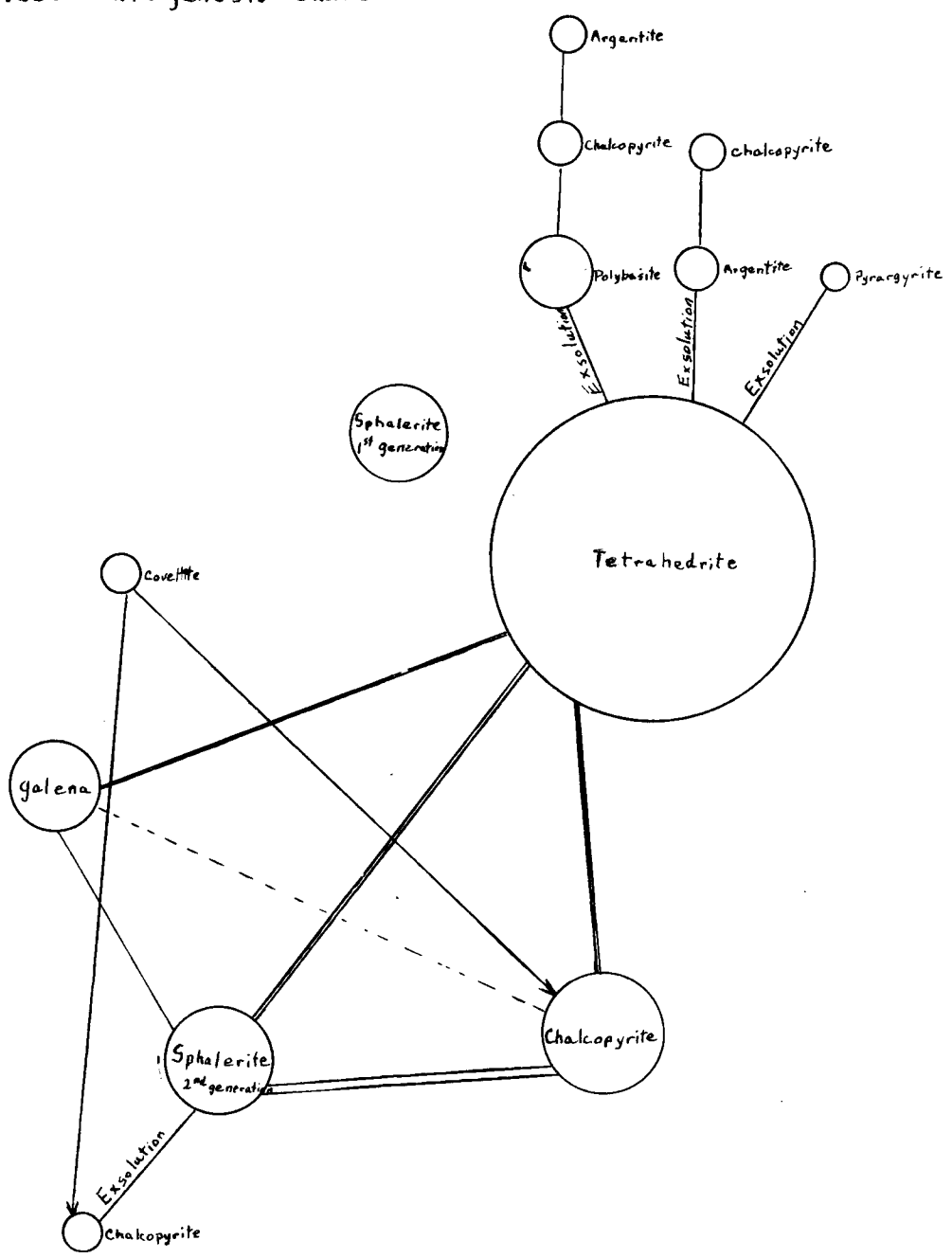
Covellite, which is found only in very minor amounts, is most often associated with the argentite. As seen under high power, the network pattern of the covellite in the argentite would indicate that the covellite is replacing the argentite, rather than forming from exsolution.

The sphalerite mineralization is the only mineral that shows two definite periods of formation, but the relationship is obscure. In the third "class" of vein, as described earlier, the sphalerite shows features of being introduced into the vein before brecciation. This sphalerite has a low iron content (honey-yellow color) and occurs alone. It is expected that this type is the earliest of the sulphide mineralization and that no other ore carrying solutions invaded the veins that carry it.

The chalcopyrite - sphalerite relationship as shown by plate 4 may be due to a solution of chalcopyrite in sphalerite - which on cooling (400-450°) unmixes to give small "islands" in the sphalerite. In other instances the sphalerite and chalcopyrite occur together as products of simultaneous deposition from the same solution - without unmixing.

From indications given by unmixing temperatures, and from the mineral assemblage itself, the assemblage is shown to be one of intermediate temperature range. The deposit can be classified therefore as mesothermal vein and breccia filling from hydrothermal solutions of unknown origin.

Vandevere Paragenesis Chart



Conclusion:

This vein deposit is typical of those found in the general vicinity of the Babine Lake area. The source of the hydrothermal solutions which carried the ore minerals is in doubt, but they may have come from the diorite intrusive which cuts the island on which these vein deposits are found. Evidence has been put forward to show that the mineral assemblage is typically mesothermal, and that the periods of mineralization are related to fracturing and brecciation of a country rock of unknown composition. Two periods of mineralization have been shown, the first of which carries only minor Zn values, and the second carrying the silver values. These silver values were shown to be an exsolution product from the major ore mineral, tetrahedrite.

Relations between the chalcopyrite, sphalerite, galena and tetrahedrite were somewhat obscure, but an attempt was made to give a plausible relationship.

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