

Protocaseyite, a new decavanadate mineral containing a $[\text{Al}_4(\text{OH})_6(\text{H}_2\text{O})_{12}]^{6+}$ linear tetramer, a novel isopolycation

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ABSTRACT

Protocaseyite, $[\text{Al}_4(\text{OH})_6(\text{H}_2\text{O})_{12}][\text{V}_{10}\text{O}_{28}] \cdot 8\text{H}_2\text{O}$, is a new mineral (IMA2020-090) occurring in low-temperature, post-mining, secondary mineral assemblages at the Burro mine, Slick Rock district, San Miguel County, Colorado, U.S.A. Crystals of protocaseyite are saffron-yellow, thick blades, with pale orange-yellow streak, vitreous luster, brittle tenacity, curved fracture, two very good cleavages, a Mohs hardness of 2, and a density of 2.45(2) g/cm³. The optical properties of protocaseyite could be only partly determined: biaxial with $\alpha = 1.755(5)$, $\beta < 1.80$, $\gamma > 1.80$ (white light); pleochroic with X and Y yellow, Z orange ($X \approx Y < Z$). Electron-probe microanalysis and crystal-structure solution and refinement provided the empirical formula $[(\text{Al}_{3.89}\text{Mg}_{0.11}\text{Ca}_{0.02})_{\Sigma 4.02}(\text{OH})_6(\text{H}_2\text{O})_{12}][\text{H}_{0.06}\text{V}_{10}\text{O}_{28}] \cdot 8\text{H}_2\text{O}$. Protocaseyite is triclinic, $P\bar{1}$, $a = 9.435(2)$, $b = 10.742(3)$, $c = 11.205(3)$ Å, $\alpha = 75.395(7)$, $\beta = 71.057(10)$, $\gamma = 81.286(6)^\circ$, $V = 1036.4(5)$ Å³, and $Z = 1$. The crystal structure ($R_1 = 0.026$ for 4032 $I_o > 2 \sigma I$ reflections) contains both the $[\text{V}_{10}\text{O}_{28}]^{6-}$ decavanadate polyoxoanion and a novel $[\text{Al}_4(\text{OH})_6(\text{H}_2\text{O})_{12}]^{6+}$ polyoxocation.

Keywords: Protocaseyite, new mineral, polyoxometalate, crystal structure, Burro mine, San Miguel County, Colorado, U.S.A.