600031

Maid of Erin Suite.

Geology 409.

Submitted by:-
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Jan 10, 1966.

ABSTRACT.

THE MAID of ERIN suite is taken from a high grade copper property in the Rainy Hollow District in north-western British Columbia. Among other common copper minerals, a rare copper-bismuth mineral called willichenite is found. This was first identified by Dr. K.deP Watson of the British Columbia Department of Mines and confirmed by Nuffield, an authority on the mineral, in 1940. The copper minerals are found in a contact metamorphic environment.

MEGASCOPIC IDENTIFICATION:

The hand specimens of the ore minerals consist mainly of massive bornite in a matrix of milky quartz. The bornite is phaneritic and fine-grained with an irridescent tarnish. Some specimens show patches of medium-grained sphalerite (< 3mm) which exhibit distinctive luster and cleavage. It is assosciated with the bornite and not found isolated in the quartz. Good crystals of green and brown vesuvianite (< 3mm) are scattered throughout the bornite. Also, the vesuvianite is very well crystallized in the quartz matrix with a length of 10mm. in some cases. In some specimens it occurs as good elongated individual crystals and in others it occurs as radial clumps up to 10mm in diameter. Azurite and malachite appear on the weathered surfaces of the specimens. The irridescent tarnish is always present on the bornite.

POLISHED SECTIONS:-

MINERAL DESCRIPTION:-

BORNITE:-

Bornite is the most predominant mineral in the suite. It is easily identified by its orange color, purple tarnish and hardness of 3+. It is weakly anisotropic to isotropic and does not show pleochroism. Generally, there is no cleavage present but when etched with HNO_3 a brick-pattern etch appears. It is intergrown with chalcopyrite, chalcocite, digenite, wittichenite and it may have replaced the chalcocite and wittichenite although this is uncertain.

CHALCOCITE:-

Chalcocite is the next most common mineral in the suite. The identification of chalcocite is mainly by its light blue-white color and a hardness 3 (softer than bornite). A confirmation etch test with HNO_3 turns chalcocite blue and in some cases brings out cleavage. A blue chalcocite called digenite is also present, occurring in the same manner as chalcocite. There may be two ages of chalcocite; one which exsolved from the bornite giving the intergrowth texture, and another later stage which filled fractures in the bornite and the gangue (vesuvianite).

CHALCOPYRITE:-

Chalcopyrite is distinguished by its brass yellow color, hardness of 3, anisotropism and association with other copper minerals. It occurs as small exsolution laths and large blebs in the bornite and sometimes as small blebs in the gangue. Except in one polished section it is not an abundant mineral.

WITTICHENITE:-

$3Cu_2S.Bi_2S_3$.

WITTICHENITE is a rare copper-bismuth mineral characterized by its color, hardness, anisotropism and resistance to etch tests. It takes a very good polish and shows no cleavage or twinning. The color is a pinkish cream and the hardness is ~C although Uytenbogaardt mentions it as having the same hardness as bornite. There is no apparent pleochroism but the anisotropism is moderate with colors from a dark brown to a cream. It is negative to every etch test tried but this may be due to its small amounts and close assosciation with chalcocite and bornite. It occurs as small blebs and needles in the bornite, suggesting exsolution. In some instances however bornite does occur in a bleb of wittichenite.

Microchemical tests were tried but no results were obtained due to the small size of the blebs and the masking effect of the copper in the test drop.

SPHALERITE:-

Sphalerite is not abundant in the suite and it does not occur in all sections. It is identified by its medium grey color, hardness of d, internal reflection and sometimes by its pitted surface. Microchemical tests confirm it well as it occurs in large enough blebs to be sampled. In some sections it cuts across bornite and chalcopyrite suggesting that it is of later age. It in turn is cut by covellite.

Covellite:-

Covellite appears to be the last mineral deposited. It is seen mostly as veins and patches cutting the other minerals. It is characterized by its blue color and extreme anisotropism (grey orange colors).

? You make me look it up in the dict.! fiery.

TEXTURES.

BORNITE – CHALCOCITE :-

Graphic intergrowths of bornite and chalcocite are common in the MAID OF ERIN suite. They are best developed in the larger open spaces between the gangue minerals, where they show well rounded tongues of one mineral projecting into the other. These intergrowths suggest a pseudo-eutectic texture in which the host has been replaced independently of its crystallographic directions. It may also be a eutectic texture in which the solute has exsolved from the solvent and the entire system has been rapidly cooled to perserve the texture. In this instance the bornite could be either the solute or the solvent but since bornite is in great excess it would be reasonable to assome it the solvent.

FIGURE 1.

EUTECTIC (?) TEXTURE OF CHALCOCITE (white) AND BORNITE (light grey). – HIGH POWER.

BORNITE - CHALCOCITE :- (con't)

FIGURE 2.

BORNITE and chalcocite also exhibit an "island and sea" texture in which the chalcocite (island) occurs within the sea (bornite). However, bornite also occurs within the chalcocite and so paragenesis is diffult to determine. The size of the inclusions vary markedly within each mineral type. The inclusions are generally well-rounded.

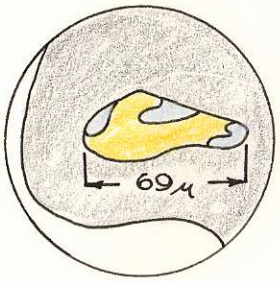


FIGURE 3.

INCLUSIONS of chalcocite and bornite also occur in the gangue (Vesuvianite) and in some cases both minerals occur in the same inclusion.

BORNITE - WITTICHENITE :-

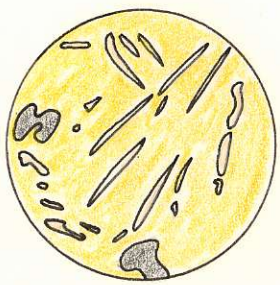


FIGURE 4.

An exsolution or replacement texture is well developed between bornite and wittichenite as tongues and embayments of one mineral form smooth sharp contacts with the other. This texture is closely assosciated with the similar Chalcocite bornite intergrowths and often all three are found together. WITTICHENITE is also seen in fine laths within the bornite. [FIG. 4]. They appear to be oriented for a short distance and then suddenly change to another direction. In another section the parallel laths followed a wavy path as though flowage had took place.

Bornite – Wittichenite – Chalcocite:

All three minerals frequently occur as intergrowths with smooth sharp contacts suggesting that they all exsolved at the same time. Wittichenite is commonly seen as small blebs on the chalcocite – bornite contact.

Figure 5.

A rim texture has been formed on some bornite chalcocite contacts. The thin rim is a grey-blue ~~mineral~~ color, darker than chalcocite. It is interesting to note that the rim does not cross the chalcocite – wittichenite contact and this implies that the rim may be digenite or a mixture of chalcocite and bornite.

Bornite – Chalcopyrite:

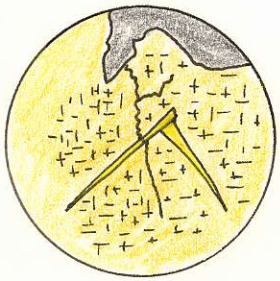


Figure 6.

Chalcopyrite is intimately associated with bornite as it occurs as irregular blebs and laths of various sizes in a groundmass of bornite.

The laths are random or sub-parallel. The sub parallel ones appear to be concentrated in areas of strain in the bornite ie stemming from fractures and sharp corners of inclusions.

Chalcopyrite – Chalcocite :-

Occasionally chalcocite occurs within the chalcopyrite in a subgraphic texture. The chalcocite is randomly oriented with smooth sharp contacts suggesting either exsolution or replacement of chalcocite by chalcopyrite. This does not occur in every case but only in a few sections containing large blebs of chalcopyrite

SPHALERITE:-

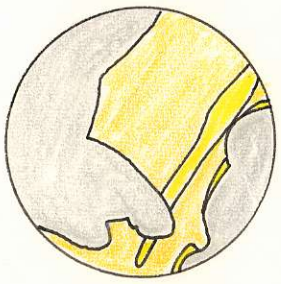


FIGURE 7.

Sphalerite appears to have come later than most of the primary minerals. In many places it has replaced bornite as shown in figure 7. The contact boundaries are sharp and the tongues and embayments, rounded. Sphalerite has, however, cut across the laths of chalcopyrite in the bornite and this strongly suggests replacement.

FIGURE 8.

Sphalerite is not the latest mineral in the suite. Figure 8 shows how covellite has cut across a contact between bornite and sphalerite Blebs of sphalerite and gangue minerals occur in the vein of covellite.

SELECTIVE REPLACEMENT:-

MANY good and varied examples of selective replacement are present in the suite. MOST are the result of fillings of small fractures which cut through inclusions of one mineral in another. The selectiveness is represented by a widening of the vein in the most easily replaced mineral. In FIGURE 9, the fracture cut across an inclusion of wittichenite in bornite The fracture was subsequently filled with covellite which replaced the wittichenite but did not react noticeably with the bornite. A thin black line ran through the center of the covellite stringer but it was too small to determine.

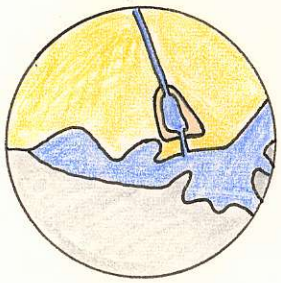


FIGURE 9.

FIGURE 10 shows how a veinlet of covellite selectively replaced the bornite but not the exsolution lath of chalcopyrite. Only the fracture can be seen in the chalcopyrite.

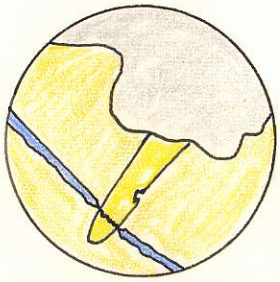


FIGURE 10.

Bornite is much more susceptible to replacement by CuS than is chalcopyrite.

FIGURE 11 shows a bleb of wittichenite selectively replaced by chalcocite. At first, the chalcocite was thought to be covellite by lack of anisotropism and positive etch tests confirmed chalcocite.

FIGURE 11.

Minerals in the Maid of Erin Suite:-

Bornite	24%
Sphalerite	20%
Chalcocite	3%
Digenite	1%
Chalcopyrite	1%
Wittichenite	1%
Covellite	Trace.

Alteration Minerals:-

Malachite
Azurite
Covellite.

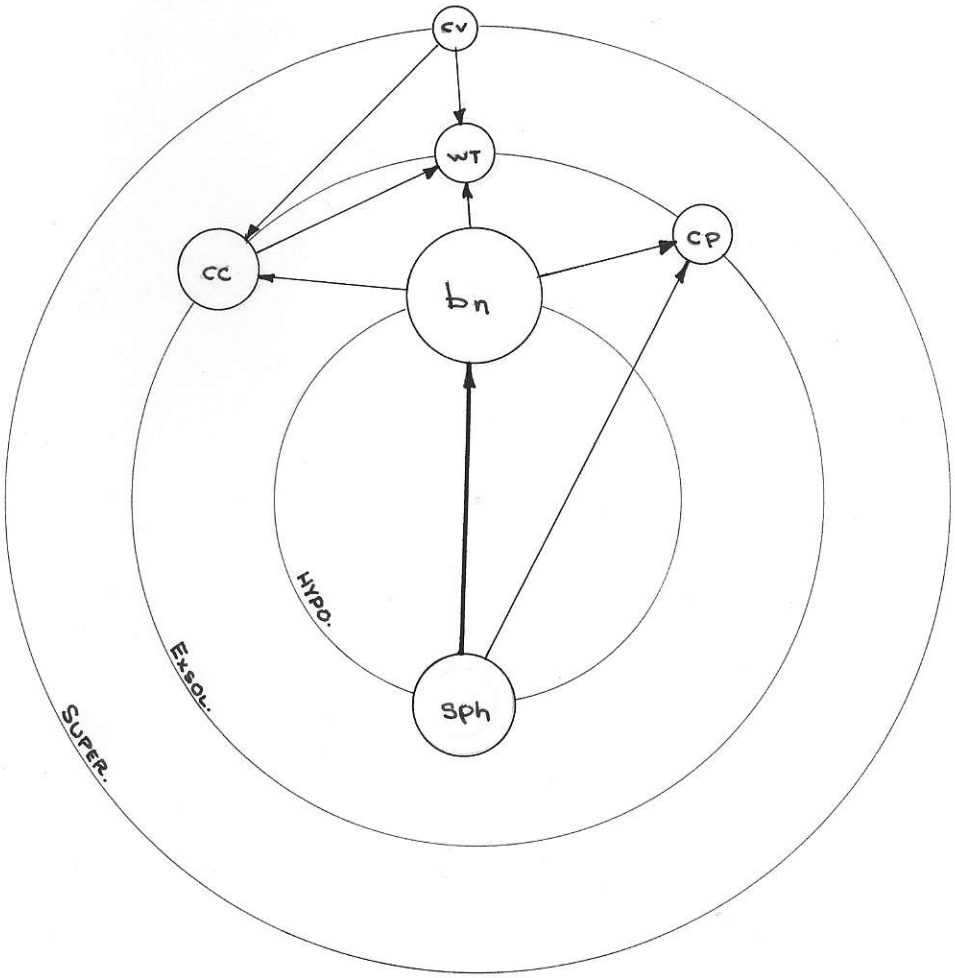
Temperature Classification of Deposit.

From Edwards, "Textures of the Ore Minerals", pg. 92, an estimation of the temperature of formation can be established.

Bornite - Chalcocite unmix below	175-225°C.
Bornite - Chalcopyrite unmix below	475°C.
Bornite - Wittichenite - no sufficient information found.	

Temperature of Deposit formation is believed to be a med. temp contact metamorphic deposit.

No garnet! You've right Lots of garnet, —grossularite — A RMF Jan-12/66



VAN DE VEER DIAGRAM
MAID OF ERIN PROPERTY.