Skeena.

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GEOLOGY 409 : REPORT #4

TORBRIT MINE

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SHORT HISTORY OF PROPERTY [1]

1916	-	Silver discovered by trenching.
1924	-	First adit driven.
1926-27	-	50 ton/day mill built.
1929	-	Property acquired by Brittania Mining and Smelting Co. Ltd.
1930	-	Property idle till acquired by Torbrit Silver Mines Ltd. in 1946.
1946-48	-	Access road, 300 ton/day mill and camp were constructed.
1949	-	Production began by cyanide recovery of native silver. This was continued for four months but silver recovery was less than expected by assay. Investigation led to discovery of ruby-silver, which was not recoverable by cyanidation. Recovery effected by floatation of ruby-silver and galena; concentrates were shipped to Trail. Native silver was shipped as bullion.
1959	-	Sept. 23, mining operation ceased.

Between the years 1949 and 1959, 18,614,015 oz. of silver and 10,700,428 lbs. of lead were produced.

Silver values ranged from 4 to 90 oz./ton, averaged about 15 oz./ton. Minister of Mines Report makes no mention of gold values or amount recovered.

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[1] Report of Minister of Mines. B.C. - 1948, 1955, 1959.

COUNTRY ROCK[1]

Country rock is intrusive and fragmental members of the Hazelton Group. These have been sheared and altered to produce a slightly schistose greenstone. Ore occurs as shoots within barite replacement bodies in the greenstone. Barite-greenstone contacts roughly parallel the greenstone schistosity.

MEGASCOPIC DETERMINATIONS

In this discussion the deposit is taken to be a replacement of greenstone as put forth in the B.C. Minister of Mines Reports.

Minerals identified; estimated relative abundance:

Barite	55%
Calcite	11
Hematite (plus Specularite)	7
Quartz (plus Jasperoid)	7
Galena	5
Sphalerite	5
Pyrite	5
Pyrargyrite	3
Native silver (plus Argentite)	Trace
Chalcopyrite	Trace
Gold	Trace
Mn. Oxide	Trace.

All hand specimens show various degrees of fragmentation; healing of fractures with gangue and ore; crustification deposits; replacements and veining. This is described in detail in the following as a probable sequence of events resulting textures and compositional variations.

The barite replacement bodies in the greenstone were highly brecciated to produce fragments varying widely in size and degree of relative displacement. Most fragments in this early stage of the deposit were very angular and often with little inter-fragmental movement. Adjacent portions of recognizable (in areas of only minor later alteration) barite crystals were often separated only 1mm. This brecciated barite became the site of later

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1. Report of Minister of Mines, B. C., 1948.

mineral deposition, both as fracture filling and as barite replacement. Some hematite may have been present in the original barite, now seen as disseminations within barite grains. Possibly this included hematite was derived from the mafic minerals in the replaced greenstone.

The amount of barite replaced by later minerals varies greatly from specimen to specimen. In areas where sulphide content is low, little or no replacement has occured, the fractures are commonly healed with dirty-grey calcite, minor quartz and barite. As sulphide and hematite content increases the barite has been increasingly replaced by the later minerals. Where ore minerals and hematite occur as crusts upon the barite fragments, replacement has occurred in a gradational manner, such that no sharp line can be drawn between the crust and the enclosed fragments.

There appears to be three generations of mineralization:

1. Fine grain disseminated hematite within the barite mass, possibly as inclusions within barite grains. This may have been derived from the mafic minerals of the replaced greenstone country rock.

2. Second stage minerals are derived from an outside source and appear to have been deposited from an aqueous solution.

Minerals of this stage are predominately hematite (plus specularite), pyrite, quartz and sphalerite, with minor galena and calcite. These are deposited as crustification on the barite fragments and as non-crustified veins and replacements. The ore bodies overall "cockade texture" is a result of this type of emplacement.

No orderly sequence for minerals in the crusts could be established. The minerals occur in fairly well defined bands with "botryoidal" interfaces between successive layers. A common assemblage is; quartz (often "jasperoid"), barite, specularite, pyrite, and sphalerite. These minerals may occur intermixed or singly in the bands, any one band may or may not be repeated at irregular intervals.

Individual bands are from 1mm.to several centimeters wide.

Often quartz-hematite (jasperoid) alternate with specular hematite, the "botryoidal" interface delimited by a thin band of fine grained pyrite. Galena grains are often included in the specularite. Bands containing well crystallized quartz or barite have convex botryoidal intersurfaces but the co-termination of crystals with long axis sub-perpendicular to the surface makes it uneven. The barite may have been introduced with the other crustifying minerals, or may be a result of redeposition of barite replaced (or dissolved) by the invading mineralizing solutions.

Irregularity of the sequence of minerals in the crusts is attributed to varying chemical conditions in different parts of the deposit. If the minerals were deposited from an aqueous solution saturated with respect to different minerals at different times in local areas the irregularities are easily explained.

Calcite, filling fractures in barite in relatively unaltered portions of the deposit is assigned to this stage.

3. The third and last phase, separated from the second phase by an unknown time interval, is responsible for introduction of most of the valuable mineral content.

Most of the galena, some sphalerite and all of the pyrargyrite, chalcopyrite and native silver appear to have been emplaced at this time. They commonly occur as fracture fillings or veins cutting the crustified masses, barite fragments and other features present. Replacement of earlier minerals seems likely, but cannot be proven by hand specimen examination. Preferred "vein" orientation is parallel to previously existing structures.

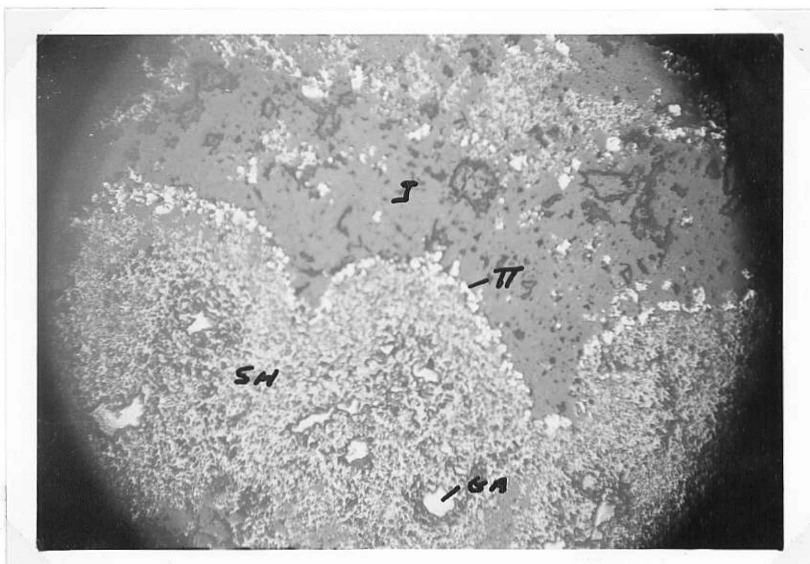
Calcite, quartz and barite constitute the gangue minerals introduced with the third phase, with calcite by far the most abundant. Perhaps the quartz and barite were emplaced as redeposited material dissolved from the hosting rock by mineralizing solutions. The minor amounts of pyrite and hematite present in the "veinlets" may also be remobilized material from the second phase of deposition.

Minor amounts of native silver coated with argentite were found as open space fillings. It is proposed that much of the silver is present as solid solution in galena. Gold, found in only two hand specimens, is also assigned to this final phase of mineralization.

Shearing occurred after final mineral emplacement but is a localized and relatively minor feature. In one specimen fractures in sheared sphalerite are filled with galena which also appears to have been sheared slightly.

3 in.

Crustification, mainly of hematite, pyrite, quartz and barite. From zone of "cockade ore".



Microphotograph of center specimen above. Band of specularite (SH) with included galena (GA) seperated from a band of "jasperoid" (J) by pyrite (π). π inclusions in "jasperoid" are pyrite grains.
(PPL, X100)

MICROSCOPIC DETERMINATIONS

GANGUE

Barite is most commonly coarsely crystalline. Signs of stress can be seen even in portions of massive barite; the cleavage traces are often curved. Along fracture zones numerous grains show physical disruption and rounding. In this environment the grains are in a matrix of calcite and fine grained quartz. Some barite has recrystallized in these fractures, giving transverse bladed crystals.

Calcite and quartz appear to have replaced barite to a minor degree along many of the fracture zones.

METALLIC MINERALS

Estimated relative abundance of metallic minerals in polished section:

Hematite	45
Galena	20
Pyrite	16
Specularite	11
Sphalerite	6
Pyrargyrite	2
Chalcopyrite	Trace
Tetrahedrite	Trace
Gold	Trace
(Silver)	Hand specimen only.

MINERAL IDENTIFICATION

HEMATITE Fe_2O_3

Specular variety shows characteristic lamellar bladed habit; anisotropic; H = G, but brittle blades break easily; negative to all standard reagent.

Fine grained hematite gives rich red internal reflection and is generally mixed with other minerals, especially fine grained quartz.

GALENA PbS

Isotropic; white (orange tint when in contact with pyrargyrite); cubic cleavage gives characteristic triangular pits.

PYRITE FeS_2

Isotropic; pale yellow; H = F+ ; poor polish; negative to standard reagents.

SPHALERITE (MARMATITE)(Zn, Fe) S

Isotropic; brown-grey color, dark red-brown internal reflection; H = D; poor polish, negative to standard reagents.

PYRARGYRITE - PROUSTITE $Ag_3(As, Sb) S_3$

The variety found in this deposit is intermediate in composition between the two end members pyrargyrite and proustite. Micro-chemistry test gave positive reactions for both antimony and arsenic.

Blue color; strong anisotropism; H = B; intense red internal reflection; good polish with care.

Etch -	$HgCl_2$	- brown or iridescent blue
	KOH	- brown, reaction rate varys
	KCn	- defines grain boundaries and darkens scratches
	HNO_3	- fumes tarnish iridescent
	HCl, $FeCl_3$,	Aqua-regia : negative.

CHALCOPYRITE Cu Fe S

Slight anisotropism; brass yellow; H = C; $AgNO_3$ positive, as distinct from gold.

TETRAHEDRITE - TENNANTITE $(cU, Fe)_{12}(As, Sb)_4 S_{13}$

The variety in this deposit is intermediate in composition. Tests for both arsenic and antimoney were positive. Some grains gave red internal reflection, indicating presence of arsenic.

Isotropic; brown grey colour; H = D; good polish; negative to standard reagents except aqua-regia which gives slow brown stain.

GOLD Au

Isotropic; yellow; H = B - C, sectile; KCn positive, as distinct from chalcopyrite, also indicates low silver content.

MODES OF OCCURENCE

HEMATITE

The great majority of hematite occurs in the crustification described in detail under hand specimen description. Coarseness of the crustification texture allows interrelationships to be determined better in hand specimen than in polished section.

In the crusts, specularite shows no disruption due to shearing and the bladed habit is not well developed. Specular hematite, outside the crustifications, occurs as masses of contorted blade-like crystals within brecciated barite. Disrupted fragments of barite, with scattered included blades of specularite, are included in the specularite. Proposed origin of this feature is as a segregation of specularite that partially replaced barite, the whole then sheared.

In polished section much of the "earthy" hematite appears to be submicroscopic inclusions in quartz rather than as free material. This quartz has a red internal reflection, deepening as hematite content increases. Possibly the amount of hematite in both hand specimen and polished section has been over estimated due to this mixing.

GALENA

Most galena is contained in relatively massive segregation. Disseminated inclusions of pyrite, sphalerite, chalcopyrite and tetrahedrite are nearly always present. These massive zones grade down to thinner vienlets and replacement stringers in barite, where corroded barite grains becomes the dominant inclusion. Where galena predominates the mineral assemblage, pyrargyrite is rather sparsely distributed as irregular shaped inclusions.

Galena is also found as isolated grains within specular hematite bands in the crustifications. This appears to have been deposited simultaneously with the specularite.

SPHALERITE

Sphalerite of both second and third phase mineralization occur in approximately equal amounts.

Second phase sphalerite occurs as distinct bands in the crustifications.

Third (last) phase sphalerite is closely associated with galena. Where sphalerite predominates, segregations and inclusions of galena, pyrite and chalcopyrite are common. Where galena predominates, sphalerite occurs as inclusions and segregations.

Sphalerite, much like galena, may occur as veins and stringers in and replacement of barite, but included grains of barite are much less common than in galena.

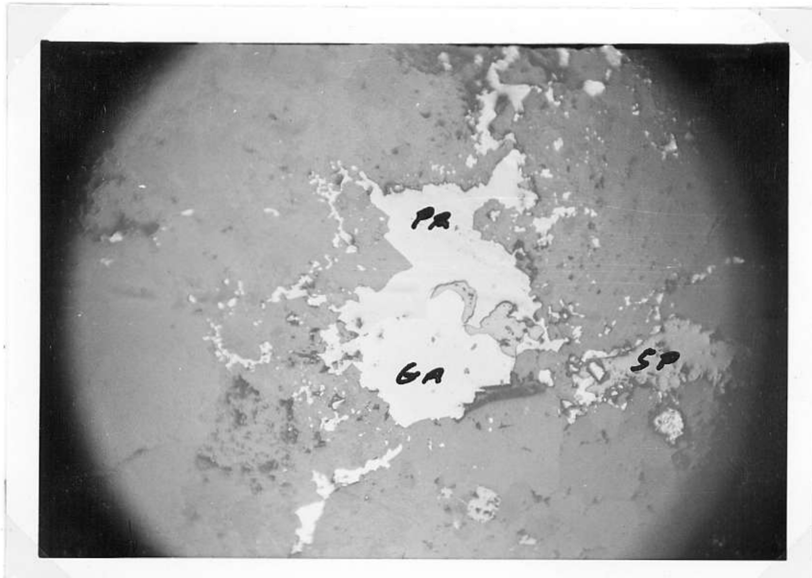
In crustified zones and in pyrite stringers sphalerite replaces pyrite, especially if the pyrite has been shattered. What generation of sphalerite this belongs to is unknown.

PYRITE

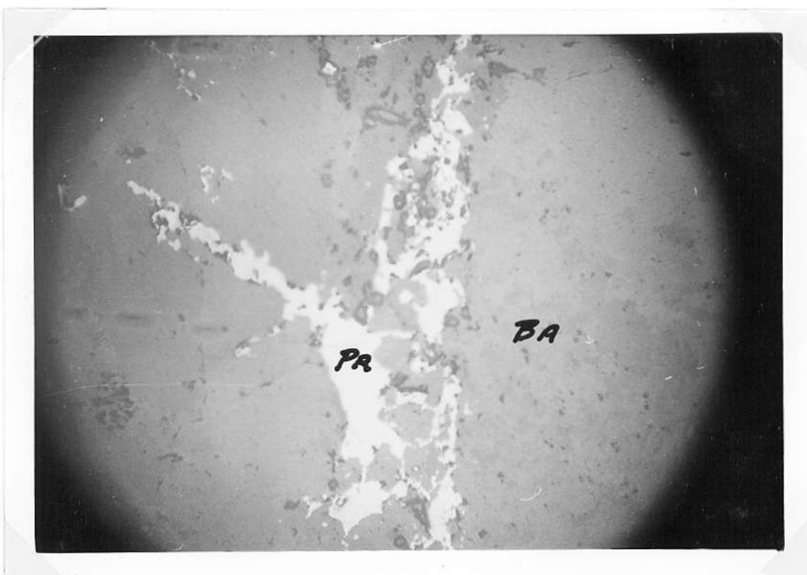
Pyrite occurs mainly as thin layers in the crustifications especially at the interface of specularite and "jasperoid" bands, or at interface of specularite and fine grain silicifird hematite. In some cases, euhedral pyrite crystals may be up to 1cm. across.

Pyrite, often relatively coarse grained, occurs in barite-hematite matrix as fracture filling in both barite and the crustifications. Many of these large crystals are fractured and partially replaced by sphalerite.

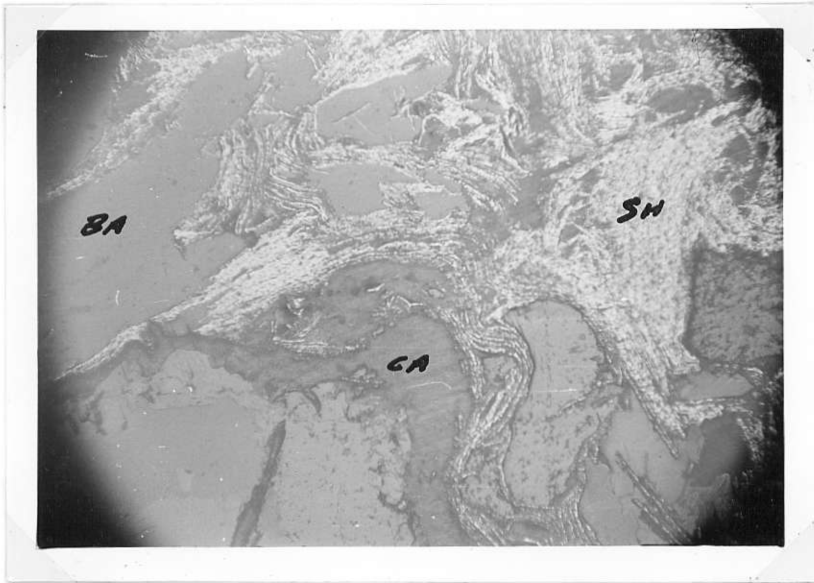
Inclusion of pyrite in galena and pyrargyrite are common, generally as small isolated anhedral grains.



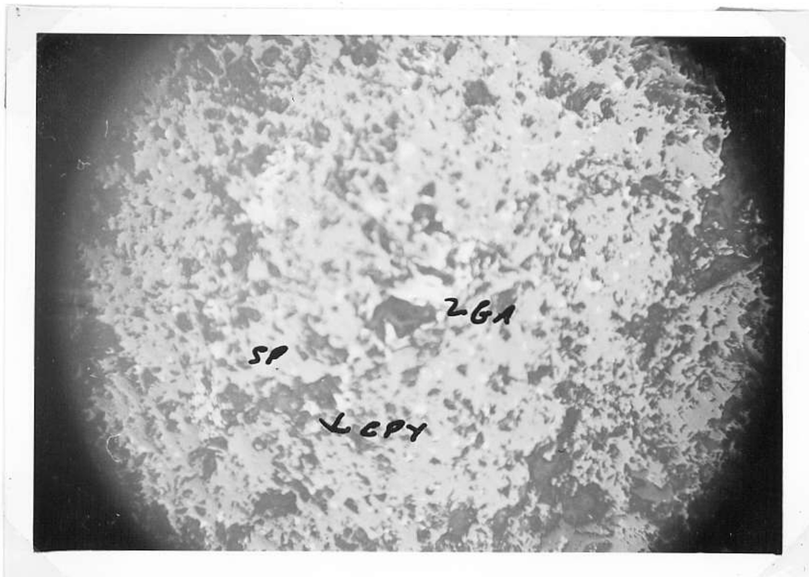
Replacement-vein of pyrargyrite (PR), galena (GA) in calcite. Sphalerite (SP) also present. (PPL, X 100)



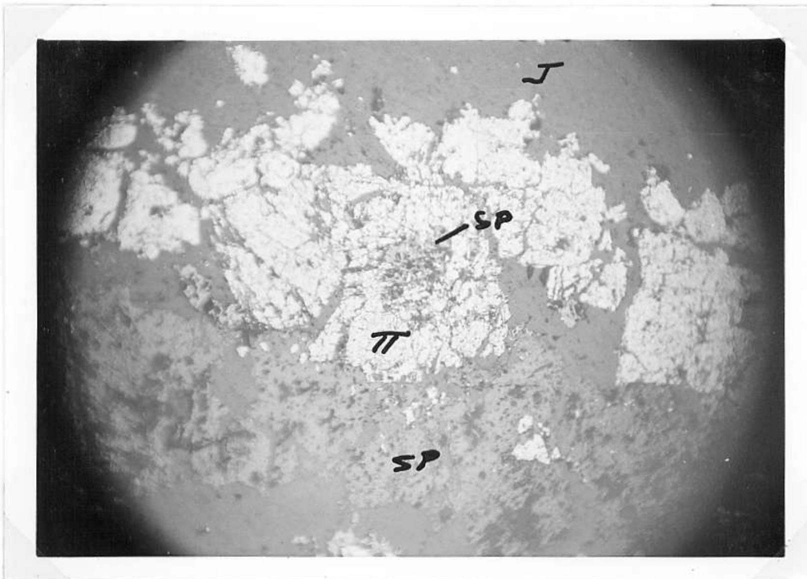
Replacement-vein of pyrargyrite (PR) in barite. Included grains are corroded barite fragments (PPL, X 100)



Specular hematite (SH) and barite fragments (BA) in fracture zone in barite. Some calcite (CA) present.
(PPL, X100)



Chalcopyrite (CPY) and galena (GA) as exsolution growths in sphalerite (SP)
(PPL, X300)



Fractured pyrite (π) replaced by sphalerite (SP). In matrix of sphalerite and "jasperoid" (J) (PPL, X100)

Fractured pyrite (π) with sphalerite (SP) filling fractures. In crustification zone with sphalerite and "jasperoid" (J) (PPL, X100)

Pyrargyrite

Pyrargyrite never occurs as large masses. Most often it is found as short replacement type stringers up to 4 mm wide in barite. In this habit it is nearly always associated with abundant calcite gangue and contains numerous inclusions of corroded grains of both calcite and barite. It appears to have replaced calcite that has filled fractures in and replaced barite.

Inclusions and segregations of galena are always present. This may be due to a partial solid solution of galena in pyrargyite which has ex-solved and segregated by diffusion. In one instance, an intergrowth of galena and pyrargyrite was found that could be interpreted as an ex-solution intergrowth.

Pyrite and sphalerite inclusions are common.

Pyrargyrite occurs to a lesser extent as inclusions in galena, but was never observed as an inclusion in sphalerite.

GOLD

Gold was found only as small round blebs in barite, calcite and galena. In the barite it occurred near a veinlet of pyrargyrite-calcite.

CHALCOPYRITE AND TETRAHEDRITE

Both chalcopyrite and tetrahedrite occur as small rounded inclusions in other third phase minerals and to a minor degree in barite-calcite fracture fillings in barite.

These minerals were not observed as constituents of the crustified zones.

Chalcopyrite occurs quite commonly in what appears to be an ex-solution intergrowth with sphalerite, the chalcopyrite having ex-solved from the much more abundant sphalerite.

TEMPERATURE OF FORMATION

The only indication of temperature conditions in the second phase of mineralization is the mineral assemblage generally ascribed to occur in deposits formed at temperatures of 500 C or higher.

Third phase mineralization occurred at temperatures above the 350-400 C range. This is indicated by chalcopyrite ex-solution intergrowth in sphalerite.

It must be noted that in this report each of the three phases of mineral emplacement has been treated as a separate sharply delimited entity. In actual fact, there may have been only one protracted phase with contemporaneous fracturing, or resurges interspersed with fracturing.

SUMMARY OF SEQUENCE OF EVENTS

1) Introduction of barite as replacement of slightly schistose greenstone; some hematite may have been formed at this stage.

2) Brecciation of barite.

3) Major amounts of hematite, quartz, pyrite and sphalerite filled fractures in and partially replaced barite. Some barite appears to have been remobilized and redeposited. Crustification texture of the "cockade ore" produced at this time.

4) Minor fracturing and shearing of emplaced mass. Galena, sphalerite, pyrargyrite, tetrahedrite, chalcopyrite and gold introduced as fracture fillings and replacements for earlier minerals. Native silver probably belongs to this phase. Some remobilization of earlier formed minerals occurred.

5) Open space fillings of calcite, as inward projecting bladed crystals.

PARAGENETIC SEQUENCE