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

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ABSTRACT

Lukechangite-(Ce), ideally Na3Ce2(CO3)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, fluorate, 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, \( \omega = 1.728(3) \) and \( \epsilon = 1.542(1) \). It is hexagonal, space group \( P6_3/mmc \), \( a = 5.068(1) \) Å, and \( Z = 2 \). The strongest X-ray powder diffraction lines \([d (\text{Å}), I, hkl]\) 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 Na2O 14.94, CaO 0.10, SrO 0.12, La2O3 16.36, Ce2O3 29.48, Pr2O3 1.95, Nd2O3 5.88, F 3.58, CO2 (28.40), and O \( [F 2 \text{wt\%}] \). CO2 was calculated by stoichiometry from the results of the crystal-structure analysis. \( D_{\text{calc}} \) is 4.02 g/cm3. The atomic arrangement of lukechangite-(Ce) has been refined to \( R = 3.4\% \). The structure is layered parallel to (001), with CO2 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 Na3La2(CO3)4F.

INTRODUCTION

There are 34 rare-earth-element (REE) fluorocarbonate mineral species known and these provide the major economic sources of REE. Many of the new REE carbonate minerals being described today will not likely ever be of economic interest because of their existence only in small quantities, but their value may be in their crystal-chemical properties. Recently there has been a great deal of interest in fluorocarbonates for industrial applications, and hence many have been synthesized. REE fluorocarbonates have useful optical properties and the 3d transition-metal fluorocarbonates are being investigated for their magnetic properties. Many of the synthesized compounds have natural equivalents whereas others have not yet been found as minerals. The synthetic equivalents are extremely valuable study material for mineralogists as many of the minerals are not found in crystals suitable for crystal-structure analysis (Mercier and Leblanc 1993a, 1993b, and 1993c). The new mineral lukechangite-(Ce) is another REE-fluorocarbonate mineral that has not been previously reported in nature yet has a synthetic, isostructural phase that was previously characterized.

Mont Saint-Hilaire is known throughout the world for its diversity in mineral species. This diversity results from the complex geochemical history of the locality, of which lukechangite-(Ce) serves as yet another example. At this locality 41 carbonate minerals have been identified (Horváth and Gault 1990), as well as approximately ten unknowns (Chao et al. 1990). Of the identified carbonates, 17 contain rare earths as essential elements (Grice 1996), and of these six contain fluorine as an essential anion: bastnäsite-(Ce), cordylite-(Ce), horváthite-(Y) (Grice and Chao 1997), parisite-(Ce), reederite-(Y), and synchysite-(Ce).

The new mineral described here, lukechangite-(Ce), found originally in the Poudrette quarry, Mont Saint-Hilaire, Rouville County, Quebec, is named in honor of Luke L.Y. Chang (1934), University of Maryland, for his contributions to the study of carbonate group minerals. The new mineral and the name were approved by the Commission on New Minerals and Mineral Names, IMA. Cotype material is housed in the collection of the Canadian Museum of Nature under catalogue no. CMNMI 81535.

Occurrence

Mont Saint-Hilaire is an alkaline intrusive complex and one of the ten Monteregian Hills, a series of plutons that are aligned along the St. Lawrence Valley for almost 150 km east from Oka to Megantic, Quebec.