Geol. 409

Little Billie Mine,
Texada Island.

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The Little Billie (Billy) Mine, Texada Island.

Introduction:

The Little Billie mine is near Vananda on the northeast coast of Texada Island. Together with the Marble Bay, Copper Queen, and Cornell properties, the Little Billie contained the main deposits of the Texada gold-copper camp. The properties were discovered in 1880 and worked intermittently from 1896 to 1926 and again after 1943 by a large number of owners. The early production was mainly for gold and silver with copper only a by-product. Later production especially during the war was for copper and the most recent interest has been in the molybdenum which the deposits contain.

The reported tenor of the ore at the Little Billie varies. 1914 values are given as 4-8% Cu with Au-Ag only $3 per ton. A 1944 report gives grades of 2.4% Cu and 0.25 oz. Au. In any case, the ores of the Little Billie have less precious metal content than those of the other deposits in the area and are probably best described as copper-gold-silver ores.

Geology:

The rocks in the area are crystalline limestones of the Marble Bay group which have been intruded by coarse grained quartz diorite and dykes of quartz-feldspar porphyry and greenstone.

The deposit is in a contact metasomatic or skarn zone which lies along the southwest contact of the quartz diorite stock. The ore bodies are outlined by assay boundaries in the replacment zone along the quartz diorite contact and also around porphyry and greenstone dykes.

Mineralogy:

Hand Specimens:

A large number of ore and gangue specimens were examined. All are reprsentative of a skarn deposit. A few were marble recrystallized from pure limestone but most were coarse grained calc-silicates. The gangue minerals identified were:

garnet- tan coloured Grossularite
green and brown Andradite

diopside
wollastonite
epidote
tremolite
quartz
calcite
clay
serpentine

These minerals form a coarse, porous crystal aggregate which was mineralized to form a disseminated sulphide and oxide deposit with localized massive sulphide and oxide zones. The ore minerals recognized were:

magnetite
bornite
chalcopyrite
pyrite
molybdenite
covellite

There is a deffinite association of green garnet with bornite and chalcopyrite while the brown garnet is associated with magnetite and lesser bornite and chalcopyrite. Molybdenite occurs as disseminated rosettes or along fracture planes and seems to have no particular association with any sulphides or garnets.

The ore specimens appear fresha and unaltered and contain only small amounts of malachite, azurite,,minor covellite and a rare specimen shows some sooty chalcocite.

Polished Sections:

At least 60 polished sections from the Little Billie and a few from Marble Bay were briefly examined and detailed study was made of 25 of these. In total 16 ore minerals were found.

1. Chalcopyrite ($CuFeS_2$)
   - yellow
   - H- C

2. Bornite (Cu_5FeS_4)
   - pinkish brown
   - H- B
   - exsolving chalcopyrite in(111) plane

3. Magnetite (Fe_3O_4)
   - grey
   - H- F
   - isotropic
   - magnetic

4. Pyrite (FeS_2)
   - light yellow
   - H- F
   - isotropic
   - cubic crystal outline

5. Pyrrhotite ($Fe_{1-x}S$)

   -

Pyrrhotite

- cream with pink tint
- H- D
- strong anisotropism
- KOH- stains irridescent
- magnetic

6. Molybdenite (MoS_2)

- white
- H- B
- soft platy curved lamellae
- anistropism extreme , undulatory extinction
- negative to all reagents

7. Tetrahedrite ($Cu_{12}Sb_4S_{13}$)

- grey
- H- D
- isotropic
- exsolving chalcopyrite
- KCN- produced zoning
- Sb proven in microchem. test

8. Sphalerite (ZnS)

- grey (dark)
- internal reflection
- H- C
- associated in small amounts with chalcopyrite

9.,10,11. Tellurides

- 3 intergrown minerals which collectively gave a positive tellurium microchem. test

9. Hessite Ag_2Te

- light grey
- H- A
- strong anisotropism
- HNO_3- black
  HCl- black
  KCN- black
  $FeCl_3$-irridescent
  KOH//---Negative

10. Wehrlite $Bi_2Te_3.Bi(Ag)$

- white
- H- B
- anisotropism weak but distinct
- HNO_3- black
  HCl- light brown

Wehrlite

- $FeCl_3$-irridescent
- KCN-negative
-- $HgCl_2$-negative
- KOH ----- Negative

11. Tellurbismuth Bi_2Te_3

- intimately associated with Wehrlite as rounded unmixing blebs which are visible only after differential etching with KOH.

- HNO_3- black
- HCl- faint tarnish
- $FeCl_3$- rapid tarnish
- KCN-negative
- $HgCl_2$-negative

---- KOH-- slowly turns irridescent (See Fig. 2)

12. Silver (Ag)

- bright white
- H- B
- minute plate-like grains in bornite
- isotropic
- light sensitive
- sectile
- HNO_3 - blackens unevenly
  KCN- brown tarnish
  $FeCl_3$-irridescent to black
  $HgCl_3$-irridescent
  HCl- negative
  KOH- negative

13. Gold (Au) ?

- minute yellow grain in tellurides
- not proven

14. Cobaltite (Co,Fe)AsS

- minute cubic grain
- white with pinkish tint
- hardness greater than needle
- negative to all chemical reagents

Secondary minerals: (minor amounts)

15. Covellite (CuS)

- blue
- H- B
- orange anisotropism
- replaces bornite along fractures

16. Chalcocite (Cu_2S)

- minor amount with bornite
- bluish white
- $FeCl_3$- blue colour

Oxidation products:

Malachite and Azurite

The mode of the ore is highly variable and the percentages of minerals listed below is not representative of ore grade but rather shows proportions of ore minerals in 15 select polished sections.

chalcopyrite	42%
bornite	12%
pyrite	6%
magnetite	5%
pyrrhotite	3%
molybdenite	½%
tetrahedrite	trace
sphalerite	trace

Tellurides are in chalcopyrite as minute inclusions.

Silver values come from Hessite, native Ag in bornite, probably Wehrlite and possibly tetrahedrite although microchemical tests did not show any silver in this mineral.

Gold could not be proven but is possibly associated with the tellurides. It is probably very finely divided and thus refractory.

Textures:

The general structure of the ore minerals is interstitial. It was formed by oxides and then sulphides filling open spaces in the metasomatized rock.

The magnetite, pyrite, (cobaltite), show early formed crystal outlines and the molybdenite is in rosettes. Pyrrhotite chalcopyrite, and bornite have assumed the shapes of the cavities they occupy.

The tellurides are rounded replacements or filiform inclusions in the chalcopyrite.

The most striking texture is exsolution texture shown by chalcopyrite in bornite and tetrahedrite. Unmixing of wehrlite and tellurbismuth is described under etch tests.

Chalcopyrite in bornite shows varying degrees of unmixing. In advanced stages rim or net texture results from chalcopyrite segregating at grain boundaries. More commonly, however, the chalcopyrite forms exsolution laths in the (111) plane of bornite.

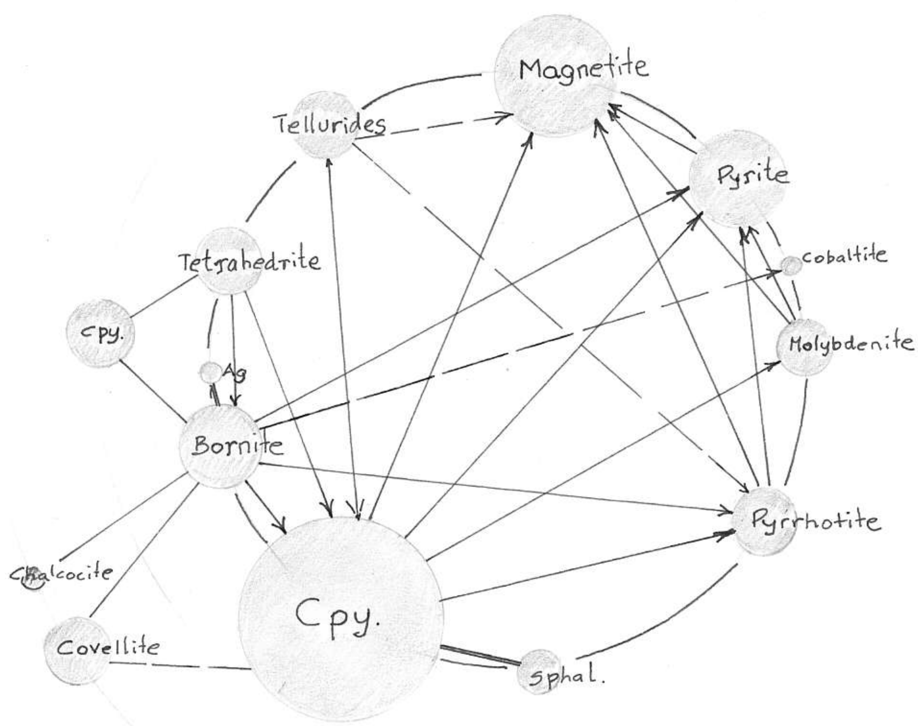
Exsolution in tetrahedrite has formed an emulsion texture. The chalcopyrite occurs as minute star shaped inclusions evenly distributed throughout the tetrahedrite. These inclusions show slight variation in size depending upon their position in the grain. The blebs in the centre of the grain tend to be larger than those at the edge but are fewer in number so that the volume of exsolved material is uniform throughout.

This texture is further unique in that some grains show a faint lineation fromed by strings of chalcopyrite blebs in the manner of a pearl necklace. (See Fig. 1)

This particular type of exsolution is thought to be formed from a high temperature environment in which cooling was very rapid and diffusion was arrested before it had progressed very far.

Paragenesis:

By far the longest period of deposition was enjoyed by chalcopyrite. This caused the late forming tellurides to appear as inclusions in the chalcopyrite but some grains showed a deffinite paragenesis of tellurides later than chalcopyrite.



Type of Deposit:

This deposit is a typical contact metasomatic deposit. The initial temperatues were around 800 degrees to form the calc-silicates (eg. wollastonite). Unmixing of chalcopyrite from tetrahedrite occurs at 500 degrees C. and from bornite at 475 degrees C. The incomplete unmixing proves that the deposit was subjected to conditions of very rapid cooling. Thus the deposit can be classed as a (very) high temperature deposit which was probably near surface and thus subject to a steep thermal gradient.

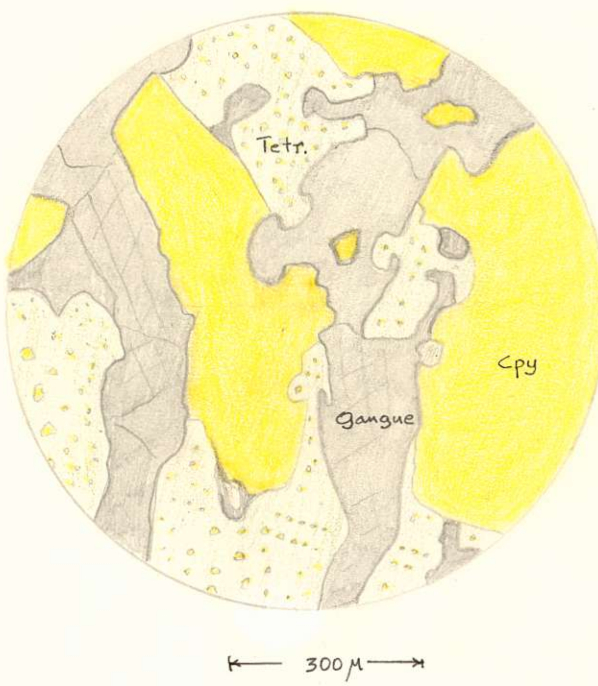
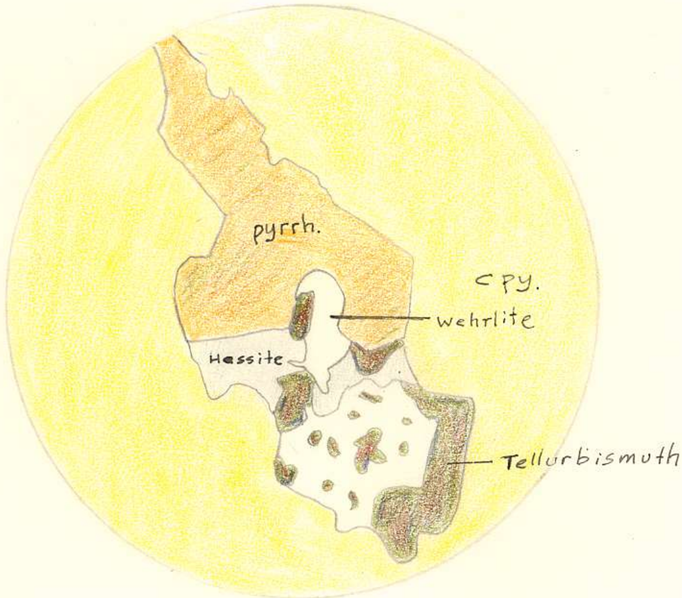
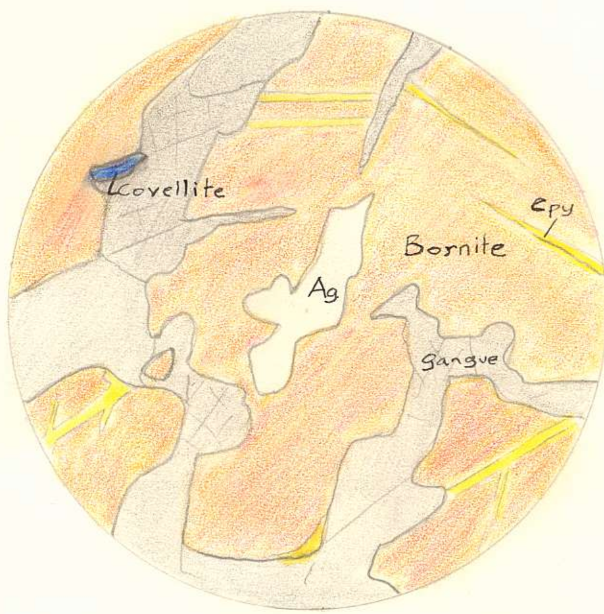


Fig. 1. Tetrahedrite Exsolving Chalcopyrite



⟵ 50 M ⟶

Fig. 2. Telluride association etched with KOH.



⟵ 300 M ⟶

Fig. 3 Bornite with exsolved chalcopyrite & Native Ag grain.

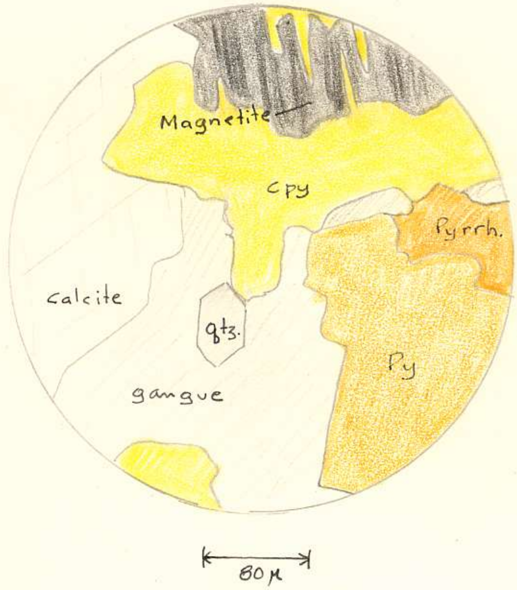


Fig. 3

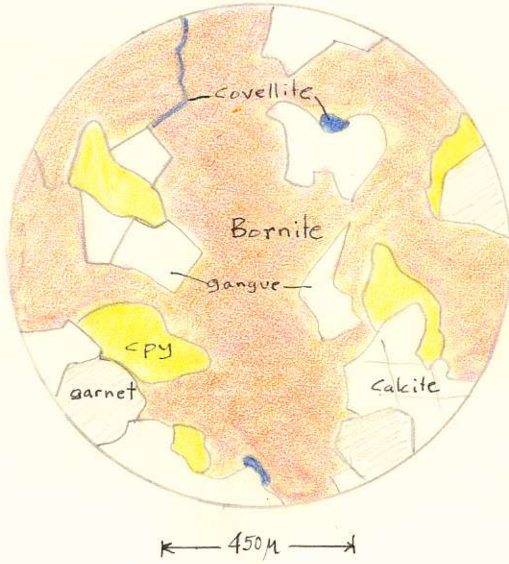


Fig. 4

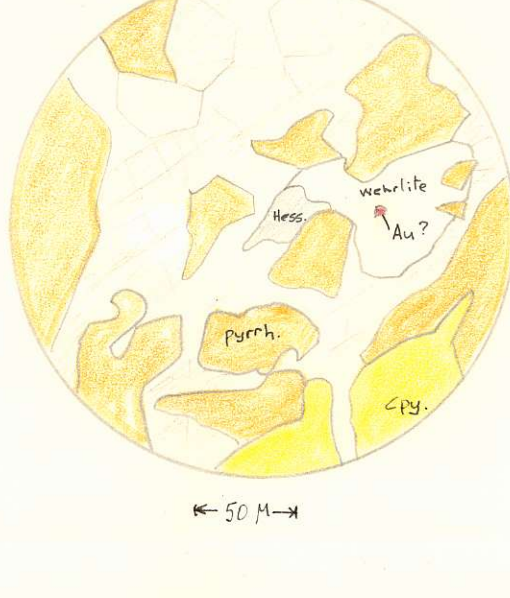


Fig 5

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