necessarily) result from a deficiency of magnesia at the time of the formation of geikielite.

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REFERENCES

Crook, T. and Jones, B. M. (1906), Geikielite and the ferromagnesium titanites: *Min. Mag.*, **14,** 160–166.

Dick, A. (1893), On geikielite, a new mineral from Ceylon: *Min. Mag.*, **10,** 145–147.

Efremov, N. (1954), Geikielite from Mount Jemorakly-Tube, North Caucasus, USSR: *Am. Mineral.*, **39,** 395–397.

Gower, J. A. (1957), *X*-ray measurement of the iron magnesium ratio in biotites: *Am. J. Sci.*, **255,** 142–156.

Kashin, S. A. (1937), Metamorphism of chromspinelids in the Camel Mountains (Southern Urals): Chromites of the USSR: Acad. Sci. USSR.

Murdoch, J. and Fahey, J. J. (1949), Geikielite, a new find from California: *Am. Mineral.* **34,** 835–838.

Palache, C., Berman, H., and Frondel, C. (1944), *The System of Mineralogy*, Wiley, New York.

Sahama, Th. G. (1953), Mineralogy of the humite group: *Annales Acad. Scient. Fenn.* Ser. A II, No. 31, 50 pp.

Swanson, H. E., and Fuyat. R. K. (1953), Standard X-ray diffraction powder patterns: *U. S. Nat. Bur. Stand., Circ. 539*, **2,** 35.

Swanson, H. E., Gilfrich, N. T. and Ugrinic, G. M. (1955), Standard *X*-ray diffraction powder patterns: *U. S. Nat. Bur. Stand., Circ. 539*, **5,** 43.

Wones, D. R. (1958a), The Phlogopite-annite join: *Carn. Inst. of Wash. Yearbook* **57,** 194–195.

Wones, D. R. (1958b), Phase relations of biotites on the join phlogopite-annite: *Bull. G.S.A.*, **69,** 1665.

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CERIANITE, CeO_2, FROM POÇOS DE CALDAS, BRAZIL

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Cerianite has been identified as a secondary mineral from Morro do Ferro on the Poços de Caldas plateau, Minas Gerais, Brazil. The cerianite occurs in soft, weathered materials lying within a radioactive zone on the southeastern slope of Morro do Ferro. Samples of these materials were collected in July, 1956, by T. C. Marvin, Geologist for the Union Carbide Ore Co., during a visit to the locality in company with Helmuth Wedow, of the U. S. Geological Survey, who had made a detailed study of the geology of the mountain. The samples containing cerianite were taken from a small, irregular zone, a few inches in width, of especially high radioactivity, at a depth of 3 to 4 feet in the wall of a prospecting trench. Freshly broken masses are weakly coherent to friable, with a greenish yellow to buff color, and, on drying, these break down surficially to a buff colored powder of flour-like consistency composed chiefly of cerianite. Small amounts of very fine-grained hydromica and kaolinite are admixed, and the masses are cut by tiny veinlets of limonite.

Morro do Ferro is a hill composed of deeply weathered phonolite and nepheline syenite cut by massive dikes of magnetite. Bastnaesite, thorogummite, and allanite have been reported from this locality (1). The cerianite is a weathering product and may have been derived from these minerals. Cerium is the only rare-earth that has a tetravalent, as well as a trivalent, state that is stable under geologic conditions. The dioxide is formed by the hydrolysis of soluble cerium salts under oxidizing conditions. Cerous hydroxide is a strong reducing agent, particularly in alkaline solution, and oxidizes to hydrous ceric oxide. The other rare-earths are not known to form oxides or compounds, other than the basic carbonates, under weathering conditions. In any case, the other rare-earth oxides are not isostructural with CeO_2. During weathering, cerium may, in this way, become separated mineralogically from rare-earths with which it was directly associated in primary minerals such as bastnaesite, $(Ce, La)(CO_3)F$. Cerium dioxide is formed also by the thermal decomposition in air of cerium compounds.

The cerianite was identified by its *x*-ray diffraction pattern which checks with that of synthetic CeO_2, and with the ASTM file. The unit cell dimension is a_0 5.411 ± 0.004 Å, comparing closely with the values, 5.397 Å to 5.416 Å, reported (2) for synthetic CeO_2. A sample from which most of the admixed hydromica and kaolinite had been removed by separation in methylene iodide was found, by *x*-ray fluorescence analysis, to contain Ce as the only major constituent together with minor Fe and very small amounts of Y, Th, Zr, and U. The Fe probably is due to admixed limonite, and the other elements may be present either in solid solution or as finely divided admixed thorogummite or other minerals. In synthetic materials, CeO_2 forms a complete series with UO_2 and ThO_2 in the fluorite structure-type (2). Under an oil immersion lens, the irregular grains of cerianite are isotropic with an index of refraction above 2.0. The mineral does not fluoresce in ultraviolet radiation, but a sample of synthetic CeO_2, prepared by igniting ceric sulfate in air, fluoresced a bright salmon pink in long-wave, and dull salmon pink in short-wave, ultraviolet.

Cerianite was first described by Graham (3) in 1955 from Lachner Township, Sudbury district, Ontario. It occurs very sparingly as minute crystals in partly absorbed inclusions of wall-rock in a dike-like zone of carbonate rock cutting a nepheline syenite. The Ontario mineral contains roughly 5 weight per cent of ThO_2 in solid solution

REFERENCES

(1) OLIVEIRA, A. I. Reservas Brasileiras de Tório: *Engenharia, Mineração e Metal.*, **24,** 164, Sept. 1956.
(2) See literature cited by FRONDEL, C., Systematic Mineralogy of Uranium and Thorium; *U. S. Geol. Survey Bull.*, **1064,** 53 (1958)
(3) GRAHAM, A. R. Cerianite, CeO_2, a new rare earth oxide mineral: *Am. Mineral.*, **40,** 560–564, 1955.

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A NEW DILUENT FOR BROMOFORM IN HEAVY LIQUID SEPARATION OF MINERALS*

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Dimethyl sulfoxide, $(CH_3)_2SO$, has been tested and is recommended as a diluent for bromoform in place of acetone. Its vapor pressure and flammability is much less than that of acetone. It is a colorless, odorless liquid.

Carbon tetrachloride, CCl_4, benzene, C_6H_6, ethyl alcohol, C_2H_5OH, and acetone, $(CH_3)_2CO$, have been used as diluents in the preparation of heavy liquids for the separation of minerals (Krumbein and Pettijohn, 1938, p. 321). The mixture most commonly used is acetone-bromoform. The disadvantages of acetone as a diluent are its high vapor pressure and its flammability.

The vapor pressures of dimethyl sulfoxide and bromoform are relatively low and of the same order of magnitude (Table 1). Changes in composition of mixtures of these compounds due to differential evaporation are small. These mixtures maintain relatively constant specific gravities during use and in storage as compared to the acetone-bromoform mixtures. A mixture having a specific gravity 2.58 did not change measurably in the second decimal place after 30 mineral separations, including filtering. There is a slight darkening in the color of the mixture after use.

Table 1 compares the salient properties of dimethyl sulfoxide, acetone, and bromoform.

The combining volumes of bromoform-dimethyl sulfoxide mixtures are additive and a straight-line mixing curve (volume+volume) can be

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