# ORE FROM THE SILVER ISLAND PROPERTY - ITS MINERALOGY, TEXTURES AND PARAGENESIS.



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Vancouver 9, B.C.,
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Vancouver 8, B.C.

Dear Sir:

I respectfully submit the following report "ORE FROM THE SILVER ISLAND PROPERTY - ITS MINERALOGY, TEXTURES AND PARAGENESIS" as partial fulfilment of the requirements for the Geology 409 course given in the Department of Geology, U.B.C. in the 1956-57 winter session.

Yours sincerely,

James G. Murray

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## LOCATION OF THE PROPERTY

Silver Island, with an area of 22 acres, is situated 3000' from the south shore of Babine Lake in the Smithers - Hazelton Mining District in northwestern British Columbia. Babine Lake, 105 miles long and 2-6 miles wide, at an elevation of 2222' above sea level is approximately 50 miles east of Smithers and 75 miles northwest of Vanderhoof. Silver Island, essentially flat, elliptical in outline, 1300' long and 750' wide, is 25 miles northeast of Burns Lake near which lies the Canadian National Railway from Vanderhoof to Smithers. The Silver Island property is accessible by boat from the south shore of Babine Lake and from there by road to Burns Lake, Smithers and Vanderhoof. (see maps, Appendix 1A and 2A)

## HISTORY OF THE PROPERTY

Prospectors were attracted to the Silver Island area as a result of successful Ag-Pb-Zn showings in the Smithers-Hazelton Mining District in the late 1800's and early 1900's. The Silver Island Mining Company was formed in 1925 and the Taltapin Mining Company was formed in 1920. The Silver Island Mining Company owned 8 claims at that time (two under Babine Lake, one comprising the "Silver Island claim" covering the surface of Silver Island, and the remaining claims on the mainland). All the important surface showings were confined to Silver Island. A shallow shaft was sunk and two short drifts were driven. The author regrets that, due to the lack of accessible recent material on the property and to the fact that he has not seen the property personally, the present status of the property is not known to him.

## GENERAL GEOLOGY

A good proportion of the Babine Lake area is drift-covered but it consists of sheared and brecciated tuffs, rhyolitic flows, tuffaceous sediments and andesite of the Hazelton Group of Jurassic age. Intrusive into these volcanics are dykes and stocks of quartz diorite, granodiorite and diorite with some quartz porphyry intrusioes present. The majority of the intrusives are Upper Jurassic in age and compose the Post-Hazelton Group. Reproduced below is the geological column for the Hazelton - Smithers Mining District.

| AGE | GROUP | ROCKS PRESENT |
|---|---|---|
| UPPER JURASSIC | POST-HAZELTON GROUP | lamprophyres and quartz diorite dykes |
| | | granodiorite, quartz diorite and diorite stocks |
| JURASSIC | HAZELTON GROUP | rhyolite and quartz porphyry intrusions |
| | | tuffs, flows, breccias and lava flows of andesitic and rhyolitic composition. Dykes, stocks sediments and tuffaceous sediments. |
| | | argillites, quartzite, conglomerates. |
| | | Andesitic tuffs and lava flows. |

About half of Silver Island is dark green diorite and the other half rhyolite with the contact diagonally across the island. Rhyolite also outcrops on the south shore of the lake opposite the island. The rhyolite dips southerly at approximately 45°. Several fissure veins (E/ S45°) in the diorite and rhyolite, only inches in width, show in the rock outcrops.

The mineralization (traceable for 50' or so on the surface) occurs in replacement veins of quartz and calcite gangue, breccia filling and fissure veins of the same composition. The main minerals found are tetrahedrite, argentite, native silver, chalcopyrite, galena, pyrite and sphalerite. Reportedly nuggets of silver were found. It is an extremely rich showing as shown by the assays of the best ore.

| Grade: | Au ozs | Ag ozs | Cu % | Pb % | Zn % |
|---|---|---|---|---|---|
| of selected sample of small bunch ore | trace | 243.6 | 3.0 | - | 3.0 |
| sample of picked ore | trace | 693.6 | 8.0 | - | 3.0 |
| sample of country rock by diorite-rhyolite contact | trace | 9.2 | trace | - | 2.0 |
| sample of best ore on the surface | trace | 556.0 | 5.5 | 0.5 | 7.0 |

MEGASCOPIC EXAMINATION OF THE ORE

Specimens of fresh and weathered ore believed to be representative of the property were examined. It consisted mainly of dense dolomite, brecciated volcanics (undifferentiated) and altered tuff. Sulphide and sulphosalt mineralization was found in crystal-lined cavities, miarolitic cavities, breccia fillings, fissure and replacement veins of quartz, calcite, and dolomite without exception. The minerals identified from these specimens by means of megascopic properties are listed below.

Metallic minerals:

| | |
|---|---|
| Pyrargyrite | $Ag_3(Sb,As)S_3$ |
| ? Argentite | $Ag_2S$ |
| Chalcopyrite | $CuFeS_2$ |
| Galena | PbS |
| Sphalerite | (Zn,Fe)S |

Non-metallic minerals:

| | |
|---|---|
| Dolomite | $CaMg(CO_3)_2$ |
| Calcite | $CaCO_3$ |
| Quartz | $SiO_2$ |
| Chalcedony | $SiO_2$ ( cryptocrystalline) |
| Siderite | $FeCO_3$ |
| Limonite | hydrous iron oxide |
| Malachite | $Cu_2CO_3(OH)_2$ |
| Azurite | $Cu_3(CO_3)_2(OH)_2$ |
| Barite (?) | $BaSO_4$ |
| Chlorite | $H_4(Mg,Fe)_3\ (Si,Al)_2\ O_9$ |

Pyrargyrite- it is the main metallic mineral present and occurs as massive and disseminated grains replacing the silicious carbonate veins. It is equally important as disseminated and massive replacements in the miarolitic dolomite and quartz-carbonate breccia fillings. Minute amounts are seen in the dense and compact dolomite.

Argentite- it is restricted generally to cavity fillings in the miarolitic dolomite where it occurs as protruding blebs. In places it winds between crystal boundaries as small, irregular, waxy, rope-like veinlets. It is conspicuous but not plentiful.

Chalcopyrite- it occurs as disseminated or massive grains in the miarolitic dolomite, breccia fillings and silicious carbonate replacement veins. As veinlets and blebs it replaces the pyrargyrite. A conspicuous 5 - 10%.

Galena- the fraction of a per cent that was seen occurs as subhedral grains in the dolomite. It is possibly cavity filling as well as replacement in occurrence.

Sphalerite- it occurs in the silicious calcite veins as tiny, pale, honey - colored to straw - colored crystals. It was not seen associated with the metallic minerals possibly due more to its colour than to any presumed absence; later "polished section" work substantiated its presence.

Dolomite- it occurs as a massive, derse, compact rock with practically no mineralization. More commonly it is miarolitic and vuggy with crystal crustifications on the breccia fragments and on the walls of fissure veins. It is the most abundant mineral present. B uff colored.

Calcite- it usually occurs as fine-grained replacement and fissure filling veinlets. In places it is coarsely crystallized with the crystals growing around projecting crystals of quartz. White colored.

Quartz- it is found as veinlets and stringers with vug-like inclusions of dolomite. The coarse grained quartz occurs as blebs and elongate crystals . The crystals on the walls of the fissure veins show comb structure.

Chalcedony- it is deposited around the quartz crystals in one place only and shows the typical colloform structure. It is a hazy white to translucent milk - white in colour.

Siderite- it occurs as fine grained, massive, brown colored carbonate inclusions in some of the fissure veins. It is not plentiful and it is associated with the partially altered parts of the veinlets.

Limonite- it occurs as a rich brown coating and a scattered colouration where the ore is weathered and oxidized.

Malachite- it occurs as a green colouration and as disseminated grains in the weathered ore. It is not strikingly noticeable.

Azurite- it is found as a blue colouration and as disseminated, irregular grains in the weathered and oxidized ore. It is more plentiful than the malachite and the blue colouration is very noticeable on the weathered specimens. No particular structures were seen.

Barite- the presence of barite at one time or another is suspected because of tabular, plate-like , euhedral crystal cavities in the dolomite. No alteration products appear in or near the cavities.

Chlorite- it occurs in some of the greenish, altered inclusions and wall alteration in the breccia. It is invariably associated with the volcanics.

## THIN SECTIONS OF THE NON-OPAQUE MINERALS

Four thin sections were examined. They are not totally representative but they do show some of the textures one would expect to find in fissure filling veins. They contain the more important non-opaque minerals met in this study. Listed below are the four main minerals present.

Dolomite (buff, warped crystal faces, no HCl reaction, coarse grained)
Calcite (white, flat crystal faces, HCl test positive, usually fine grained)
Quartz (white - grayish white, hardness 7 )
Sphalerite ( pale straw-colored, minute crystals)

The dolomite and calcite were differentiated by comparing the thin sections to the rock from which they were cut and testing the respective types of carbonate with cold HCl.

The dolomite is mainly massive but the outermost areas (free surface areas) show euhedral crystal development with a chevron-like zoning in the crystals. The zoning is due to minute dirty inclusions. Fine grained calcite veinlets with fragments or inclusions of the zoned dolomite cut and replace the slightly brecciated dolomite. Quartz replaces the fine grained calcite in the stringers as irregular disseminated grains. The quartz has a wavy or undulating extinction. Sphalerite (high relief, isotropic) is found only in this silicious calcite. It is mostly equidimensional with an alteration halo of yellow stain. Although dodecahedral the sphalerite shows cubic and octahedral cleavage forms as expected. Later veinlets of medium grained calcite with no silica cut the silicious veinlets of calcite and the dolomite. Finally, small veinlets of fine crystallized quartz cut all the previous veinlets and the dolomite. There are inclusions of carbonate in these veinlets. Under X - nicols the quartz has the appearance of a white and gray mat of toothpicks with small euhedral hexagons scattered throughout. The carbonate inclusions have the appearance of a biscuit board with rectangular and hexagonal sections of quartz impregnating it. This is sieve texture ( appendix 3A).

## EXAMINATION OF POLISHED SECTIONS

Nineteen sections were examined and the following minerals identified on the basis of chemical, physical or optical properties and etch tests.

Chalcopyrite
- $HNO_3$ fumes tarnish, all others negative
- yellow colour
- hardness C
- slightly anisotropic

Galena
- galena white
- black triangular pits
- isotropic
- hardness B
- $HNO_3$ turns black without effervescence

Sphalerite
- true gray
- isotropic
- internal reflection
- hardness C
- etch tests negative except aqua regia - brown with effervescence

Pyrargyrite
- light greenish or bluish gray
- isotropic
- brittle
- hardness C
- deep red internal reflection
- fusible at 1
- $HNO_3$ - nil to brown with irridescence

  HCl - nil to brown
  KCN - tarnishes brown, brings out scratches
  KOH - nil to faint tarnish
  $FeCl_3$ - nil to brings out scratches
  $HgCl_2$ - nil

Polybasite $(Ag,Cu)_{16}$ $(Sb,As)_2$ $S_{11}$

- excellent polish
- hardness C
- strongly anisotropic (light gray, light brown, dark brown, black)
- very light gray
- satiny surface
- $HNO_3$ - nil to brown with some effervescence

  HCl - nil to brown
  KCN - turns black and brings out scratches
  KOH - negative
  $FeCl_3$- nil to irridescence

  $HgCl_2$- tarnishes quickly irridescent to brown

Argentite

- light gray
- isotropic
- hardness A
- sectile
- surface with fine scratches due to polishing
- $HNO_3$ - darkens a bit but no reaction

  HCl - fumes tarnish and halo does not wash off
  KCN - turns brown and brings out scratches
  KOH - nil
  $FeCl_3$- turns irridescent

  $HgCl_2$- stains immediately irridescent

## Chalcopyrite

It occurs as veinlets, blebs and irregular replacement bodies in the carbonate gangue. In places it encloses euhedral rhombs of dolomite or has straight - line contacts with it with no replacement occuring. Porphyroblastic triangular outlines on the chalcopyrite against the carbonate are common.

It shows mutual boundaries texture with the polybasite even when veined by it. It occurs occasionally discontinuously with polybasite in the same fracture in the pyrargyrite.

Blebs, irregular patches, stringers and veinlets of chalcopyrite cut the pyrargyrite giving mutual boundaries and cusp textures. In places it shows a pseudo - eutectic texture with the pyrargyrite to invariably form an "aureole" around a polybasite veinlet (appendix 5A). Most of the chalcopyrite has polybasite and pyrargyrite associated with it. Elongate blebs and stringers of chalcopyrite cut across the gangue - pyrargyrite contacts.

It occurs as tiny blebs with the sphalerite or is enclosed by it. The chalcopyrite - sphalerite contacts are straight and clear cut. Cusp texture, with the cusps in the sphalerite, and mutual boundaries texture are the rule.

Chalcopyrite occurs as rims around the argentite. It apparently replaces it in preference to the gangue. A few parallel, oriented needles of chalcopyrite were seen in the argentite which may be replacement along crystallographic directions. Cusp texture was seen with the cusps in the argentite.

It occurs as irregular blebs in and around the galena with mutual boundaries texture the main relationship.

## Galena

Galena - gangue contacts are irregular. The galena occurs as replacement blebs or grains in the carbonate and so cuts the zoning obliquely.

It occurs as small blebs in the polybasite showing mutual boundaries relations.

The galena occurs as blebs in or adjacent to the chalcopyrite with sphalerite usually present (appendix 4A & 7A).

There is the occasional irregular bleb of galena in the pyrargyrite and they show mutual boundaries texture.

## Sphalerite

It shows mutual boundaries texture, euhedral outlines and straight - line contacts with the gangue.

The sphalerite is almost invariably in polybasite and exhibiting mutual boundaries or cusp texture. It seems to occur only in single blebs which are a matter of a hundred microns across. (appendix 3A & 4A )

It is occasionally found in the pyrargyrite as small blebs. Mutual boundaries relationships are the rule.

Sphalerite is also found as subhedral grains in the chalcopyrite. More commonly, mutual boundaries texture, straight-line contacts, cusp textures with the cusps in the chalcopyrite prevail between the two minerals (appendix 4A ). Rarely are tiny emulsion blebs of sphalerite in chalcopyrite found.

Relationships between argentite-sphalerite and galana-sphalerite could not be found.

## Pyrargyrite

The pyrargyrite occurs as large massive grains that replace the carbonate gangue but seems to leave the quartz crystals unchanged. (appendix 4A ) . The pyrargyrite being brittle seems to have been fractured.

It shows porphyroblastic outlines, mutual boundaries textures, and pseudo-eutectic textures in its relationship with chalcopyrite. Cusp texture with the cusps in the chalcopyrite was noticed. Pyrargyrite also occurs as blebs in the chalcopyrite.

The pyrargyrite cuts the sphalerite-chalcopyrite contacts in places. Mutual boundaries texture was noticed also between the pyrargyrite and sphalerite.

Pyrargyrite replaces the galena and may or may not replace the argentite with which it shows cusp texture with the cusps in the argentite. It shows mutual boundaries or straight - line contacts with the galena. There are some irregular blebs of pyrargyrite in galena and the two are cut or surrounded by polybasite.

## Polybasite

It occurs as massive replacements inthe carbonate gangue and as irregular blebs cutting the carbonate.

Veinlets of polybasite cut the chalcopyrite-pyrargyrite contacts. Cusp texture with the cusps into the chalcopyrite is present. Polybasite seems to come in on the same fracture as the chalcopyrite but it seems to replace the chalcopyrite discontinuously.

Polybasite replaces the pyrargyrite as irregular veinlets and along grain boundaries to give a "rim texture" (appendix 8A ). It shows a cusp texture with the pyrargyrite also with the cusps in either mineral. Discontinuous veinlets and blebs of polybasite are also present in the pyrargyrite. The polybasite seems to replace the pyrargyrite preferably where there is galena, sphalerite or chalcopyrite. The polybasite looks super-imposed on the chalcopyrite and pyrargyrite because of the differences in relief.

It cuts the sphalerite and gangue contacts. Cusp texture was seen with the cusps in the sphalerite.

Mutual boundaries texture, cusp texture and straight- line contacts are the main relationships in its association with argentite. There are some rims of polybasite on the argentite which may be a replacement texture. These rims are irregular and vary in thickness so they should not be envisioned as geometric patterns. The polybasite is exceptionally similiar to the argentite in colour,hardness and associations. The satiny surface, lack of sectility and absence of scratches of the polybasite were used continuously to distinguish the two minerals and to test for them after each change of position of the sections. Optical properties were conclusive when any doubt still arose.

The polybasite replaces and surrounds the galena. It is darker than the galena and shows mutual boundaries texture with it.

## Argentite

The argentite has triangular and rhombic outlines on account of it being in the interstices of the dolomite. Its relationship with the carbonate gangue is one that gives striking effects. It gives sharp outlines to the contacts. In places it encloses dolomite rhombs to give the dolomite a porphyroblastic texture (see appendix 7A ).. Almost without exception the argentite-dolomite gangue contacts are straight-line contacts that are parallel to the zoning in the carbonate brought out by etching with HCl and $HNO_3$. Argentite also occurs as blebs and veinlets in and around the carbonate crystal contacts. Often it is marred by fine lines which extend all the way across it. Frequently the argentite has a border or rim of chalcopyrite. (appendix 3A and 6A ). This was used for a while by the author as a criterion of recognition of argentite but later found that polybasite was also intimately present in many cases.

Argentite shows cusp texture with polybasite with the cusps in the argentite.

It seems to be replaced by chalcopyrite and usually associated with it.

The argentite shows mutual boundaries texture with the sphalerite with the latter tending to be subhedral. Cusp texture with the cusps into the sphalerite was also noticed.

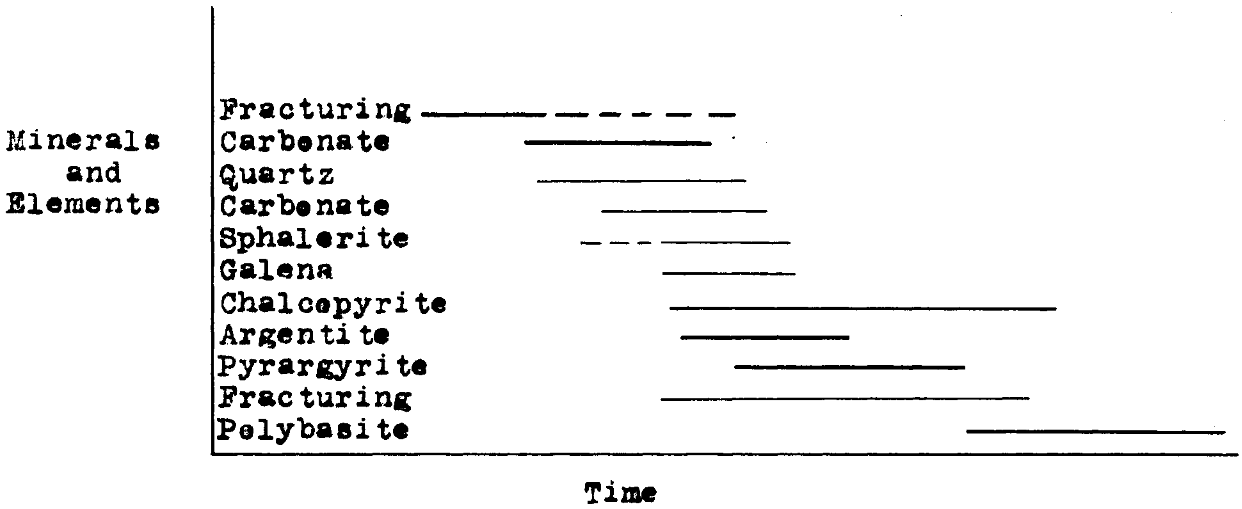
Mutual boundaries texture only was seen between galena and argentite.

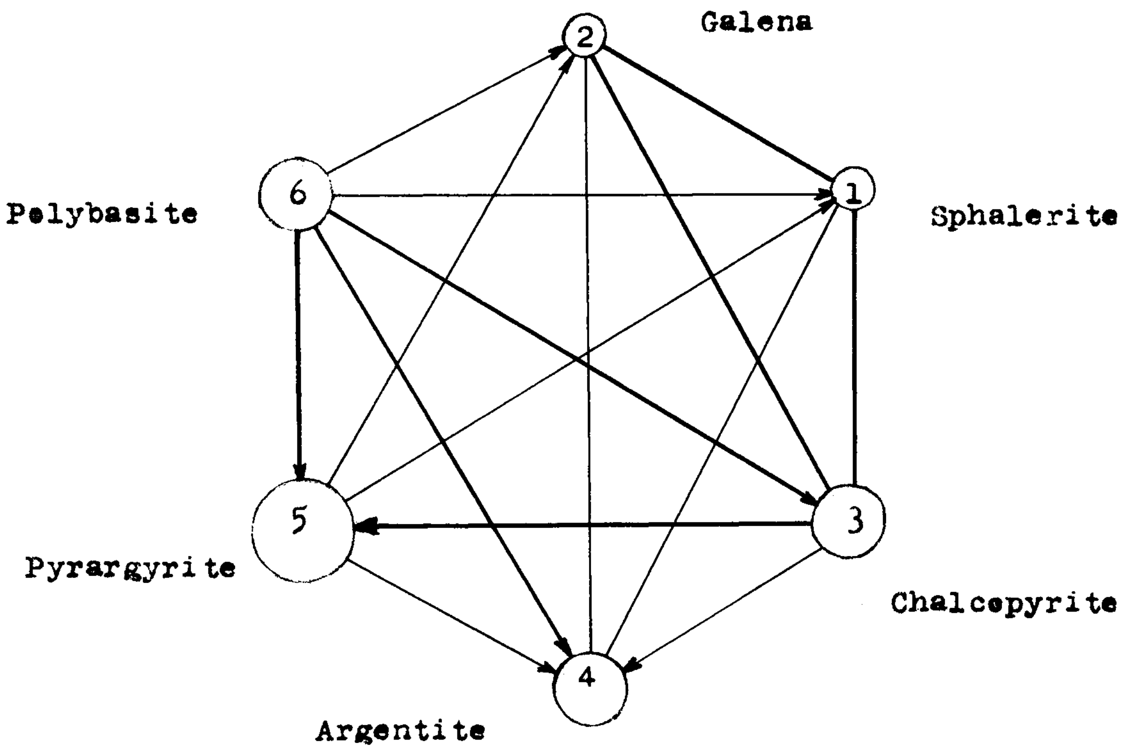
## PARAGENESIS

Fracturing of the Hazelton and Post-Hazelton Groups set the stage for the later mineralization. Carbonate solutions of dolomite and calcite precipitated these minerals in the open spaces mainly but some replacement took place in the country rock. Intercrystallization movement took place in these fractures. Following a period of initial silicification of the carbonates a series of carbonate and quartz veinlets were formed. Some time might have elapsed before the first sphalerite was formed but there is the possibility it appeared at the time of the silicification of the carbonate. A graph with the elements or minerals plotted against time will show the paragenetic seguence of the metallic minerals quickly and briefly.

A "Vandeveer diagram" will be given to show the mineral relationships. These illustrations should cover the deposit fairly completely.

Time-Sequence Graph




VANDEVEER DIAGRAM

# CONCLUSION

The Silver Island showing is an extremely rich deposit. It is an epithermal fissure vein, breccia filling and replacement deposit as it has the following characteristics.

--- Iron-poor sphalerite

--- Gangue minerals are quartz,chalcedony,calcite and dolomite

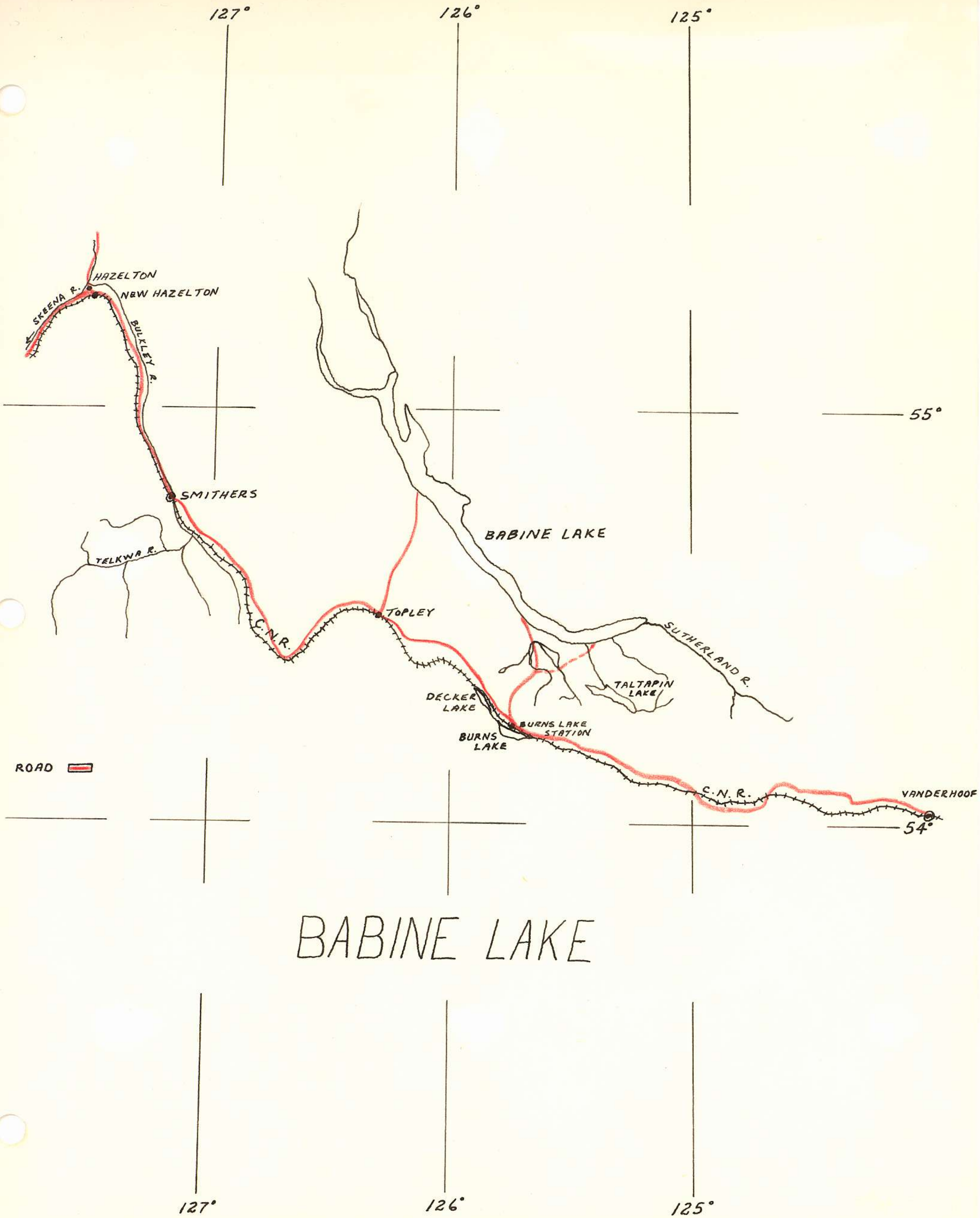
--- Propylitization and silicification

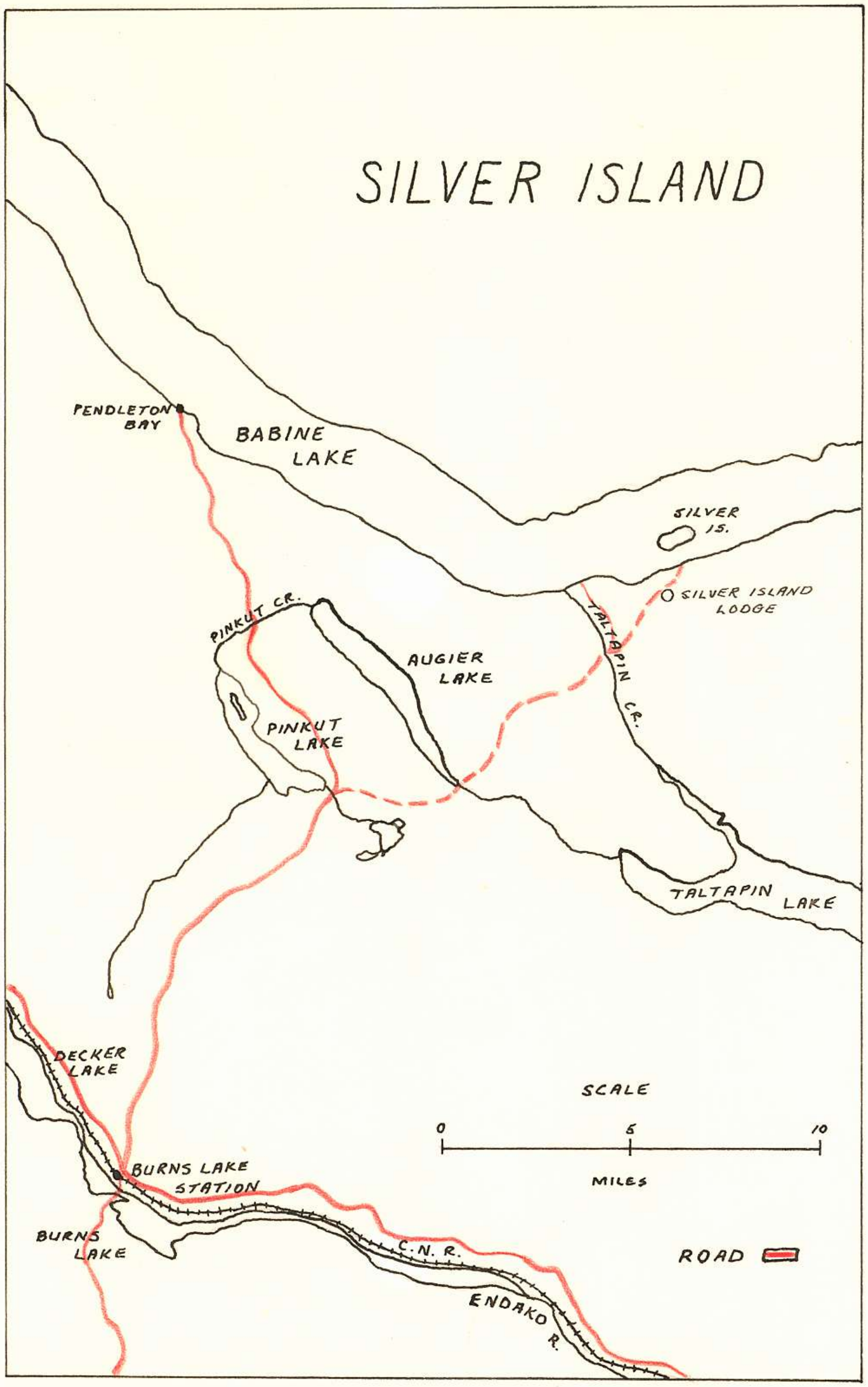
--- Structures: comb texture,colliform banding,zoning of the dolomite

--- All the metallic minerals are found in other epithermal deposits

The temperature of formation was probably below 250 C. The initial fracturing,presence of carbonate and sphalerite were probably the important ore controls along with any structure that may be present. In all probability the ore is restricted in depth and does not extend below 400 feet beneath the surface. The highest grade ore can be expected to be found where the dolomite and calcite are miarolitic and the carbonates are silicious, other things being equal and favorable.

APPENDIX


127°
126°
125°
55°
54°
HAZELTON
NEW HAZELTON
SKEENA R.
BULKLEY R.
SMITHERS
TELKWA R.
C.N.R.
TOPLEY
BABINE LAKE
SUTHERLAND R.
TALTAPIN LAKE
DECKER LAKE
BURNS LAKE STATION
BURNS LAKE
ROAD
C.N.R.
VANDERHOOF
BABINE LAKE
127°
126°
125°


SILVER ISLAND
PENDLETON BAY
BABINE LAKE
SILVER IS.
SILVER ISLAND LODGE
PINKUT CR.
AUGIER LAKE
TALTAPIN CR.
PINKUT LAKE
TALTAPIN LAKE
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MILES
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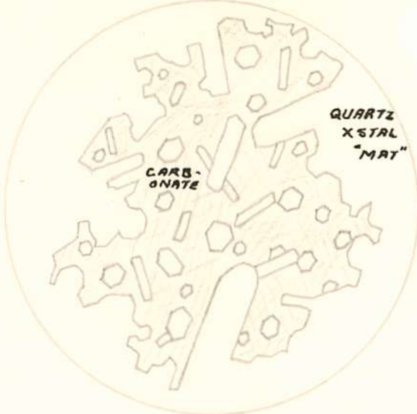
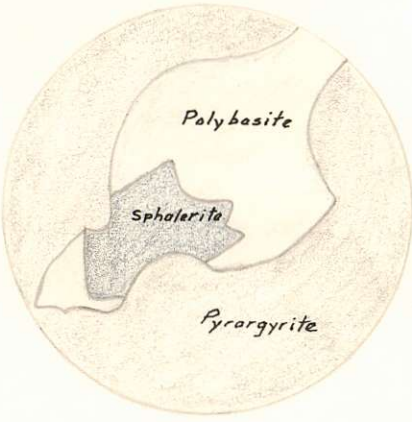
C.N.R.
BURNS LAKE
ROAD
ENDAKO R.




x80

Carbonate in quartz crystal veinlet. Note biscuit-board or sieve texture of the inclusion due to the quartz crystals.

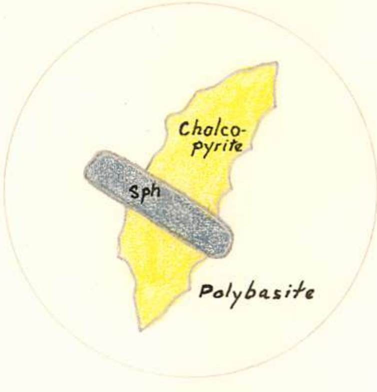



120u diam.

Polybasite and sphalerite showing mutual boundaries texture. Sphalerite and pyrargyrite showing cusp texture. Polybasite later than sphalerite and pyrargyrite.

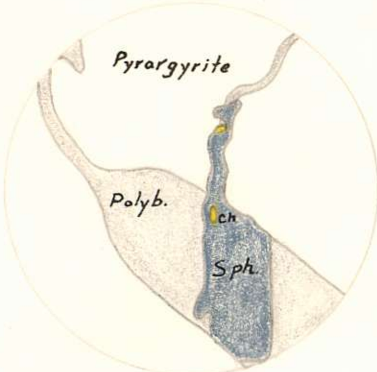

40u diam.

Chalcopyrite (ch) replacing argentite in preference to carbonate gangue. Argentite showing polishing lines.



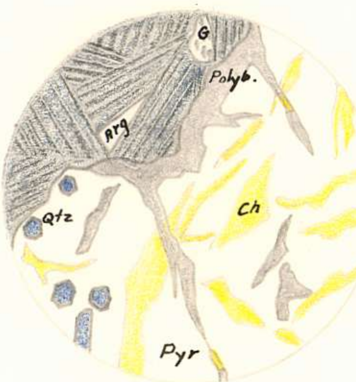

120u diam.

Chalcopyrite and sphalerite (sph) showing mutual boundaries texture. Polybasite and chalcopyrite showing cusp texture. Approximate width of polybasite veinlet.




600u diam.

Typical associations of chalcopyrite (ch), sphalerite (sph), polybasite (polyb), and pyrargyrite. Note selectivity of the polybasite. Polybasite is the latest mineral to form here.

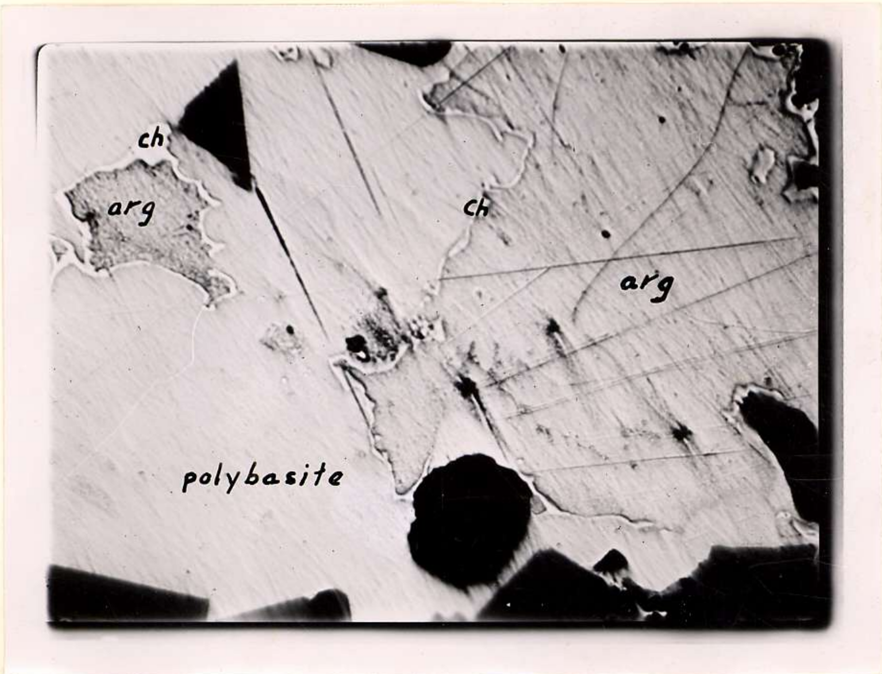



1160u diam.

Composite polished section diagram, etched and restored. Galena (g) replacing carbonate and argentite (arg) filling interstices. Chalcopyrite replacing pyrargyrite. Polybasite (polyb) replacing pyrargyrite (pyr) and chalcopyrite (ch). Quartz (qtz) as euhedral hexagons in pyrargyrite (not replaced).

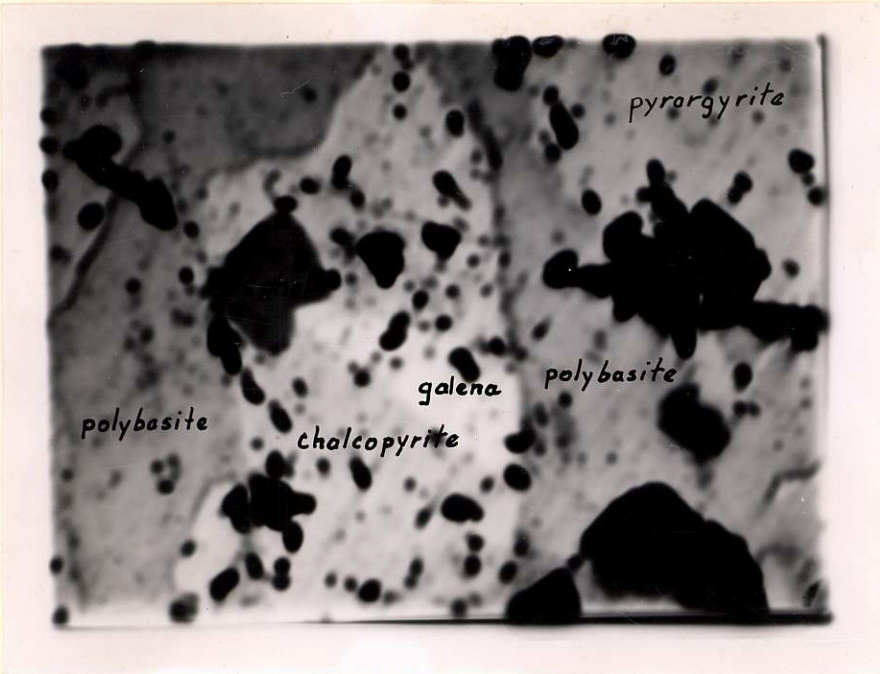

x 165

Veinlet of polybasite (polyb) replacing pyrargyrite (pyrarg) with "aureole" of chalcopyrite (ch) showing pseudo-eutectic texture with the pyrargyrite.



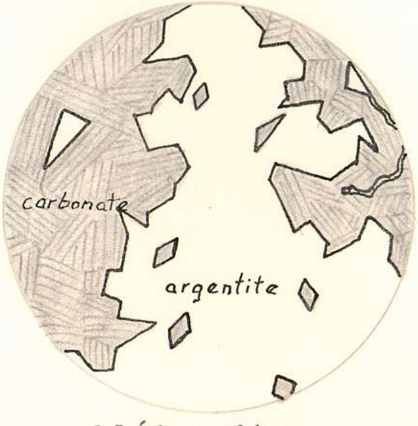

x 80

Polybasite and argentite (arg) with boundary of chalcopyrite (ch). Note straight-line contacts with gangue (black).



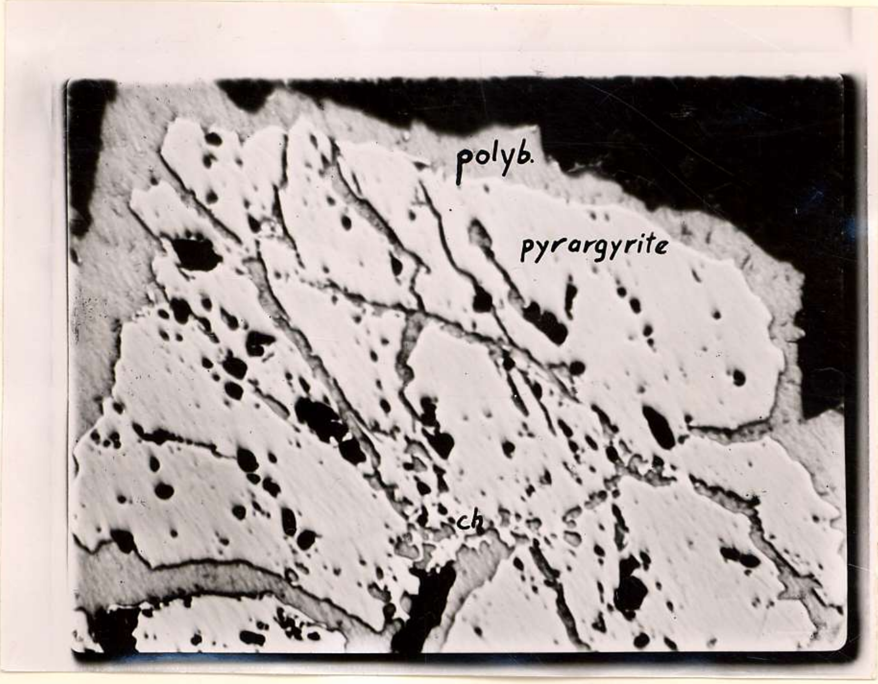

x 165

Sphalerite (sphal), galena and chalcopyrite showing mutual boundaries texture. Polybasite and pyrargyrite, to a lesser degree.




1160 u diam.

Etched with HCl and restored to show striking features and textures. Note straight - line contacts with carbonate. Facets of argentite filling interstices with sides parallel to zoning. Porphyroblastic rhombs of dolomite in the argentite. Note veinlet of argentite between grain boundaries of carbonate.




x 80

"Rim texture" formed as a result of polybasite (polyb) replacing pyrargyrite and chalcopyrite (ch, bright white) along grain boundaries and gangue contact (black).

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