CLEAVABLE BORNITE FROM USK, B. C.[1]

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Some samples of bornite recently obtained from an auriferous copper prospect near Usk, B. C., exhibit an unusually perfect cleavage. Generally this mineral presents only traces of octahedral cleavage, but in the specimens referred to the cleavage was almost as perfect as that of fluorite, with surfaces up to two centimeters in diameter. Some fragments which were measured on the goniometer gave angles well in accord with the theory for octahedral cleavage.

In some parts of the cleavage masses it is quite apparent that the bornite is no longer pure, but that there is also present a considerable proportion of a mineral resembling chalcocite. With a view to determining the general purity of the bornite, Mr. J. E. Thomson, of the University of Toronto, prepared three polished surfaces for "mineragraphic" observation. The intermingling of bornite and chalcocite was plainly seen, the latter being chiefly along cleavage planes in the former. By means of a rectangularly-ruled glass inserted in the field of the microscope he determined the ratio of the areas occupied by the two constituents and found that on most of the polished surfaces examined the chalcocite area was twice as great as the bornite area. In one of them, however, the bornite area was 54.17% while the chalcocite area was 45.83%. The volume ratios of the minerals in the masses examined may be assumed to be proportional to the ratios of the areas. With this in view it is possible, assuming that the specific gravities of the minerals are 5 for bornite and 5.5 for chalcocite, to determine the mass ratios. Where the areas are related to one another as two of chalcocite to one of bornite, the percentage composition of the intergrowth should be—chalcocite 68.75%, bornite 31.25%.

A chemical analysis of carefully selected material made by Mr. A. C. Wheatley is shown in I.

[1] [The need of investigation of material as to its homogeneity before too much significance is attached to deductions from analyses is strikingly brought out in this contribution. Ed.]

	I.	Molecular ratio	II.
Copper	67.51%	—1.068 or 7.026	67.14%
Iron	8.49	—0.152 or 1.	8.43
Sulfur	24.88	—0.778 or 5.112	24.16
Total	100.88		99.73
Sp. gr.	5.28		5.248

An analysis of "bornite" from Ragisvaara[1] is given for comparison in II. The formula corresponding to the above analyses is $7Cu_2S.Fe_2S_3$. From the evidence shown by the examination of polished surfaces it is clear that we are here dealing with a mixture of bornite and chalcocite and it is only a chance that the ratios of these two in the mixture permit the deduction of such a simple chemical formula. The Ragisvaara mineral is no doubt also a mixture. It is plainly unsafe to use occurrence of material of the same composition at two widely separated localities as a criterion of its definite character, for both may be mixtures.

As the relative amounts of chalcocite and bornite in the pieces analyzed are uncertain, it is impossible to decide whether the bornite has the formula indicated by the best modern analyses, $5Cu_2S.Fe_2S_3$, or favors the view of Kraus and Goldsberry[2] that bornite is variable in the ratio of Cu_2S to Fe_2S_3.

This intergrowth might be interpreted as derived from a natural cubic cuprous sulfide possessing a perfect octahedral cleavage, by the alteration, in part, to bornite. In view of the relations between the two minerals shown on mineragraphic study, however, the writer is inclined to interpret the mixture as partial alteration of unusually cleavable bornite to chalcocite.

CRISTOBALITE IN THE SPHERULITIC OBSIDIAN FROM YELLOWSTONE NATIONAL PARK[3]

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The various forms of silica furnish us with the best and most complete example of polymorphism. In addition to the common minerals, quartz, chalcedony, and opal, we have the compara-

[1] Dana, System of Mineralogy, p. 77.

[2] *Am. J. Sci.*, **37**, 539. 1914.

[3] [This article represents an interesting demonstration of the value of even the simplest of the modern optical methods in the recognition of the less common minerals. Ed.]