

ACTINIDES IN GEOLOGY, ENERGY, AND THE ENVIRONMENT

Cabvinite, $\text{Th}_2\text{F}_7(\text{OH})\cdot 3\text{H}_2\text{O}$, the first natural actinide halide

PAOLO ORLANDI¹, CRISTIAN BIAGIONI^{1,*}, AND FEDERICA ZACCARINI²

¹Dipartimento di Scienze della Terra, Università di Pisa, Via S. Maria 53, I-56126 Pisa, Italy

²Resource Mineralogy, University of Leoben, Peter Tunner Str. 5, A-8700 Leoben, Austria

ABSTRACT

The new mineral species cabvinite, $\text{Th}_2\text{F}_7(\text{OH})\cdot 3\text{H}_2\text{O}$ (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%): ThO₂ 82.35, F 19.93, H₂O_{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 $\text{Th}_2\text{F}_{6.7}(\text{OH})_{1.3}\cdot 3\text{H}_2\text{O}$. 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) Å³, *Z* = 4. The crystal structure has been solved and refined to *R*₁ = 0.021 on the basis of 813 reflections with *F*_o > 4σ(*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