

Caseyite, a new mineral containing a variant of the flat-Al₁₃ polyoxometalate cation

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ABSTRACT

Caseyite, $[(V^{5+}O_2)Al_{10-x}(OH)_{20-2x}(H_2O)_{18-2x}]_2[H_2V^{4+}V_9^{5+}O_{28}][V_{10}^{5+}O_{28}]_2[(Na,K,Ca)_{2-z}(SO_4)_{2-z} \cdot (60+8x+y+4z)H_2O]$, where $x = 0-2.5$, $y = 0-2$, $z = 0-2$, is a new mineral (IMA 2019-002) occurring in low-temperature, post-mining, secondary mineral assemblages at the Burro, Packrat, and West Sunday mines in the Uravan Mineral Belt of Colorado, U.S.A. Crystals of caseyite are yellow tapering needles or blades, with a pale yellow streak, vitreous luster, brittle tenacity, curved fracture, no cleavage, Mohs hardness between 2 and 3, and 2.151 g/cm³ calculated density. Caseyite is optically biaxial (+) with $\alpha = 1.659(3)$, $\beta = 1.670(3)$, $\gamma = 1.720(3)$ (white light), $2V = 52.6(5)^\circ$, has strong $r < v$ dispersion, optical orientation $Z \approx \mathbf{a}$ (elongation of needles), and no pleochroism. Electron-probe microanalysis provided the empirical formula $[(V^{5+}O_2)Al_{8.94}(OH)_{17.88}(H_2O)_{15.88}]_2[H_2V^{4+}V_9^{5+}O_{28}][V_{10}^{5+}O_{28}]_2[(Na_{0.82}Ca_{0.35}K_{0.27})_{\Sigma 1.44}(SO_4)_{1.33} \cdot 70.24H_2O]$ (+0.94 H). Caseyite is monoclinic, $P2_1/n$, $a = 14.123(8)$, $b = 30.998(15)$, $c = 21.949(11)$ Å, $\beta = 97.961(8)^\circ$, $V = 9516(9)$ Å³, and $Z = 2$. The crystal structure ($R_1 = 0.0654$ for 9162 $I_0 > 2\sigma I$ reflections) contains both normal $[V_{10}O_{28}]^{6-}$ and doubly protonated mixed-valence $[H_2V_1^{4+}V_9^{5+}O_{28}]^{5-}$ decavanadate isopolyanions, and a novel vanadoaluminate heteropolycation (“flat-Al₁₀V□₂”), ideally $[(V^{5+}O_2)Al_{10}(OH)_{20}(H_2O)_{18}]^{11+}$, closely related to the technologically important flat-Al₁₃ polyoxocation.

Keywords: Caseyite, new mineral, polyoxometalate, flat-Al₁₃ polyoxocation, crystal structure, Packrat mine, Burro mine, West Sunday mine, Colorado