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OCCURRENCE OF WAIRAKITE AT THE GEYSERS, CALIFORNIA

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Wairakite, the lime analogue of analcime, first discovered in hydrothermally altered rocks at Wairakei, New Zealand (1, 2) has been identified recently in a greywacke fragment from The Geysers, California. This fragment, made available by courtesy of Dr. Donald E. White, United States Geological Survey, was erupted in 1955 from a new well drilled to a depth of 600 feet and cased to 200 feet.

At The Geysers, wairakite, undoubtedly of hydrothermal origin, replaces feldspar almost completely, and lines cavities and fractures in the greywacke. Thus its occurrence resembles that at Wairakei. The Californian wairakite displays the characteristic two sets of polysynthetic twinning and possesses the same refractive indices as its counterpart from New Zealand.

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MICROHARDNESS OF ALUMINUM BORIDE MONOCRYSTALS

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SYNTHESIS AND GENERAL DESCRIPTION

Single crystals of aluminum boride (AlB_{12}) were obtained by two methods of synthesis at the Bureau of Mines Electrochemical Experiment Station, Norris, Tenn. In the first method aluminum chips and anhydrous boron oxide (B_2O_3) were heated in a graphite crucible, under vacuum, to the point of incipient melting. Argon at 2–5 psi was then admitted, and the temperature was raised rapidly to the reaction point. The first reaction occurred at 1140–1200° C., and the final reaction took place at 1350° C. The regulus from this final reaction was digested first in hydrochloric acid and then in hydrofluoric acid. From this synthesis three types of crystals were obtained, as shown in Figures 1–3.

The maximum diameter of crystals obtained by this method of synthesis was 2 mm. The maximum length of the long yellow crystals was 5 mm. Some showed distinct red-yellow pleochroism.

For the second synthesis the ordinary aluminothermic method was used. (1) The crystals obtained by this method, shown in Fig. 4,

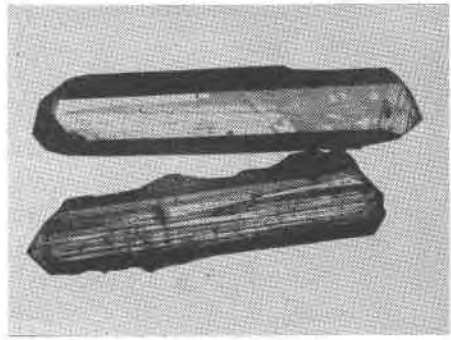

FIG. 1. Long yellow orthorhombic crystals of aluminum boride. ×42.

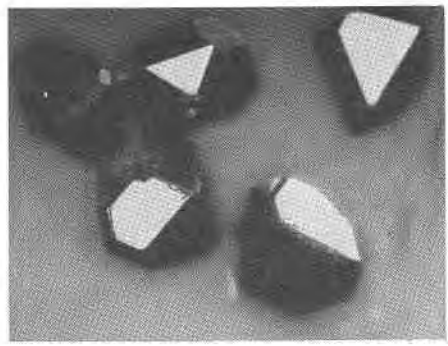

FIG. 2. Yellow orthorhombic, short bipyramidal crystals. ×42.

were red by transmitted light, flat tabular, pseudo-hexagonal and probably monoclinic. The maximum diameter was 5 mm. The quantity of crystals recovered from both methods of synthesis was small.

PROPERTIES

Density.—The density of selected crystals was determined by the sink-float method, using bromoform diluted with carbon tetrachloride as the immersion liquid. The figures obtained are shown in Table 1.

TABLE 1. DENSITY OF ALUMINUM BORIDE CRYSTALS

Type of crystal	Density (gm./cc.)
1. Solid yellow orthorhombic, short bipyramidal	2.591±0.005
2. Red hexagonal, flat tabular	2.534±0.008
3. Long yellow, pseudo-hexagonal	2.574±0.003

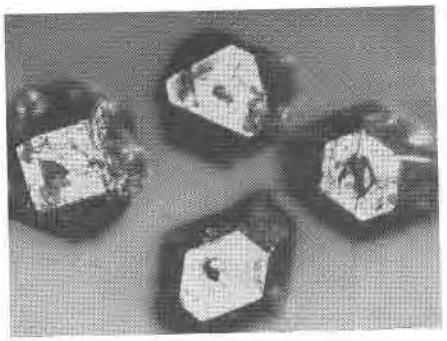

FIG. 3. Yellow "dished" orthorhombic crystals. ×42.

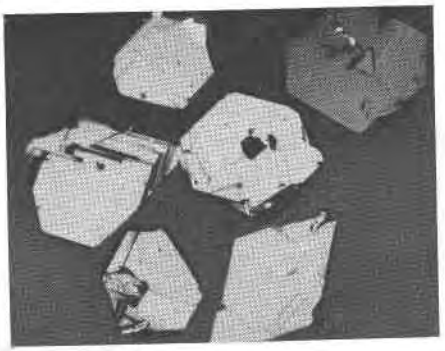

FIG. 4. Red tabular pseudohexagonal crystals. ×42.

Hardness.—The crystals selected for hardness testing were mounted in bakelite, surfaced first on a 600-grit diamond wheel, then on a 1000-grit diamond wheel, and were finally polished with 0 to 2 micron diamond paste on a teakwood wheel. This method gave optically flat surfaces of sufficient area for indenting.

Indentations were made with a Tukon microhardness tester, using a Knoop indenter and a 100-gram load. An oil-immersion objective (97×, 1.25 N.A.) was used to measure the length of indentations. Accuracy and reproducibility of the tests were determined by making indentations in molded boron carbide (Norbide) and in crystals of black silicon carbide.

Of the three types of yellow aluminum boride crystals tested, none showed a distinct variation in hardness. The average hardness value obtained from thirty indentations was 2754 K_{100}. The range in hardness was 2715–2788 K_{100}. Coincident indentations made in the molded boron carbide specimen gave an average hardness value of 2755 K_{100}, with a range of 2695–2841 K_{100}, while those made in the silicon carbide speci-

men gave an average hardness value of 2520 K_{100}, with a range of 2410–2600 K_{100}. These figures are comparable with those obtained by Thibault and Nyquist (2), 2760 K_{100} for molded boron carbide and 2550 K_{100} for gray silicon carbide, in their study of Knoop hardness.

Thirty indentations, made in four of the red pseudohexagonal crystals, gave an average hardness value of 2433 K_{100}, with a range of 2354–2527 K_{100}. Abrasion tests on the polished surfaces of silicon carbide and molded boron carbide, using crushed crystals of yellow aluminum boride, showed that the silicon carbide was scratched and pitted by the crystals, while the boron carbide was unaffected. A similar test using crushed red crystals showed no abrasion on either the silicon carbide or the boron carbide.

From the foregoing tests it appears that the hardness of yellow aluminum boride crystals is $\approx$2700 K_{100} and that they are harder than silicon carbide and very nearly as hard as boron carbide. The hardness value for the red pseudo-hexagonal crystals is $\approx$2400 K_{100}.

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DEVICE FOR PRECISELY CONTROLLING AN IRIS DIAPHRAGM*

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The photoelectric measurement of the reflectivity of ore-minerals, ably discussed by Bowie (1957), is facilitated if precise control of the light is achieved by means of an iris diaphragm. The device described below was designed for use on an ore-microscope, but could be used in any optical system where fine adjustment of the iris is desired.

The instrument is shown assembled on a microscope tube (Fig. 1*a*) and in "exploded" view (Fig. 1*b*).

The conventional control of an iris diaphragm is usually by means of a lever (K) acting more or less concentrically with the iris. The present device is mounted beside the lever and is coupled to it. An additional lever (A) moves coaxially on the microscope tube, resting on a flange. Mounted on the lever (A) is a flat knurled disk (D) in which is cut a spiral groove.

* Publication authorized by the Director, Geological Survey and Museum.