

The unit cell and space-group of alamosite (PbSiO₃).

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ALAMOSITE was first described by Palache and Merwin,¹ who thought it might be isomorphous with wollastonite. For that reason it has been re-examined, using X-ray methods.

A specimen from the original locality at Alamos, Sonora, Mexico (B.M. 1910,330) was made available through the courtesy of the British Museum (Natural History), and in physical appearance it tallied with the original description. The crystals were aggregates of fibres arranged in bundles which cleaved perfectly perpendicular to the fibre axes. Small tablets could be readily cut out for X-ray analysis. The refractive indices were very high and the dispersion was large. As the axial ratios found by X-ray methods agreed with those given by Palache and Merwin, the latter's chemical analysis and density determination were not repeated.

Unit cell.—From Weissenberg photographs the unit-cell dimensions were found to be:

$$a \ 11.28 \pm 0.05, \ b \ 7.03 \pm 0.01, \ c \ 13.06 \pm 0.05 \ \text{\AA.}, \ \beta \ 120^\circ \pm 30'.$$

Using Palache and Merwin's density of 6.488 ± 0.003 and their chemical analysis, which confirmed the formula as PbSiO₃, *Z* (number of molecules in the unit cell) was found to be 12.3. No alternation of intensities which might indicate pseudo-symmetry was observed.

The *h0l* reflections were present only when $l = 2n$ and the space-group is therefore *Pc* or *P2/c*, which differ only in the possession of a centre. Tests for piezo-electricity with a Giebe-Scheibe oscillator gave negative results and, as the X-ray photographs show very many accidental absences, the centred group *P2/c* is to be preferred.

Experimental technique.—The crystal studied was tabular, the larger faces being (010), and was mounted on goniometer arcs to rotate about [010]. To decrease absorption, Weissenberg photographs, including that of the zero layer, were taken with the beam inclined at less than 70° to the axis of rotation. Weissenberg photographs about [010] do not

¹ C. Palache and H. E. Merwin, Amer. Journ. Sci., 1909, ser. 4, vol. 27, p. 399.

show the $0k0$ reflections, essential for the space-group determination, so the latter were examined separately without resetting the crystal. Knowing the length of the b -axis from the layer-line spacings, the Weissenberg camera was inclined so that each $0k0$ reflection in turn was set exactly at the Bragg angle. The $[010]$ axis was displaced by 1° in an arbitrary direction from the axis of rotation and the crystal was set to revolve continuously. It was thus assured that the crystal would pass twice per revolution through the Bragg angle. Each $0k0$ reflection up to $\theta = 40^\circ$ was in this way recorded separately on a small stationary film, about ten minutes being adequate for each exposure.

Comparison with parawollastonite.—The cell dimensions of monoclinic (para-)wollastonite found by Barnick¹ can be compared with those found for alamosite if the axes a , b , and c used above are changed to new axes a' , b' , and c' by the transformation $a' = -2a - c$, $b' = -b$, and $c' = c$. In this new orientation dimensions of the two minerals correspond as follows:

<i>Wollastonite.</i>	<i>Alamosite.</i>
a 15.36 Å.	a' 19.96 Å.
b 7.29	b' 7.03
c 7.08	c' 13.06
β $95^\circ 24.5'$	β $96^\circ 30'$
Z = 12	Z = 24
Space-group $P2_1/c$	Space-group in this orientation $B2/a$

Previous goniometric measurements of alamosite.—Palache and Merwin referred their morphological description of alamosite to the above transformed axes. The axial ratios given by the X-ray measurements are: $a/b = 2 \times 1.384$ and $c/b = 2 \times 0.928$, with $\beta 96^\circ 30'$, in fair agreement with Palache and Merwin's values of $a/b = 1.375$, $c/b = 0.924$, $\beta 95^\circ 50'$.

Discussion.—The ionic radius of Pb^{++} is 1.32 \AA. as against 1.06 \AA. for Ca^{++} . If alamosite were isomorphous with monoclinic wollastonite it would be expected that its cell would be somewhat greater in all directions than that of wollastonite; however, an increase is found in one direction only (along the a' cell edge), while the b' -axis shows a decrease, and the c' -axis is somewhat less than twice the length of the corresponding dimension of wollastonite. Alamosite does not show the pseudo-symmetry of wollastonite (halving of the b -axis). It is unlikely, therefore, that alamosite could be used for the analysis of the structure of wollastonite by the method of isomorphous series. Powder photographs are

¹ M. Barnick, Mitt. Kaiser-Wilhelm-Inst. Silikatforschung, 1936, no. 172; Naturwiss., 1935, vol. 23, p. 770. [M.A. 6-332.]

unlike those of wollastonite. It seems, however, quite possible that alamosite may contain Si_3O_9 rings for the following reasons:

i. $\beta = 120^\circ$ and the lattice is thus roughly hexagonal. The cleavage (010) is excellent and could be accounted for by layers of Si_3O_9 rings parallel to (010).

ii. $Z = 12$ and there are 4 atoms in each general position; the independent units of structure would then be 3Pb, 3Si, and 9O—not inconsistent with the presence of Si_3O_9 rings.

iii. One refractive index is widely separated from the other two (α 1.947, β 1.961, γ 1.968) and may indicate anisotropic structure units such as Si_3O_9 rings.

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