

ALUMINUM-BEARING SCORODITE FROM HOBART BUTTE, OREGON

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Hobart Butte is located in Lane County, Oregon, about two and a half miles northwest of Blackbutte Mine Postoffice. The upper part of the hill is composed largely of an altered andesite tuff, which is quarried for the clay it contains. It is in this quarry that the scorodite is found. The mineral occurs in zones that are very suggestive of old hot spring channels.¹

The andesite tuff is quite thoroughly altered to a fine material with low birefringence. Some unaltered glass is present. This glass contains very cloudy, brown incipient spherulites of feldspar (?), which are white in reflected light.

Small amounts of realgar were found in the quarry, but not in close association with the scorodite.

Megascopic description

In the hand specimen the scorodite is light green in color, has a high vitreous luster, occurs in colloform crusts, and shows an open cellular structure. Except for color and luster, the mineral closely resembles geyserite opal. Iron stains accompany the scorodite in some specimens.

Optical tests

In thin section the scorodite appears in colloform crusts up to 1.5 mm. thick, coating the glass and altered tuff. It is colorless, has a high relief in balsam and indices of refraction greater than the balsam. It shows an aggregate structure with spherulites and axiolites that closely resemble some types of chalcedony. Sections of normal thickness show lower second order interference colors. The birefringence determined in sections containing quartz is about 0.020. The fibers are length slow. The accompanying figure shows the appearance of the mineral in thin section.

The indices of refraction were found to be: $n_{\alpha}=1.712$, $n_{\gamma}=1.728$. Because of the difficulty of orientation n_{β} was not determined. The indices were measured as follows: The crushed fragments of clear scorodite were placed in methylene iodide. The grains were then examined in sodium light and α -monobromnaphthalene slowly added until the grains showing the highest index of refraction matched the oil. The index of refraction of the oil was then determined by using a hollow prism and the minimum deviation method. The procedure was then repeated for the lowest index. The maximum error in this measurement is ± 0.003 . The birefringence thus obtained agrees within the limits of error found in thin sections containing quartz.

¹ Hague, James Duncan, Notes on the deposition of scorodite from arsenical waters in the Yellowstone National Park: *Am. Jour. Sci.* (3), **34**, 171-175 (1887).

Spectrographic and chemical tests

For a chemical examination about 2 grams of scorodite were roughly hand picked under a binocular microscope and crushed. It was then screened; the minus 80 plus 60 material was then separated with acetylene tetrabromide to remove the clay and other impurities. The product of this separation was then again hand picked to obtain as pure a sample as possible for spectrographic analysis.

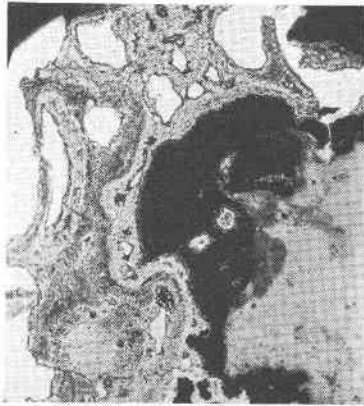


FIG. 1. Colloform crust of aluminum-bearing scorodite on iron-stained altered tuff. About 15X. Plane polarized light.

A spectrum covering the region from 2800 to 3400 Å was made on a 21-foot concave grating instrument. The elements iron, arsenic, and aluminum were found to be present in considerable abundance. No other lines were noted on the film.

Heated alone in a closed tube, the mineral yields abundant water. In a closed tube with charcoal, a good arsenic mirror is formed. On charcoal, the material fuses to a black magnetic globule.

The mineral, unlike most scorodite, is not completely soluble in HCl or HNO₃. It is decomposed by these acids, leaving a white residue. When the HCl solution is made ammoniacal, a brown precipitate is formed. When this precipitate is treated with KOH, the solution acidified with HCl and again made ammoniacal, a slight white precipitate is produced. These tests show the presence of iron and some aluminum. If the material is first fused with NaPO₃, a stronger aluminum test is obtained. After the precipitation of iron and aluminum, arsenic is readily precipitated by H₂S. After this separation, a test was made for the phosphate radical, but none was found.

The ammonium paramolybdate microchemical test for arsenic gives excellent results with a nitric acid solution of the mineral. Ammonium chloride gives a good microchemical iron test.²

Summary and conclusions

The above spectrographic and chemical tests indicate a mineral containing iron, arsenic, aluminum, and water. Except for the aluminum, the mineral contains the same elements as in scorodite. The indices of refraction and birefringence are somewhat lower than those given for scorodite. The simplest explanation seems to be that the mineral under investigation is an aluminum-bearing scorodite. Isomorphism of aluminum and iron is not unusual, although it has not been reported in scorodite.

The approximate composition was estimated by means of Gladstone and Dale's Law.³ This was done by computing the theoretical mean index of refraction of $\text{Fe}_2\text{O}_3 \cdot \text{As}_2\text{O}_5 \cdot 4 \text{H}_2\text{O}$ (scorodite) and $\text{Al}_2\text{O}_3 \cdot \text{As}_2\text{O}_5 \cdot 4 \text{H}_2\text{O}$ (hypothetical compound), and comparing these values with the mean index for the mineral under investigation. The values of n for these compounds were computed to be:

Scorodite (iron end member)	1.784
Mineral under investigation	1.720
Hypothetical aluminum end member	1.577

Since n_β was not determined, the mean index of the mineral under study was taken as $\sqrt{n_\alpha n_\gamma}$ instead of $\sqrt[3]{n_\alpha n_\beta n_\gamma}$, a close approximation. The ratio of the iron member to the hypothetical aluminum member of the series was found to be 2.23:1.

The percentage composition of this aluminum-bearing scorodite was calculated, by this method, to be:

Fe_2O_3	24.9 per cent
Al_2O_3	7.1 per cent
As_2O_5	51.8 per cent
H_2O	16.2 per cent

This, of course, must be regarded only as a rough approximation.

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² Staples, Lloyd W., Mineral determination by microchemical methods: *Am. Mineral.*, **21**, 613-634 (1936).

³ Larsen, Esper S., and Berman, Harry, The Microscopic Determination of The Non-opaque Minerals, *U. S. Geol. Survey, Bull.*, **248**, 30-32 (1934).