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ACTINIDES IN GEOLOGY, ENERGY, AND THE ENVIRONMENT

Cabvinite, $Th_2F_7(OH)\cdot 3H_2O$, the first natural actinide halide

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ABSTRACT

The new mineral species cabvinite, $Th_2F_7(OH)\cdot 3H_2O$ (IMA 2016-011), has been discovered in the Mo-Bi ore deposit of Su Seinargiu, Sarroch, Cagliari, Sardinia, Italy. It occurs as white square prismatic crystals, up to 100 μm in length and 40 μm in thickness, associated with brookite and iron oxy-hydroxides in vugs of quartz veins. Electron microprobe analysis gave (mean of five spot analyses, in wt%): ThO_2 82.35, F 19.93, H_2O_{calc} 10.21, sum 112.49, O=F –8.40, total 104.09. On the basis of 2 Th atoms per formula unit, the empirical formula of cabvinite is $Th_2F_{6.7}(OH)_{1.3}\cdot 3H_2O$. Main diffraction lines in the X-ray powder diffraction pattern are [*d* (Å) (relative visual intensity) *hkl*]: 8.02 (ms) 110; 3.975 (s) 121,211; 3.595 (m) 310,130; 2.832 (m) 400,321,231; 2.125 (m) 402; 2.056 (m) 332; and 2.004 (ms) 440,521,251. Cabvinite is tetragonal, space group $I4/m$, with $a = 11.3689(2)$, $c = 6.4175(1)$ Å, $V = 829.47(2)$ Å^3, $Z = 4$. The crystal structure has been solved and refined to $R_1 = 0.021$ on the basis of 813 reflections with $F_o > 4\sigma(F_o)$. It consists of Th tricapped trigonal prisms, connected through corner-sharing, giving rise to a framework hosting [001] tunnels. Cabvinite is the first natural actinide halide, and the site of discovery appears to provide a natural laboratory for the study of Th mobility and sequestration.

Keywords: Cabvinite, halide, thorium, fluorine, crystal structure, Su Seinargiu, Sardinia, Italy