

X-RAY CRYSTALLOGRAPHY OF SEAMANITE

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The description of seamanite, a hydrated manganese borate-phosphate, was presented by E. H. Kraus, W. A. Seaman, and C. B. Slawson in 1930.¹ During the succeeding decade, seamanite has not been reported from a second locality nor has the work of Kraus, Seaman, and Slawson been supplemented by an investigation employing x -ray methods. This paper will present certain new data on the crystallography of this mineral.

The crystals used in the present work came from the Chicagon mine, near Iron River, Michigan. They show the prism $\{110\}$ and the pyramid $\{111\}$. None of the crystals had terminal faces at both ends and, conse-



FIG. 1. Typical etch figures obtained on the prism face of seamanite indicating the symmetry plane (001). The edge to the left is [001]. Magnified 200 \times .

quently, the crystal class could not be decided in terms of the morphology.² Inasmuch as the x -ray method does not yield a unique determination of the probable space group, etching experiments were undertaken.

When treated with dilute HCl for a few minutes, etch figures were readily obtained on the prism faces. One of the typical figures resulting from this treatment is shown as Fig. 1. This indicates the existence of a symmetry plane parallel to (001) and, consequently, holohedral symmetry.

¹ Kraus, E. H., Seaman, W. A., and Slawson, C. B., Seamanite, a new manganese phospho-borate from Iron County, Michigan. *Am. Mineral.*, **15**, 220-225 (1930).

² Kraus, Seaman, and Slawson state that seamanite is orthorhombic holohedral, but they do not mention observing terminations at both ends of the crystals, nor do they mention any other evidence to substantiate this conclusion.

Seamanite was investigated by Weissenberg and powder diffraction methods employing unfiltered iron radiation. The Weissenberg photographs showed the absence of $0kl$ reflections with k odd and $h0l$ with $h+l$ odd, but hkl and $hk0$ reflections of all sorts were present. Thus the probable space group is $Pbnm - V_h^{16}$.

The lattice constants, a_0 and b_0 , were determined directly by rotation about the c -axis, using a number of $hk0$ reflections as well as pinacoidal reflections, in a camera with $r=57.3$ mm. The value of c_0 was determined indirectly from Laue photographs made parallel to the a and b -axes. This technique was employed because of the needle-like habit of the crystals. The results obtained are as follows.

Absolute	Ratios	Ratios (K. S. & S.)
$a_0 = 7.83 \text{ \AA}$	0.517	0.519 ₆
$b_0 = 15.14$	1	1
$c_0 = 6.71$	0.443	0.450 ₈
(All $\pm 0.02 \text{ \AA}$)		

The calculated density based upon these cell edges and the composition $4 [\text{Mn}_3(\text{PO}_4)(\text{BO}_3) \cdot 3\text{H}_2\text{O}]$ is ³

$$\rho = \frac{4 \times 372.6 \times 1.65}{7.83 \times 15.14 \times 6.71} = 3.09$$

This theoretical density disagrees with the specific gravity previously reported (3.128)⁴ but it agrees with a determination made by us through the use of several small crystals and Thoulet's solution, 3.08 (4° C).

Kraus, Seaman, and Slawson suggested the probable isomorphism of seamanite and reddingite on account of the similarity of the axial ratios and the supposed chemical similarity. However, a powder diffraction pattern of reddingite, from Buckfield, Maine, is quite different from that of seamanite and this indicates that these minerals are not isostructural.

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³ For the purpose of the calculation of the density, equal molecular amounts of P_2O_5 and B_2O_3 have been assumed. This is not strictly in accord with Slawson's analysis, in which a slightly greater amount of B_2O_3 was indicated. The use of the actual determinations would yield a calculated density slightly lower.

⁴ This value becomes 3.12 if it is assumed that the measurements were made at 20° C. and that no temperature correction was applied.