THE SPACE GROUP OF CONICHALCITE

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Conichalcite, $CaCu(AsO_4)(OH)$, is classified with the adelite group of minerals which is closely related to the descloizite group (*Dana's System of Mineralogy*, **2,** p. 804, 1951). The space group of descloizite, $ZnPb(VO_4)(OH)$, in the Dana orientation ($c<a<b$), generally is regarded as *Pnam* (Bannister, *Min. Mag.*, **23,** 376–386, 1933; Richmond, *Am. Mineral.*, **25,** 441–479, 1940), although for purposes of comparison with brackebuschite and pyrobelonite it is convenient to use the orientation $b<a<c$ for which the corresponding space group notation is *Pnma* (Barnes & Qurashi, *Am. Mineral.*, **37,** 407–422, 1952). This orientation also has the advantage from the *x*-ray crystallographic point of view that it is the standard form for D_{2h}^{16} (*International Tables for X-Ray Crystallography*, **1,** 151, 1952). The space group of adelite, $CaMg(AsO_4)$-(OH,F), is reported to be $P2_12_12_1$ (Hägele, *Neues Jahrb. Min.* Abt. A, Beil.-Bd. 75, 101, 1939), with only very weak reflections eliminating the *n* and *a* glides. From this fact, and the general similarity of the reflection intensities from the principal zones of both minerals, Hägele argues that the space group of descloizite also is $P2_12_12_1$ but that the *hk*0 reflections for which *h* is odd, and the 0*kl* reflections for which $k+l$ is odd, are too weak to be observed. This, in turn, suggests that the space group of conichalcite probably is $P2_12_12_1$, as conjectured in Dana (*System of Mineralogy*, **2,** p. 806).

X-ray studies of conichalcite, however, have produced two different space group assignments, *Pmma* (for "higginsite," Richmond, *Am. Mineral.*, **25,** 441–479, 1940) and *Pnma* (Berry, *Am. Mineral.*, **36,** 484–486, 1951) after interchanging *b* and *c* in each case, both of which have $P2_12_12_1$ as a possible lower symmetry.

We have now examined crystals from two localities as follows:

(*a*) "higginsite" type material from the Higgins Mine, Arizona (Harvard Museum, 92923), of which two different fragments, cut from separate, small, crystals, gave identical results.

(*b*) material labelled "erinite" from Tintic, Utah (Royal Ontario Museum, E3001) and identified by powder and Weissenberg methods as conichalcite (Berry, *Am. Mineral.*, **36,** 484–486, 1951).

Zero level precession photographs for the 0*kl* zone are shown in Fig. 1 for the two types of material, (*a*) and (*b*), and it will be observed that several reflections for which $k+l$ is odd are clearly visible. In fact, spots

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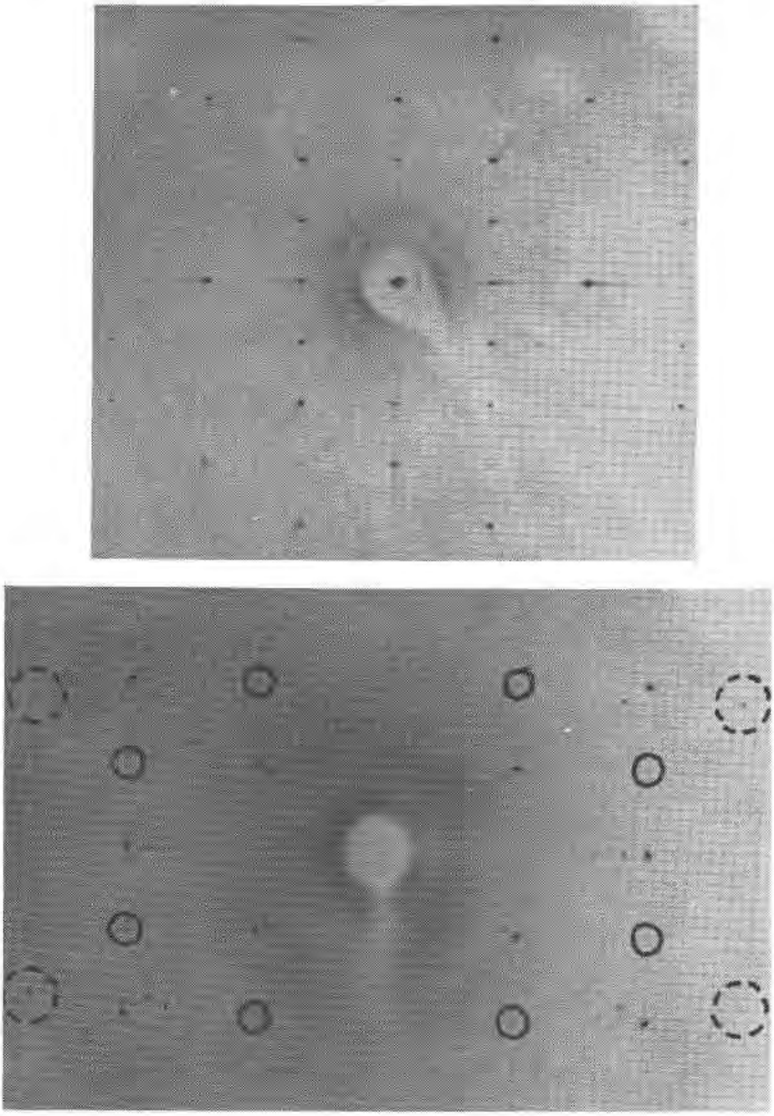

FIG. 1. Conichalcite; zero level, *a* axis, precession photographs; b^* horizontal, c^* vertical. Top "higginsite"; filtered MoK_α radiation. Bottom "erinite"; unfiltered Fe radiation; K_α spots, {012}, {021}, indicated by circles; K_β spots, {032}, indicated by dotted circles.

due to the following reflections are present in the original negatives: 012; 021; 032, 034; 036, 038; 052, 054, where the indices refer to the *Pnma* orientation. Reflections, in the *hk*0 zone, for which *h* is odd are considerably weaker, and the corresponding precession photographs are not suitable for reproduction. The following reflections, however, have been observed: 120, 140; 310; 360; 530, 550; 710, 730, 740. Precession photographs, therefore, show only axial halvings for the principal zones, and there are no systematic *hkl* absences, so that the space group of conichalcite is now established as $P2_12_12_1$. It is interesting to note that the list of observed reflections that forbid the *n* and *a* glides in conichalcite is very similar to corresponding observations on adelite (Hägele, *Neues Jahrb.* Min. Abt. A, Beil.-Bd. 75, 101, 1939). It may also be pointed out that the case of conichalcite serves as another example of the power of the Buerger precession method for space group investigations.

The structure of conichalcite is under investigation in connection with studies of the minerals of the descloizite group at the National Research Laboratories. It is appropriate, therefore, to mention at this time that a few very weak spots corresponding to reflections with $k+l$ odd have now been observed on a 200-hour 0*kl* Weissenberg film of descloizite. Thus it appears that Hägele's contention that the space group of descloizite is $P2_12_12_1$ probably will be confirmed. If so, then the necessity for separating the adelite and descloizite groups, at least on structural grounds, would virtually be eliminated. This will be discussed in greater detail in connection with the structure determination at present in progress on conichalcite, descloizite, pyrobelonite, and brackebuschite.

COMPLEX INCLUSIONS IN PEGMATITIC MINERALS

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Recently I reviewed the literature on mineral inclusions and related facts which have a bearing on temperature of crystallization. It was surprising to find a considerable amount of excellent descriptive and illustrative data in petrographic and mineralogic papers published throughout the last century. It was even more surprising to note that the early workers, such as Brewster, Sorby, and Zirkel observed many features of inclusions which are not mentioned in most current works. The question arises: were the earlier observations erroneous or are the current workers failing to notice these features?

It has been recorded that certain pegmatitic minerals contain complex inclusions which consist of intergrowths of minute crystals, usually with