

COMPOSITION OF VEATCHITE¹

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ABSTRACT

Veatchite was described in 1938 as a hydrous calcium borate, $2\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$, a lower hydrate of the colemanite-inoite series. Reinvestigation shows that it is a strontium borate with the probable formula $3\text{SrO} \cdot 8\text{B}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$.

INTRODUCTION

Veatchite was described by Switzer² as a new hydrous calcium borate, $2\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$, from Lang, California. Shortly thereafter it was pointed out by Dr. W. T. Schaller³ of the U. S. Geological Survey that on the basis of his studies of the colemanite-meyerhofferite-inoite series⁴ the physical properties of veatchite were not consistent with its chemical composition, as given. It was at his suggestion, therefore, that veatchite was re-examined. A spectrographic examination of veatchite, kindly made by K. J. Murata of the U. S. Geological Survey, showed that the mineral is a strontium borate and not a calcium borate, as first reported. Veatchite is the only known naturally occurring strontium borate.

In a second find of veatchite, recently made at Lang, the mineral has a platy rather than a fibrous habit. It occurs in thin seams associated with colemanite in gray shale. Surfaces parallel to these seams are coated by a very thin layer of veatchite having a pronounced pearly luster.

Although veatchite is the first reported strontium borate, other strontium minerals are found in or near many of the Mohave Desert region borate deposits. Strontianite is found in deposits of commercial importance 10 miles north of Barstow, San Bernardino County, California.⁵ Celestite has been noted in the borate deposits at Borate, San Bernardino County, California; at Mt. Blanco, Death Valley, California, and at White Basin, Clark County, Nevada.

¹ Published by permission of the Secretary, Smithsonian Institution, and of the Director, U. S. Geological Survey.

² Switzer, George, Veatchite, a new calcium borate from Lang, California: *Am. Mineral.*, **23**, 409-411 (1938).

³ Personal communication.

⁴ Schaller, W. T., Borate minerals from the Kramer district, Mohave Desert, California: *U. S. Geol. Survey, Prof. Paper* **158**, 169 (1930).

⁵ Knopf, Adolph, Strontianite deposits near Barstow, California: *U. S. Geol. Survey, Bull.* **660**, 257-270 (1917).

CHEMICAL ANALYSES

The original analysis of veatchite reported $\text{SrO} + \text{CaO}$ all as CaO , resulting in an incorrect formula being deduced. The spectrographic analysis, showing dominant strontium, also showed that a little calcium was present so that a new chemical analysis was required.

A new partial analysis of the type material (Table 1, column 1) was made on a sample very kindly furnished by Dr. Clifford Frondel of Harvard University. The analysis given in Table 1, column 3 was made

TABLE 1. CHEMICAL ANALYSES OF VEATCHITE

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------------------------------|------|------|------|-------|--------|--------|--------|-----------------|--------|
| SrO | 29.5 | 29.7 | 29.8 | 30.3 | }31.08 | }31.20 | 30.0 | .317 = 3 × .106 | 32.45 |
| CaO | 1.7 | 1.7 | 1.3 | 1.4 | | | | | |
| B ₂ O ₃ | 57.3 | 57.8 | 57.7 | 58.6 | 59.03 | 59.26 | 58.5 | .840 = 8 × .105 | 58.16 |
| H ₂ O(+) | | | 9.6 | 9.7 | 9.50 | 9.54 | 9.6 | .533 = 5 × .107 | 9.39 |
| Insol. | 1.0 | | | | 0.62 | | | | |
| | | | 98.4 | 100.0 | 100.23 | 100.00 | 100.00 | | 100.00 |

1. Veatchite, Lang, California. Fibrous habit. New partial analysis of type material. (Harvard Museum No. 92944 and U. S. National Museum No. 105697) W. W. Brannock, analyst.
2. Same as 1, recalculated to correct for insoluble.
3. Veatchite, Lang, California. Platy habit (U.S.N.M. R-8327). W. W. Brannock, analyst.
4. Same as 3, corrected for insoluble and calculated to 100%.
5. Veatchite, Lang, California. Original analysis. F. A. Gonyer, analyst.
6. Same as 5, corrected for insoluble and calculated to 100%.
7. Average of 2, 4 and 6.
8. Molecular ratios. Formula becomes $3(\text{Sr}, \text{Ca})\text{O} \cdot 0.8\text{B}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$.
9. Calculated composition for $3\text{SrO} \cdot 8\text{B}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$.

on the material of platy habit described above. Both new analyses were of necessity made upon 0.1 to 0.2 gram samples.

The chemical data are summarized in Table 1. The molecular ratios in best agreement indicate the probable formula to be $3(\text{Sr}, \text{Ca})\text{O} \cdot 0.8\text{B}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$. A possible alternate formula $\text{SrO} \cdot 3\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ is obtained if the ratios $\text{SrO} = 1 \times .317$, $\text{B}_2\text{O}_3 = 3 \times .280$ and $\text{H}_2\text{O} = 2 \times .275$ are chosen. Additional analyses on larger amounts of material will be needed to demonstrate positively which formula is correct.

UNIT CELL DIMENSIONS

The unit cell dimensions were given by Switzer⁶ as $a_0 = 6.72 \text{ \AA}$, $b_0 = 41.26 \text{ \AA}$, $c_0 = 41.20 \text{ \AA}$. These values, though given as Angstrom units

were in reality in kX units. However, precision of the measurements is such that the difference is not significant. The best value of β is probably that of Murdoch⁷ who gives $\beta = 121^\circ 02'$.

Using the values given above and a unit cell content of $16[3\text{SrO} \cdot 8\text{B}_2\text{O}_3 \cdot 5\text{H}_2\text{O}]$, the calculated density becomes 2.586. This value compares favorably with the measured value 2.58.⁸

If the alternate formula $\text{SrO} \cdot 3\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ is used and the unit cell content taken as $44[\text{SrO} \cdot 3\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}]$, the calculated density becomes 2.590.

⁶ *Op. cit.*

⁷ Murdoch, Joseph, Crystallography of veatchite: *Am. Mineral.*, **24**, 130-135 (1939).

⁸ Murdoch, Joseph, *op. cit.*