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A SO-CALLED BORNITE-CHALCOPYRITE INTERGROWTH

FROM LEGATE CREEK, PACIFIC, B. C.

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During a geological investigation of the M. & K. copper property, fifteen miles up Legate Creek from Pacific, B. C., the writer's attention was attracted by the interesting and rather unusual association of the ore minerals. This association consists of a somewhat intimate mixture of bornite, galenite and chalcopyrite occurring as solid masses in the basins of drag folds in a series of Jurassic lavas and tuffaceous sediments. Bornite and galenite are the most persistent minerals, and form the typical ore. The chalcopyrite, which is of the very fine-grained dense variety, occurs in branching veinlets and thin finger-like masses cutting thru solid masses of the other two minerals. The field evidence strongly suggests replacing relations for the chalcopyrite; and in order to obtain more detailed evidence regarding the paragenesis of the minerals, several specimens were collected, and their polished surfaces were submitted to mineragraphic examination. This paper has to do with the relation of the bornite and chalcopyrite as disclosed by this examination.

The polished surfaces show the presence of four metalliferous minerals—bornite, galenite, chalcopyrite and sphalerite. Bornite and galenite are most consistently present (as noted in the field). Sphalerite occurs sporadically in scattered grains. Chalcopyrite is characteristically absent from certain portions of the ore, while in other portions it is very abundant. Covellite occurs as narrow veinlets cutting all the other minerals of the sections (Fig. 4) and as an alteration product of the bornite (Figs. 1 and 2).

Under a magnification of 100 diameters the bornite appears to be homogeneous. Continued intensive examination of sections of this mineral brings into view a maze of minute lighter colored inclusions but these are so small that only the merest suggestion

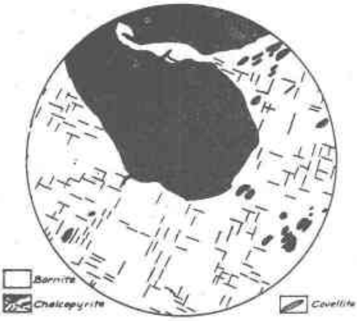

Fig. 1—Showing the characteristic "intergrowth" and the development of chalcopyrite needles as apophyses from larger masses of chalcopyrite.

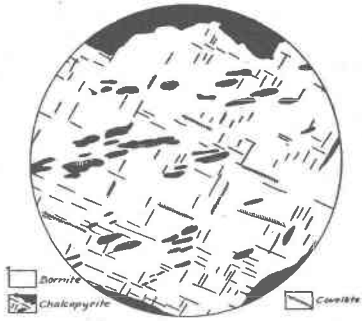

Fig 2—Showing the unequal development of the chalcopyrite needles and lenticles along 3 of the directions of cleavage of the bornite.

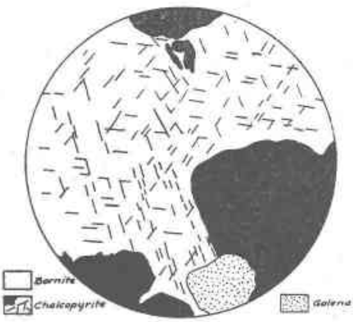

Fig. 3—Showing the triangular pattern produced by the nearly equal development of the "intergrowth" in 3 directions.

Fig 4—Showing the development of finger-like masses of chalcopyrite with rectilinear extensions parallel to the orientation of the chalcopyrite needles.

of their character may be obtained. On raising the magnification to 800 diameters, the inclusions take the form of needles or lenticles oriented as shown in the accompanying sketches.

These sketches are camera lucida drawings and accurately represent the positions and shapes of the various minerals for the magnification under which they were drawn. Owing to the difficulty of making accurate drawings with a magnification of 800, this was reduced to 500 diameters, and the sketches were then made. The magnification was further reduced to 250 diameters during the process of reproduction. It is to be noted that the field of the microscope and the mineral patterns as seen thru the microscope appear very much smaller than the corresponding features after they are drawn by the camera lucida method. Consequently the sizes of the mineral grains appear much larger in the sketches as reproduced than they do to the eye of the observer with a magnification of 500.

The "intergrowths" have the following characteristics:

(1) The main field or groundmass is always bornite.

(2) The needles or lenticles are always chalcopyrite.

(3) In the case of some grains of bornite, the section is so cut that the chalcopyrite needles are arranged in two linear sets nearly at right angles to each other (Figs. 1 and 4).

(4) In other cases, there are three linear sets of chalcopyrite needles nearly equally developd and occupying three zones at about 60° to one another. (Fig. 3.)

(5) In other places, two sets of needles intersect at nearly 90°, while a set of rather thick lenticles, more broadly spaced than the needles, occupies some linear position between the two sets of needles. (Figs. 1 and 2.)

(6) In several cases the needles and lenticles of chalcopyrite appear as apophyses or offshoots from some larger mass of the mineral (Fig. 1.)

(7) Covellite occurs along the borders of the chalcopyrite needles and lenticles, with sharp boundaries against the chalcopyrite and in gradation contact with the bornite. (Figs. 1 and 2.)

From the above characteristics, the "intergrowths" are interpreted by the writer as replacements of bornite along its octahedral cleavage planes by chalcopyrite, and not as simultaneous (or eutectic) intergrowths for the following reasons:

(1) There is a very marked lack of uniformity in the ratio of chalcopyrite to bornite in the "intergrowth."

(2) If the "intergrowth" were of eutectic character, one would hardly expect both chalcopyrite and bornite to be present, isolated from the "intergrowth" and occurring as separate homogeneous developments.

(3) The number of chalcopyrite needles and lenticles is increased very considerably in those specimens which contain larger masses of the mineral. In cases where larger masses of chalcopyrite are absent the areas of bornite are homogeneous and free of the "intergrowth." This suggests that in some way the presence of needles and lenticles is related to the occurrence of larger masses of chalcopyrite.

(4) The relationship suggested immediately above is manifested in Fig. 1, where needles of chalcopyrite are found as small offshoots or apophyses from larger masses of the mineral. These apophyses have the same orientation as the rest of the needles, which suggests

that the presence of the needles is one of the early phases of the replacement of bornite by chalcopyrite.

(5) Fig. 4 illustrates one of the common relationships between the two minerals. Here finger-like masses of chalcopyrite show an elongation and somewhat rectilinear outlines parallel to the orientation of the two sets of needles. This case exemplifies one of the later stages in the replacement of the bornite, which is interpreted as the development of the finger-like masses by the enlargement and coalescence of the chalcopyrite needles with the retention in general of an orientation parallel to the cleavage planes of the bornite.

The mineragraphic evidence, therefore, seems to substantiate the field evidence that chalcopyrite is replacing bornite; and it also draws attention to one other case of the lack of homogeneity of the mineral bornite.

MINERAL LOCALITIES IN THE VICINITY OF MIDDLETOWN, CONNECTICUT

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A few of the pegmatite quarries in the vicinity of Middletown, from which minerals have been taken in the past, are still being worked. Many others have been abandoned, and their locations may be lost, if a permanent record is not somewhere preserved. It was with this thought in mind that the following paper was written.

Of the many feldspar prospect-holes opened in Middlesex and adjacent portions of Hartford counties, Connecticut, fourteen may be selected as more or less famous for the minerals they have produced. The entire group lie within a radius of 14 kilometers (9 miles) of Wesleyan University (Locality 18, Fig. 1). The Connecticut pegmatite dikes are composed of predominating quartz and perthitic feldspar with some muscovite and biotite. Most of the gem minerals occur in pockets from a few centimeters to over one meter in diameter. Some of the larger pockets have shown quartz crystals 6 decimeters long, and 3 decimeters in diameter. Perthite crystals with well developed planes have equalled the quartz in their dimensions. These minerals project from the walls of the cavities, and are covered by platy crystals of cleavelandite which form a background for the rarer minerals.