On some interesting relations between chalco-
pyrite and sphalerite in the ores from the
Hitachi mines, Japan.

by

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Among many interesting features of the ores from the Hitachi mines in northeast Japan, some relations between chalcopyrite and sphalerite are worthy of a brief description. The deposits of the mines consist of several lenticular masses of cupriferous pyritic ores, which were formed by the hydrothermal replacement at the final stage of intense contact metamorphism of amphibolite and related rocks due to the intrusions of granodiorite and some smaller igneous bodies.

Chalcopyrite and sphalerite, under description, occur mainly as the materials, which fill up the interstices between pyrite crystals, or as microscopic offshoots replacing it. The contemporaneous origin of these two minerals is inferred from their intimate association even in small interstices and narrow offshoots. In general, however, chalcopyrite is more abundant in the ores, which were formed near the intrusive rocks; whereas, sphalerite increases in amount as the ore bodies are farther removed from the igneous bodies.

Small amounts of these two minerals occur also as narrow veins, which traverse the other minerals irrespective of the previous textures. Such veins are characterized by simple mineral compos-

日立鉱山産鑛石中の黄銅鑛と閃亜鉛鑛との興味有る關係に就て

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ition and each traverse the other. Fine veins of sphalerite cutting chalcopyrite, are as often noted as the veins of chalcopyrite, which traverse sphalerite.

However, the interesting features regarding these minerals are the inclusions of one mineral in the other. Under the high magnification of microscope, abundant spots of chalcopyrite are found in the crystals of sphalerite (Plate I, Fig. 1). They are especially common in the ores from the deposits near the igneous rocks, such as those of the Sasame, Chusei and Irishiken groups. These spots of chalcopyrite are distributed throughout the sphalerite crystals, often elongated in some directions. According to Prof. C. F. Tolman,⁽¹⁾ such chalcopyrite inclusions in sphalerite are extremely common in the ores of the Cordillerian Region of North America. The included specks of pyrite are often so small that they are recognized only under the oil immersion lenses. In some cases, these inclusions are arranged in extreme regularity as rows of dots or as lodlets parallel to the crystallographic orientation of sphalerite. In other cases, the spots are irregular in shape, and are irregularly distributed throughout sphalerite. Thompson⁽²⁾ has also described the same structure in the ores from Ducktown, Tenn. In his case, chalcopyrite appeared in relatively large spots, which are arranged along the cleavages of sphalerite, and he concluded that these spots were formed by replacement along the cleavage.

(1) C. F. Tolman, personal communication.

(2) A. P. Thompson, Econ. Geol. Vol. 9, 1914, p. 153.

In some banded ores from Leadville, Colo., such spots of chalcopyrite are found in the sphalerite of ores, which elsewhere contain no chalcopyrite. In other words, chalcopyrite is strictly confined within the crystals of sphalerite. Such a special mode of occurrence may be due to the conditions, under which the sphalerite was replaced easier than any other minerals by chalcopyrite, which was therefore developed only by the replacement of sphalerite.

It may also be possible, however, that these spots were derived from the copper and iron sulfides, which were included in sphalerite as solid solutions at higher temperatures or under different conditions. According to Young and Moore⁽³⁾, the iron content in chalcocite combines with the copper sulfide to separate as chalcopyrite under the high pressure of hydrogen sulfide. In somewhat similar ways, it may be possible that the iron and copper sulfides, which might have been contained in small amounts in sphalerite would have separated by changes in conditions of physico-chemical equilibria.

This assumption is favoured also by the following observation. In the same ores of the Hitachi mines, in which chalcopyrite spots are found in sphalerite, minute dendritic bodies and skeleton crystals of sphalerite are found in chalcopyrite under high magnifications. (Plate I, Fig. 2) Such skeleton crystals or dendrites of sphalerite are never found in other minerals, and although the replacement of pyrite by sphalerite is not rare, the replacing sphalerite assume a quite different shape from the inclusions, described above.

(3) S. W. Young and N. P. Moore, Econ. Geol. Vol. 11, 1916, 349.

Accordingly, there is some reason to suspect that also these inclusions of sphalerite in chalcopyrite might have been derived from the impurities of chalcopyrite, due to subsequent changes of physico-chemical conditions.

Still another suggestion, that the both minerals were deposited simultaneously, might explain the phenomena. Under this assumption, however, it is difficult to explain the fact that the two minerals do not form mixtures, in which the relative amounts of them are approximately uniform, but they make up two quite different mixtures, that is, chalcopyrite with a negligible amount of sphalerite and sphalerite with only a slight amount of chalcopyrite. If the two minerals should have been deposited contemporaneously, it would be more probable to form similar mixtures throughout the whole mass, but this is not the actual case.

Explanation of figures.

Fig. 1. Chalcopyrite inclusions (light) in sphalerite (dark)

X Ca. 240. (An ore from Chusei)

Fig. 2. Dendritic bodies and skeleton crystals of sphalerite (dark) in chalcopyrite (light gray). Marcasite (light) is developed along fissures as a secondary mineral. X Ca. 150. (An ore from Irishiken)

s, Sphalerite; cc, chalcopyrite; m, marcasite.