

Smamite, $\text{Ca}_2\text{Sb}(\text{OH})_4[\text{H}(\text{AsO}_4)_2] \cdot 6\text{H}_2\text{O}$, a new mineral and a possible sink for Sb during weathering of fahlore

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ABSTRACT

Smamite, $\text{Ca}_2\text{Sb}(\text{OH})_4[\text{H}(\text{AsO}_4)_2] \cdot 6\text{H}_2\text{O}$, is a new mineral species from the Giftgrube mine, Rauenthal, Sainte-Marie-Aux-Mines ore-district, Haut-Rhin department, France. It is a supergene mineral found in quartz-carbonate gangue with disseminated to massive tennantite-tetrahedrite series minerals, native arsenic, Ni-Co arsenides, and supergene minerals picroparmacolite, fluckite, and pharmacolite. Smamite occurs as lenticular crystals growing in aggregates up to 0.5 mm across. The new mineral is whitish to colorless, transparent with vitreous luster and white streak; non-fluorescent under UV radiation. The Mohs hardness is $\sim 3\frac{1}{2}$; the tenacity is brittle, the fracture is curved, and there is no apparent cleavage. The measured density is $2.72(3)$ g/cm³; the calculated density is 2.709 g/cm³ for the ideal formula. The mineral is insoluble in H₂O and quickly soluble in dilute (10%) HCl at room temperature. Optically, smamite is biaxial (–), $\alpha = 1.556(1)$, $\beta = 1.581(1)$, $\gamma = 1.588(1)$ (white light). The $2V$ (meas) = $54(1)^\circ$; $2V$ (calc) = 55.1° . The dispersion is weak, $r > v$. Smamite is non-pleochroic. Electron microprobe analyses provided the empirical formula $\text{Ca}_{2.03}\text{Sb}_{0.97}(\text{OH})_4[\text{H}_{1.10}(\text{As}_{1.99}\text{Si}_{0.01}\text{O}_4)_2] \cdot 6\text{H}_2\text{O}$. Smamite is triclinic, $P\bar{1}$, $a = 5.8207(4)$, $b = 8.0959(6)$, $c = 8.21296(6)$ Å, $\alpha = 95.8343(7)^\circ$, $\beta = 110.762(8)^\circ$, $\gamma = 104.012(7)^\circ$, $V = 402.57(5)$ Å³, and $Z = 1$. The structure ($R_{\text{obs}} = 0.027$ for 1518 $I > 3\sigma I$ reflections) is based upon $\{\text{Ca}_2(\text{H}_2\text{O})_6\text{Sb}(\text{OH})_4[\text{H}(\text{AsO}_4)_2]\}$ infinite chains consisting of edge-sharing dimers of $\text{Ca}(\text{H}_2\text{O})_3\text{O}_2(\text{OH})_2$ polyhedra that share edges with $\text{Sb}(\text{OH})_4\text{O}_2$ octahedra; adjacent chains are linked by H-bonds, including one strong, symmetrical H-bond with an O–H bond-length of ~ 1.23 Å. The name “smamite” is based on the acronym of the Sainte-Marie-aux-Mines district.

Keywords: Smamite, new mineral species, arsenate, crystal structure, weathering, fahlore, Sainte-Marie-aux-Mines