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Meyrowitzite, $Ca(UO_2)(CO_3)_2{\cdot}5H_2O$, a new mineral with a novel uranyl-carbonate sheet

Anthony R. Kampf[1,*], Jakub Plášil[2], Travis A. Olds[3], Barbara P. Nash[4], Joe Marty[5], and Harvey E. Belkin[6]

[1]Mineral Sciences Department, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, U.S.A.
[2]Institute of Physics ASCR, v.v.i., Na Slovance 1999/2, 18221 Prague 8, Czech Republic
[3]Department of Civil and Environmental Engineering and Earth Sciences, University of Notre Dame, Notre Dame, Indiana 46556, U.S.A.
[4]Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112, U.S.A.
[5]5199 East Silver Oak Road, Salt Lake City, Utah 84108, U.S.A.
[6]U.S. Geological Survey (Ret.), Reston, Virginia 20190 U.S.A.

Abstract

Meyrowitzite, $Ca(UO_2)(CO_3)_2{\cdot}5H_2O$, is a new mineral species from the Markey mine, Red Canyon, San Juan County, Utah, U.S.A. It is a secondary phase found on calcite-veined asphaltum in association with gypsum, markeyite, and rozenite. Meyrowitzite occurs as blades up to about 0.2 mm in length, elongate on [010], flattened on {100}, and exhibiting the forms {100}, {001}, {101}, {110}, and {011}. The mineral is yellow and transparent with vitreous luster and very pale yellow streak. Fluorescence under a 405 nm laser is from weak greenish yellow to moderate greenish blue. The Mohs hardness is ca. 2, tenacity is brittle, fracture is irregular, and there is one perfect cleavage, $\{\bar{1}01\}$. The measured density is 2.70(2) g/cm^3. The mineral is optically biaxial (+) with α = 1.520(2), β = 1.528(2), and γ = 1.561(2) (white light). The $2V$(meas) = 53.0(6)°; weak dispersion, $r > v$; optical orientation: $Z = \mathbf{b}$, $Y \wedge \mathbf{a} \approx 19°$ in obtuse β; pleochroism pale yellow, $X \approx Y < Z$. Electron microprobe analyses provided the empirical formula $Ca_{0.94}(U_{1.00}O_2)(CO_3)_2{\cdot}5(H_{2.02}O)$ on the basis of U = 1 and O = 13 apfu, as indicated by the crystal structure determination. Meyrowitzite is monoclinic, $P2_1/n$, a = 12.376(3), b = 16.0867(14), c = 20.1340(17) Å, β = 107.679(13)°, V = 3819.3(12) Å^3, and Z = 12. The structure (R_1 = 0.055 for 3559 $I_o > 2\sigma I$) contains both UO_7 pentagonal bipyramids and UO_8 hexagonal bipyramids, the latter participating in uranyl tricarbonate clusters (UTC). The two kinds of bipyramids and the carbonate groups link to form a novel corrugated heteropolyhedral sheet. This is the first structural characterization of a uranyl-carbonate mineral with a U:C ratio of 1:2. Meyrowitzite is apparently dimorphous with zellerite.

Keywords: Meyrowitzite, new mineral species, uranyl tricarbonate, crystal structure, zellerite, Markey mine, Red Canyon, Utah