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Lukechangite-(Ce), a new rare-earth-fluorocarbonate mineral from Mont Saint-Hilaire, Quebec

JOEL D. GRICE[1] AND GEORGE Y. CHAO[2]

[1]Research Division, Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario, Canada K1P 6P4
[2]Ottawa-Carleton Geoscience Centre, Department of Earth Sciences, Carleton University, Ottawa, Ontario, Canada K1S 5B6

ABSTRACT

Lukechangite-(Ce), ideally $Na_3Ce_2(CO_3)_4F$, is a new mineral from Mont Saint-Hilaire, Quebec. It occurs as tabular, short prismatic, and barrel-shaped crystals up to 1 mm. It is colorless to pale beige with a white streak and a vitreous, or somewhat pearly on {0001}, luster. Associated minerals include microcline, analcime, sodalite, aegirine, serandite, eudialyte, catapleiite, fluorite, petersenite-(Ce), siderite, astrophyllite, and albite. Lukechangite-(Ce) is soft, Mohs hardness ≈ 4½, brittle, with an uneven to conchoidal fracture, and with perfect {0001} cleavage. Lukechangite-(Ce) is uniaxial negative, ω = 1.728(3) and ϵ = 1.542(1). It is hexagonal, space group $P6_3/mmc$, a = 5.068(1), c = 22.87(5) Å, V = 509(1) Å^3, and Z = 2. The strongest X-ray powder diffraction lines [d (Å), I, hkl] are: 5.71(50)(004), 4.31(100)(101), 3.804(50)(006), 3.169(70)(105), 2.877(60)(106), 2.534(70)(110), 2.192(90B)(109,200,201), 1.978(70)(205), and 1.658(50)(209,210,211). An average of the electron-microprobe analyses gave Na_2O 14.94, CaO 0.10, SrO 0.12, La_2O_3 16.36, Ce_2O_3 29.48, Pr_2O_3 1.95, Nd_2O_3 5.88, F 3.58, CO_2 (28.40), and O ≡ F − 1.51, total 99.30 wt%. CO_2 was calculated by stoichiometry from the results of the crystal-structure analysis. D_{calc} is 4.02 g/cm^3. The atomic arrangement of lukechangite-(Ce) has been refined to R = 3.4%. The structure is layered parallel to (001), with CO_3 groups oriented parallel to the layering forming thick slabs incorporating either Ce or Na cations and a separate Na-F layer. The structure of lukechangite-(Ce) resembles that of huanghoite-(Ce) and baiyuneboite-(Ce) and is isostructural with synthetic $Na_3La_2(CO_3)_4F$.