Don't like supergene origin of chalcocite, wittichenite.

70%

600030

Mineralographic Study of Ores from Maid of Erin Claim, Rainy Hollow, B. C.

General (1, p. 42)

The Maid of Erin Claim is in the Squaw Creek, Rainy Hollow area of the Atlin Mining Division. Access to the area is by a road known as the Haines "Cut - Off" which links Haines Alaska on Lynn Canal with the Alaska Highway.

The Maid of Erin lies on the south-western slope of Mineral Mountain at elevations between 3,200 and 3,700 feet. Connection is made between the claim and the Haines Road by 3½ miles of tractor road, now in disrepair.

Considerable development work has been done since 1903 when the claim was located. It has lain idle since 1928. Between the years 1911 and 1922, 157 tons of ore yielding 77,653 lbs. of copper, 5,843 oz. of silver, and 6 oz. of gold, were shipped to Tacoma.

The rocks exposed on the claim are quartzites, marble, and argillite of Permo-carboniferous age, skarn which replaces mainly marble, quartz diorite which part of a batholith, a small body of diorite, and one of gabbro. Ore has been found in light-green medium-grained skarn composed mainly of yellowish-green andradite garnet and white monticellite; in white, rusty weathering fine-grained skarn consisting chiefly of monticellite and carbonate; in green medium-grained skarn composed essentially of dark-green zoisite and yellowish-green andradite garnet; in white medium- grained skarn consisting mostly of diopside; and in light-grey coarse-grained skarn composed principally of wollastonite and calcite. Practically no mineralization has been found in the abundant, light-brown fine-grained type of skarn that consists mainly of andradite garnet, or in the rarer, coarse-grained variety composed of buff-coloured clinozoisite and pink and green idocrase.

The main problem presented by the Maid of Erin ore is the occurence of silver, which averages about 60 oz. per ton. No silver mineral had been found in previous sections, and no silver minerals were found in the nine sections described here, except for a very minor amount of native silver found in oxidized material. Sections were taken from six specimens.

One polished section was made from each of specimens 2, 3 and 5. Two sections were made from each of specimens 1, 4 and 6, which showed variation in mineral content within the individual specimens.

Determinations of minerals and their paragenesis

The following minerals, listed in their apparent order of paragenesis, were found in the sections.

Sphalerite
Bornite
Linnaeite - position in sequence doubtful.
Chalcocite - white chalcocite and rims of "blue chalcocite".
Wittichenite
Chalcopyrite
Chalcocite - probably "blue chalcocite" of supergene origin.
Covellite
Silver - (?)

Sphalerite

Spectrographic analysis gave the following elements for sphalerite from section two.

Bismuth	-	?
Cadmium	-	trace +
Copper	-	trace +
Iron	-	trace +
Manganese	-	trace ++
Silver	-	?
Zinc	-	major
Cobalt	-	trace +

The sphalerite gives normal etch reactions but does not show internal reflection with inclined light from the carbon - arc lamp. Absence of internal reflection may be due to manganese in solid solution. As shown in Fig. 4, the sphalerite exhibits straight, angular boundarys embayed by bornite, and therefore is considered to be prior to bornite, and the earliest of the mineral assemblage.

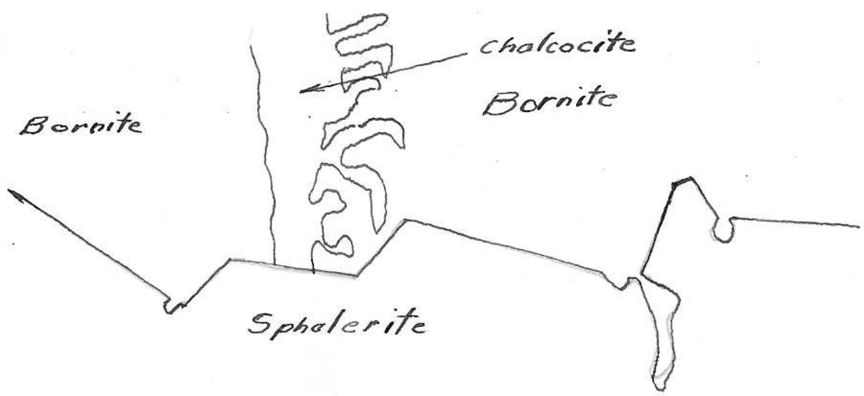

FIG. 4 Field 1.2 mm.
Drawn from Section 4(a)

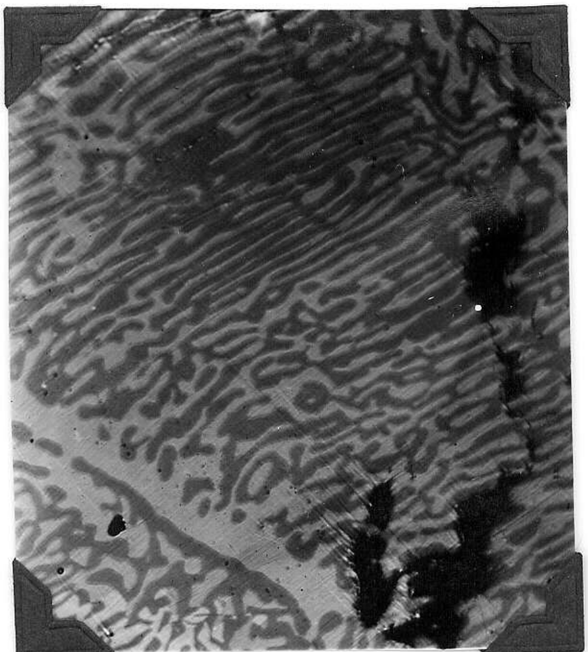

Fig. 1 - Bornite-chalcocite graphic texture. Dark grey-bornite; medium grey-chalcocite; light grey-wittichenite.

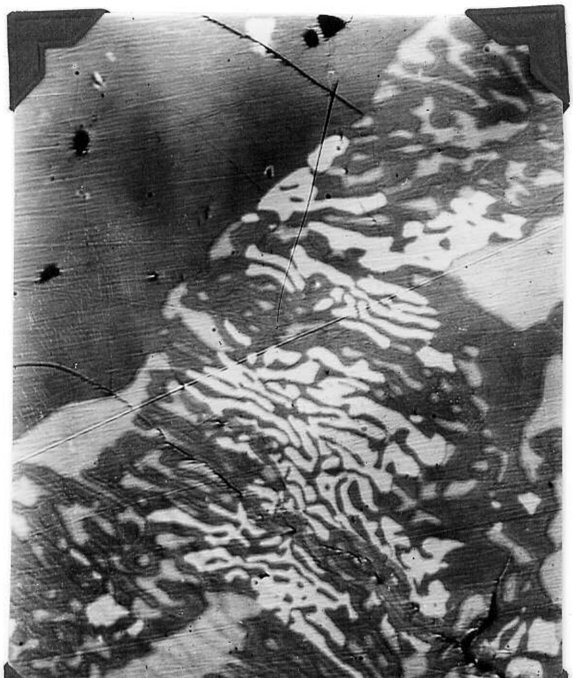

Fig. 2 - Bornite-chalcocite graphic texture, with wittichenite, lightest grey.

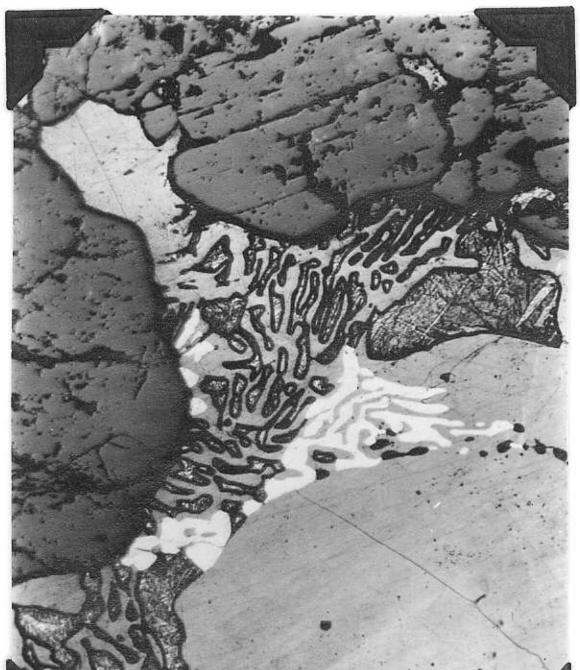

Fig. 3 - Bornite-chalcocite graphic texture. Dark grey-bornite; medium grey-chalcocite; light grey-wittichenite.

Bornite and Chalcocite

Bornite and chalcocite comprised about 70% of the metallic minerals found in the sections. Bornite predominates somewhat over chalcocite. Bornite and chalcocite occur almost invariable in these sections as graphic intergrowths. Much of the intergrowth is more or less regular, as in Fig. 1, showing control of the texture by cleavage directions of the bornite, O(111); but the irregular texture of Fig. 2 and Fig. 3 is more prevalent. The chalcocite-bornite boundaries are invariably marked by rims of "blue chalcocite", chalcocite containing bornite in solid solution (2, p.78).

In Fig. 1, the chalcocite appears to originate from a vein in the lower left of the area. Edwards (p. 103) states:

"Graphic textures resulting from replacement can frequently be recongized from their association with veins of the metasome traversing the host. They are typified by graphic intergrowth of bornite and chalcocite (Figs. 123, 124), concerning whose origin there has been much controversy."

Fig. 2 shows clearly that both chalcocite and bornite are present in excess of the intergrowth. Edwards states:(p.103)

"A further feature of such replacement intergrowths is that both component minerals may be present in excess of the intergrowth, whereas in eutectic or eutectoid intergrowths, only one component may be in excess of the eutectic."

As stated previously "blue chalcocite" forms rims between white chalcocite and bornite wherever they have a common boundary. These rims are visible in Fig. 2 by close examination but etching with KCN has accentuated the rims in Fig. 3 by differential etching.

Regarding "blue chalcocite" rims, Edwards states: (p. 78)

"Blue chalcocite also, can form as a product of supergene replacement, and is often found as a narrow zone separating white chalcocite from the bornite it is replacing."

The evidence provided by the three features cited above, plus the similarity of textures in Figs. 1 and 2 and Figs. 123 and 124 of Edwards from sections of ore from North Lyell, which Edwards believes to be due to supergene replacement of bornite by chalcocite, argue strongly for replacement origin of the graphic textures in the Maid of Erin specimens.

Wittichenite *How determined?*

Wittichenite occurs in all the sections, replacing chalcocite. Fig. 3 shows that wittichenite replaced the normal white chalcocite and the rims of "blue chalcocite" with equal ease.

The etch reactions of the wittichenite differed from those of Colquijirca, Peru in being completely negative to mercuric chloride, and giving a slight stippled tarnish with potassium hydroxide, whereas that from Colquijirca gave slightly light brown tarnish with mercuric chloride, and was negative to potassium hydroxide. (Short, p. 142)

Chalcopyrite

Chalcopyrite was found only in section 5. Throughout the section it was invariably associated with chalcocite, present as very irregular areas in the chalcopyrite, of .05 mm or less.

Within the one large area of chalcopyrite (4 mm), the chalcocite areas form a fringe of about 104 mm width, paralleling the boundary between chalcopyrite and bornite, and lying within the chalcopyrite. The small areas of chalcocite show distinct anisotropism from grey to bornite pink, and have simultaneous extinction over areas up to 1.2 mm. Elsewhere throughout the section there are numerous small areas of chalcopyrite (0.2 - .02 mm) always in association with chalcocite. In these areas also, where two or more separate areas of chalcocite are found in one grain of chalcopyrite, they exhibit simultaneous extinction. Therefore the chalcocite areas are considered to be replacement remnants, and to have been introduced before the chalcopyrite.

Linnaeite

Linnaeite was determined by etch reactions, which corresponded with the etch reactions for linnaeite as given by Short (p. 143). It comprises a very minor portion of sections la, lb, and 2, in grains ranging in size up to 16μ.

All grains are in contact with the gangue minerals which form about 50% of these sections, and with either chalcocite - bornite texture or sphalerite. Linnaeite appears to have entered along boundaries between gangue and the early formed minerals sphalerite and bornite. The mutual relations do not show whether the replacement of bornite by chalcocite, and subsequently replacement of wittichenite by chalcocite preceeded or followed introduction of linnaeite.

In polished section the linnaeite is readily distinguished from the associated minerals by its creamy white colour, pitted surface, high relief above the copper minerals and sphalerite, and tendency to show crystal forms which appear to be sections of orthorhombic crystals. ?

Chalcocite ("blue chalcocite")

Chalcocite with a grey-blue colour distinct from that of normal white chalcocite was seen in sections 2 and 3, where it occurs in veins traversing wittichenite. It occurs in sections 1a, 1b, as irregular replacements of normal chalcocite, and is related to fractures.

X-ray analysis by Dr. R. M. Thompson confirmed that this occurence is chalcocite and not digenite. This chalcocite exhibits an unusual fibrous texture with polarized light. The darker colour suggests that it has bornite in solid solution and is "blue chalcocite". The fracture relationship and fibrous texture indicate a supergene origin.

Covellite

Covellite occurs in large distinct fractures with gangue (probably calcite) in section 5. The covellite is very fine grained and exhibits the fiery red anisotropism typical of covellite. It is quite evidently of supergene origin.

Silver (?) .

Three grains of an isotropic silver-white mineral (too small, about .01 mm, for identification) were seen in section 5. The hand specimen showed much malachite stain, so that this was probably supergene silver such as reported by Dr. Watson (p. 44).

Descriptions of individual sections

Section 1(a)

Metallic minerals largely graphic bornite-chalcocite texture with wittichenite replacing chalcocite. Some irregular areas of "blue chalcocite".

Section 1(b)

Similar to 1(a) but with linnaeite on upper and lower borders.

Section 2

Sphalerite is the predominant mineral. The bornite-chalcocite texture is very irregular in this section, with bornite predominating. Some "blue Chalcocite" occurs veining wittichenite, and linnaeite occurs inthe lower-left corner.

Section 3

The metallic minerals are largely bornite-chalcocite texture with wittichenite replacement. "Blue chalcocite" is seen veining wittichenite on the lower margin of the section.

Section 4(a)

Metallic minerals of this section are comprised of about 45% bornite, 25% sphalerite, 20% chalcocite, with 10% wittichenite.

Section4(b)

Sphalerite constitutes only about 5% of the section, but is otherwise similar to 4(a). Sphalerite was irregularly distrubuted in specimen NO. 5.

Section 5

This section is much stained by malachite, and is the only section containing chalcopyrite. Bornite is the predominant metallic mineral. Chalcocite occurs in the chalcopyrite and in bornite, but not as a graphic texture.

Section 6(a)

Bornite is the predominant metallic mineral, with minor chalcocite and wittichenite. Graphic bornite-chalcocite texture constitutes a minor portion of the section. On the left margin of this section is an occurence of wittichenite as a fine line traversing bornite, apparently replacing bornite along a cleavage direction. Wittichenite also occurs in the section in areas up to 1 mm. replacing chalcocite.

Section 6(b)

Largely bornite-chalcocite texture with bornite predominant, and some wittichenite. Some sphalerite in areas up to 4 mm. occurs on the upper margin. There are also a few grains of linnaeite.

Conclusion

If the writer is correct in considering the graphic texture of bornite and chalcocite as being due to supergene replacement of bornite by chalcocite, then the mineral assemblage of the Maid of Erin ore is derived by hydrothermal (mesothermal ?) introduction of sphalerite, bornite and possibly linnaeite with supergene introduction of chalcocite, wittichenite, chalcopyrite, covellite, "blue chalcocite", and silver. ??

In support of terming chalcopyrite as supergene, other than that it definitely replaces chalcocite which is termed supergene, it may be noted that chalcopyrite occurs only in section 5, which was oxidized material.

Another, and more likely possibility is that the ore of section 5 differed from that of the other sections in having primary bornite, chalcocite, and chalcopyrite, followed by development of supergene covellite and silver (no graphic texture was developed) and may be considered as a separate type of ore.

Bibliography

Short, M. N., Microscopic Determination of the Ore Minerals; U. S. Dept. of the Interior, Geological Survey Bulletin 914 (1940).

Watson, K. DeP., The Squaw Creek - Rainy Hollow Area, Northern British Columbia; B. C. Dept. of Mines, Bulletin No. 25, (1948).