

Poor English
but otherwise
a careful job.
Good photos.

600195

MINERALOGRAPHY OF THE LITTLE BILLY MINE,
TEXADA ISLAND, B.C.

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Introduction

The Little Billy Mine, in the Nanaimo Mining Division, is near Vananda, on the northeastern coast of Texada Island.

Showings ~~have been~~^{are} reported to ~~have been~~^{have been} first discovered in 1880 and the first mention of the property is in the B.C. Minister of Mines Report of 1897. The property was first owned by the Vananda Copper and Gold Mining Company, Limited. A smelter was erected in 1899 for the Little Billy and several other adjacent mines. Work done in sinking a shaft started in 1911 and was stopped in 1913. The mine was reopened in 1916 and the ore is reported to have averaged: Gold, \$5 per ton (value in 1916); Silver, 102 oz. per ton; Copper, 2½ percent. Little work was actually done in the following years and in 1928 the property was acquired by the Central Copper and Gold Company of Vancouver. In 1928 and 1929 some diamond-drilling and geophysical work was done but the property lay idle from 1929 to 1943, when it was acquired by the Industrial Metals Mining Company. A great deal of work was done, but no stoping, and in 1945 the property was sold to the Vananda Mining Company. Work was done from 1945 to 1952 and the ore was shipped to Tacoma. Since 1952 work has apparently been at a standstill but the property is still owned by the Vananda Mining Company.

The total production (up to 1952) has been determined to be 67,500 tons. This includes 11,675 oz. of gold, 38,525 oz. of silver and 1,822,630 lbs. of copper.

The average grade of ore mined was 0.25 oz. of gold per ton and 2.4% copper. The ore was mined by shrinkage-stoping.

General Geology

The main rocks on the property include limestone, quartz diorite, and many small greenstone dykes. In addition to these, bodies of calcic-silicate rocks consisting mainly of garnet have replaced limestone and have partly replaced greenstone dykes along the contacts of the quartz diorite. Parts of these replacement rocks have been sufficiently well mineralized with bornite and chalcopyrite to form the ore-bodies of the mine. These ore-bodies, though variable, are generally tabular in shape.

Mineralography

This problem consisted of many variable hand specimens along with many polished sections. Several other polished sections were made and investigated.

Megascopic

Several specimens of coarse, fibrous wollastonite and fine grained brownish-green garnet were observed. These samples lacked metallic mineralization. A few specimens of finer wollastonite exhibited good bornite values and possibly some chalcopyrite. The writer did not observe any tremolite among the specimens provided.

A few specimens of skarn had high values of molybdenite. There was also some euhedral pyrite and some chalcopyrite in association. The groundmass was mainly calcite and recrystallized limestone with secondary mineralization of azurite and malachite in fractures and joints.

Some specimens had very high bornite values with a little

calcite. Malachite and azurite were also observed. A few samples had high chalcopyrite values along with minor bornite in quartz and calcite gangue. The quartz appeared to replace the calcite. Some of the coarser calcite had good chalcopyrite values along with large cubic pyrite crystals.

Fibrous, radiating epidote was found in calcite associated with quartz and garnet. There were some minor chalcopyrite values, usually found along fractures in garnet. Some samples showed sharp contacts with serpentine and serpentine samples were observed with no other association. These samples were generally fine grained and were light green, dark green, and pink in color.

High bornite and magnetite ore was observed in garnet mainly. There was also some minor epidote and calcite as was verified by thin sections.

Good description

Microscopic

The percentages of minerals varied from one polished section to another and an exact sequence of abundance of minerals was impossible to obtain. The average amount of mineralization other than gangue, in the polished sections, was approximately 15 percent.

The primary minerals included bornite, chalcopyrite, sphalerite, pyrrhotite, tetrahedrite, hessite, wehrlite, magnetite, cobaltite, pyrite and molybdenite. The secondary minerals included malachite, azurite, covellite and goethite.

Minerals and Textures (In approximate order of relative abundance)

Bornite (Cu_5FeS_4)

Color pink; Hardness B; Weakly anisotropic; HNO_3 , effervesces and stains brown; FeCl_3 , yellow-brown stain; KCN, brown stain; other reagents negative.

Tarnished easily to purple. Found associated with chalcopyrite, cobaltite, magnetite and several other copper minerals. It is generally massive and does not exhibit any significant textures.

Chalcopyrite (CuFeS_2)

Color yellow; Hardness C; Weakly anisotropic; Aqua regia, weak stain; negative to all other reagents.

Closely associated with bornite, molybdenite, pyrite and sphalerite. Occurs as replacement along fractures and the crystallographic axes as is illustrated in Figs. 5 and 6. It appears to be exsolved as in Fig. 6, but has matched walls indicating replacement as in Fig. 4. It shows mutual boundaries with sphalerite and is exsolved from sphalerite as is shown in Figs. 2 and 3.

Magnetite (Fe_3O_4)

Color silver-gray; Hardness >E; Isotropic; negative to all reagents; strongly magnetic.

The magnetite did not show good crystal form as exhibited mutual boundaries with bornite, which appeared to be its only association.

Pyrite (FeS_2)

Color pale yellow; Hardness >E; Isotropic; Aque regia, weak tarnish; all other reagents negative.

It exhibited a poor polish and had a good cubic crystal form. It was found to be closely associated with chalcopyrite.

Molybdenite (MoS_2)

Color white; Hardness B; Strongly anisotropic; white to dark blue-black; negative to all reagents.

It was found as long plates and was closely associated with chalcopyrite and sphalerite as is illustrated in Fig. 2.

Tetrahedrite ($5\text{Cu}_2\text{S} \cdot 2(\text{Cu}, \text{Fe})\text{S} \cdot 2\text{Sb}_2\text{S}_3$)

Color gray; Hardness D; Isotropic; HNO_3 , fumes weakly tarnish; negative to other reagents.

Appeared to be exsolved from bornite as in Fig. 6 but usually occurred as thin stringers as is illustrated in Figs. 7 and 8.

Sphalerite (ZnS)

Color gray; Hardness C; Isotropic; red-brown internal reflection; HNO_3 , weak tarnish; Aqua regia, dark brown stain; remaining reagents negative.

It was associated with chalcopyrite and molybdenite and exsolved chalcopyrite as shown in Figs. 2 and 3. Good evidence of replacement was noticed but not photographed.

Cobaltite (CoAsS)

Color pinkish-white; Hardness E; Weakly anisotropic; negative to all reagents.

Highly fractured in bornite as is illustrated in Fig. 8.

Hessite (Ag_2Te)

Color gray white; Hardness A; Anisotropic, white to blue with multiple twinning; HNO_3 , black stain; FeCl_3 , irridescent tarnish; HgCl_2 , brown stain; other reagents negative.

Usually found in bornite as in Fig. 1 but was occasionally found in chalcopyrite. It was found to be the only source of silver and was very fine. *grained*

Wehrlite* ($\text{Bi}_{2+x}\text{Te}_{3-x}$)

Color white to yellow white; Weakly anisotropic.

It was found as minute amounts in association with Hessite and bornite and the exact relationship with hessite could not be determined. It was observed only twice and in both instances occurred where the concentration of hessite was relatively large as is illustrated in Fig. 1.

Malachite ($\text{Cu}_2\text{CO}_3(\text{OH})_2$)

Identified best in hand specimen. It was fine grained, green in color and occurred in fractures in calcite as supergene products of bornite and chalcopyrite.

* Identified by Dr. R.M. Thompson. Optical properties were recorded by writer but it was too fine to record etch tests.

Azurite ($\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$)

Identified best in hand specimens. It was fine grained, blue in color and was associated with malachite in calcite and is a supergene product of bornite and chalcopyrite.

Covellite (Cu_2S)

Color blue to gray; pleochroic; Hardness B; Fire-red anisotropism; KCN, black stain; negative to other reagents.

Occurred in fractures in the bornite as is illustrated in Fig. 7.

Goethite ($\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$)

Color gray; Hardness ~D; Weakly anisotropic; HCl, black stain; negative to other reagents.

Closely associated with covellite in fractures and was found where the amount of covellite was relatively large. Was first thought to be delafossite but this is improbable due to its rarity. Its occurrence is illustrated in Fig. 7.

Pyrrhotite (FeS)
+

Color pink; Hardness D; Strong anisotropism, gray, blue and brown; HNO_3 , fumes tarnish; KOH, weak brown stain; all other reagents negative.

Occurred as small round blebs in chalcopyrite.

Paragenesis

The first minerals in the paragenetic sequence were probably the high temperature minerals and most evidence collected seems to bear this out. Magnetite, cobaltite, pyrite and molybdenite were first in the sequence. This suite of minerals was followed by bornite. Bornite was observed to be later than magnetite in the high bornite-magnetite ore. Bornite has filled fractures in cobaltite, as in Fig. 8, thus showing that bornite came after the cobaltite.

Chalcopyrite followed bornite in the sequence but pyrrhotite may have preceded the chalcopyrite. The pyrrhotite occurred as round blebs in the chalcopyrite, having a mutual boundary relationship and, as pyrrhotite is a high temperature mineral and chalcopyrite an intermediate temperature mineral, the pyrrhotite probably came first. Chalcopyrite replaced pyrite and molybdenite. Pyrite appeared as cubic crystals surrounded by chalcopyrite. Evidence indicating replacement of molybdenite by chalcopyrite, though not photographed, was shown by the occurrence of chalcopyrite between molybdenite cleavage plates. The chalcopyrite, on first glance, appeared to have been exsolved from the bornite but, on close inspection, evidence showed that chalcopyrite replaced the bornite. It replaced bornite along crystallographic axes and along fractures showing matched walls as is shown in Figs. 4 and 5.

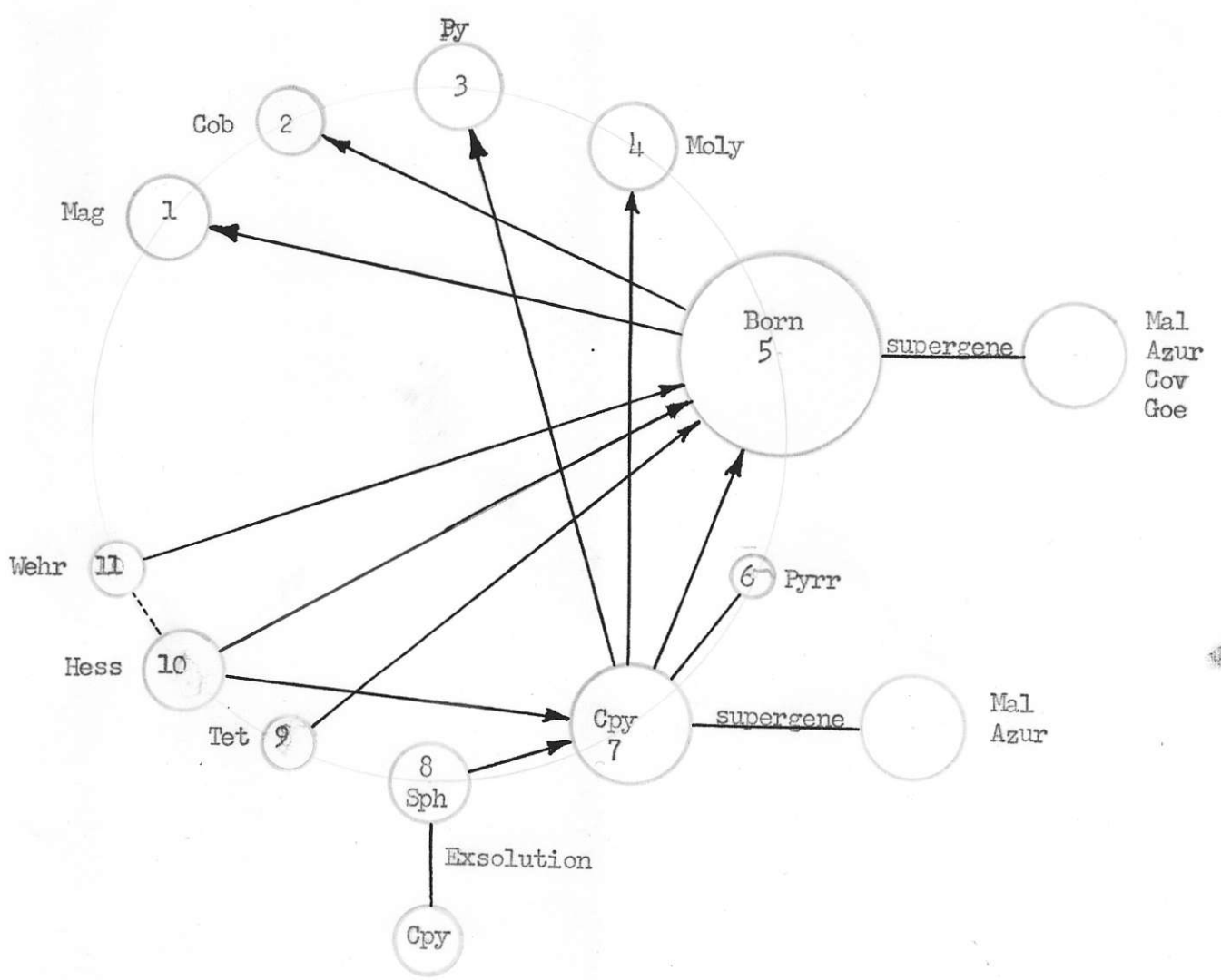
Sphalerite probably came in close to the same time as chalcopyrite but was observed to replace the chalcopyrite in one instance. Generally, the texture exhibited was a mutual boundary texture. The sphalerite exsolved chalcopyrite as is shown in Figs. 2 and 3. The next mineral in the sequence was probably tetrahedrite. It occurred as thin stringers in bornite as in

Figs. 7 and 8 and also gave a false impression of exsolution as in Fig. 6.

not necessarily

The tellurides, hessite and wehrlite, being low temperature minerals, were probably the last minerals in the paragenetic sequence. These genetic relationships could not be determined but wehrlite was only observed when there was a relatively high concentration of hessite as is shown in Fig. 1. Hessite was seen to replace both bornite and chalcopyrite but wehrlite was only observed in association with bornite.

Supergene alteration of bornite has resulted in malachite, azurite, covellite and goethite. Malachite and azurite were also observed as supergene minerals of chalcopyrite. These secondary minerals occurred in fractures in the bornite and chalcopyrite.



Conclusion

The mine has been classified as a contact metamorphic replacement deposit formed by the intrusion of quartz diorite into impure limestone and no evidence was observed to dispute this statement. The deposit includes high to low temperature mineral assemblages and shows good copper values with some silver in the form of hessite. Though gold occurs at the Little Billy Mine, the writer did not observe any in any of the sections. To recover the silver values, the ore would have to be crushed finely before it is milled but, due to the type of gangue minerals, crushing would be a relatively minor problem.



Fig. 1 x 300

Hessite and wehrlite
in bornite.

Section

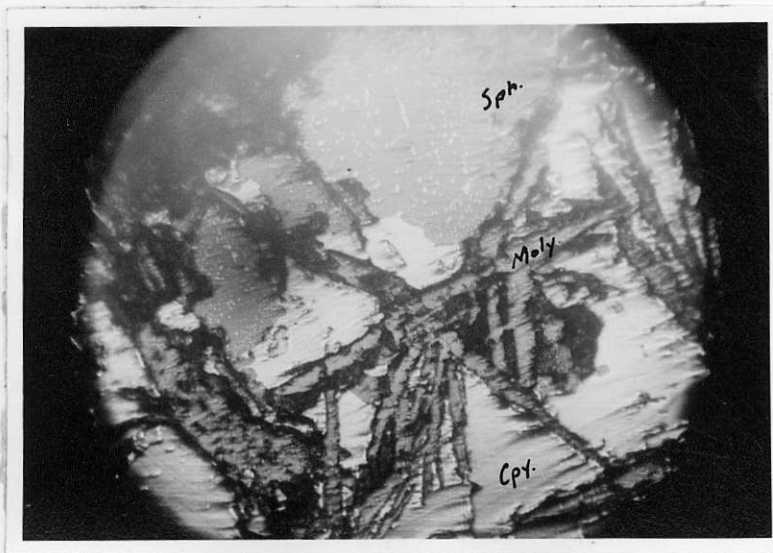


Fig. 2 x 100

Relationship between
molybdenite, chalcopyrite
and sphalerite and the
exsolution of chalcopyrite
from sphalerite.

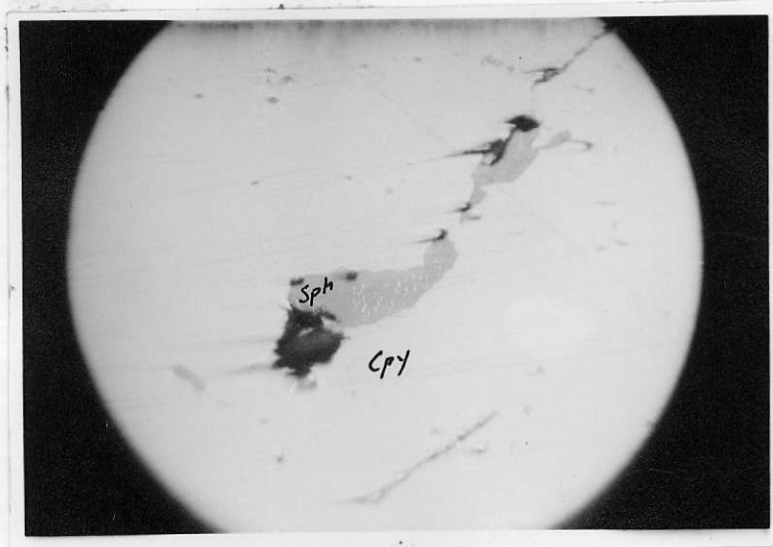


Fig. 3 x 300

Chalcopyrite exsolved
from sphalerite.

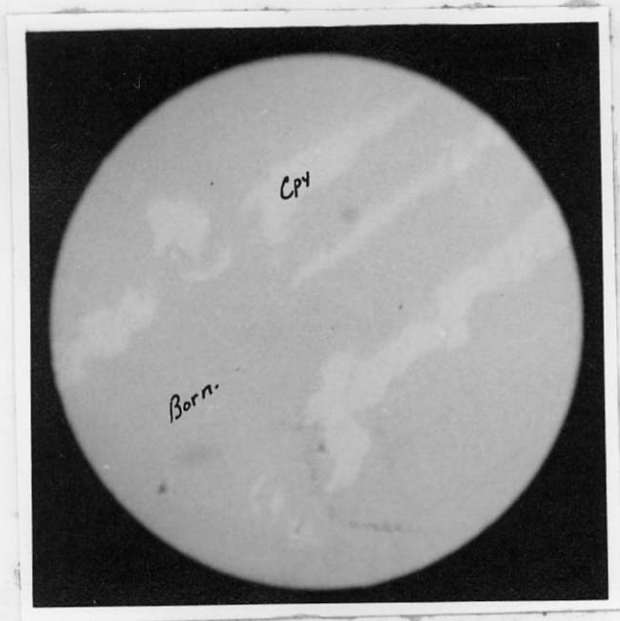


Fig. 4 x 300

Chalcopyrite showing
matched walls in
bornite.

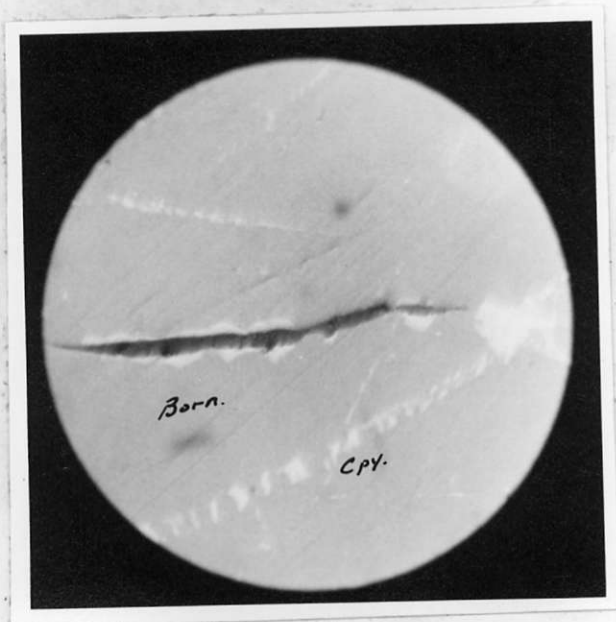


Fig. 5 x 300

Chalcopyrite replacing
bornite along
crystallographic axes
and along fractures.

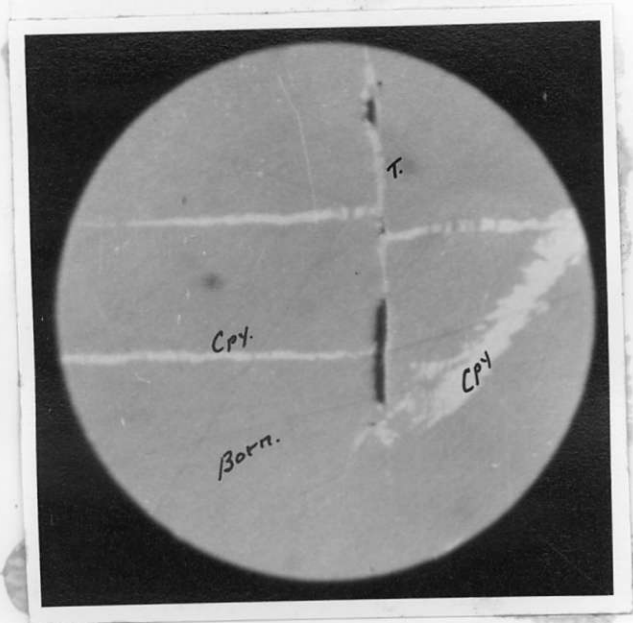


Fig. 6 x 300

Chalcopyrite and
tetrahedrite appears to
be exsolved from bornite
but actually are not.

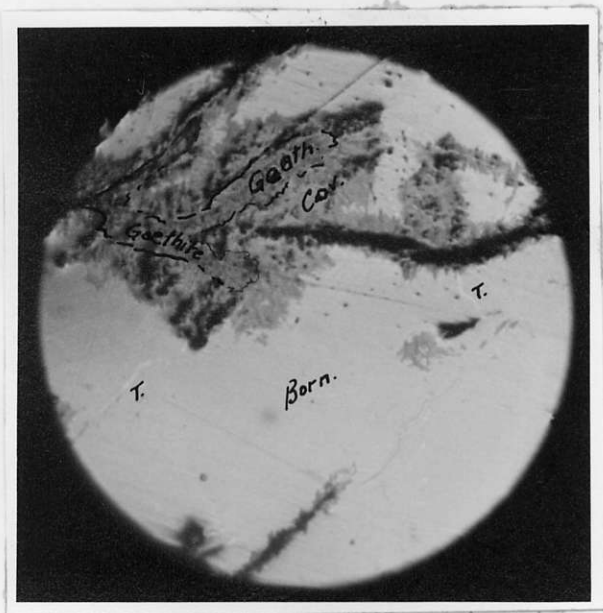


Fig. 7 x 100

Goethite and covellite
along fractures in
bornite and thin
stringers of tetrahedrite
in bornite.

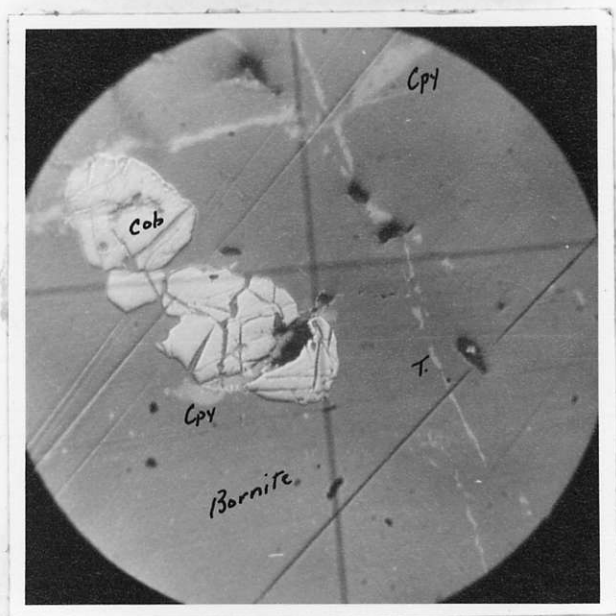


Fig. 8 x 100

Cobaltite, chalcopyrite
and tetrahedrite in
bornite.

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