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Lead-tellurium oxysalts from Otto Mountain near Baker, California: VII. Chromschieffelinite, $Pb_{10}Te_6O_{20}(OH)_{14}(CrO_4)(H_2O)_5$, the chromate analog of schieffelinite

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Abstract

Chromschieffelinite, $Pb_{10}Te_6O_{20}(OH)_{14}(CrO_4)(H_2O)_5$, is a new tellurate from Otto Mountain near Baker, California, named as the chromate analog of schieffelinite, $Pb_{10}Te_6O_{20}(OH)_{14}(SO_4)(H_2O)_5$. The new mineral occurs in a single 1 mm vug in a quartz vein. Associated mineral species include: chalcopyrite, chrysocolla, galena, goethite, hematite, khinite, pyrite, and wulfenite. Chromschieffelinite is orthorhombic, space group $C222_1$, $a = 9.6646(3)$, $b = 19.4962(8)$, $c = 10.5101(7)$ Å, $V = 1980.33(17)$ Å^3, and $Z = 2$. Crystals are blocky to tabular on {010} with striations parallel to [001]. The forms observed are {010}, {210}, {120}, {150}, {180}, {212}, and {101}, and crystals reach 0.2 mm in maximum dimension. The color and streak are pale yellow and the luster is adamantine. The Mohs hardness is estimated at 2. The new mineral is brittle with irregular fracture and one perfect cleavage on {010}. The calculated density based on the ideal formula is 5.892 g/cm^3. Chromschieffelinite is biaxial (–) with indices of refraction $\alpha = 1.930(5)$, $\beta = 1.960(5)$, and $\gamma = 1.975(5)$, measured in white light. The measured $2V$ is 68(2)°, the dispersion is strong, $r < v$, and the optical orientation is $X =$ **b**, $Y =$ **c**, $Z =$ **a**. No pleochroism was observed. Electron microprobe analysis provided: PbO 59.42, TeO_3 29.08, CrO_3 1.86, H_2O 6.63 (structure), total 96.99 wt%; the empirical formula (based on 6 Te) is $Pb_{9.65}Te_6O_{19.96}(OH)_{14.04}(CrO_4)_{0.67}(H_2O)_{6.32}$. The strongest powder X-ray diffraction lines are [d_{obs} in Å (*hkl*) *I*]: 9.814 (020) 100, 3.575 (042,202) 41, 3.347 (222) 44, 3.262 (241,060,113) 53, 3.052 (311) 45, 2.9455 (152,133) 55, 2.0396 (115,353) 33, and 1.6500 (multiple) 33. The crystal structures of schieffelinite ($R_1 = 0.0282$) and chromschieffelinite ($R_1 = 0.0277$) contain isolated $Te^{6+}O_6$ octahedra and $Te_2^{6+}O_{11}$ corner-sharing dimers, which are linked into a three-dimensional framework via bonds to Pb^{2+} atoms. The framework has large channels along **c**, which contain disordered SO_4 or CrO_4 groups and H_2O. The lone-electron pair of each Pb^{2+} is stereochemically active, resulting in one-sided Pb-O coordination arrangements. The short Pb-O bonds of the Pb^{2+} coordinations are all to $Te^{6+}O_6$ octahedra, resulting in strongly bonded layers parallel to {010}, which accounts for the perfect {010} cleavage.

Keywords: Chromschieffelinite, new mineral, tellurate, crystal structure, schieffelinite, Otto Mountain, California