Lead-tellurium oxysalts from Otto Mountain near Baker, California: I. Ottoite, Pb₂TeO₅, a new mineral with chains of tellurate octahedra

ANTHONY R. KAMPF,[1,*] ROBERT M. HOUSLEY,[2] STUART J. MILLS,[3] JOSEPH MARTY,[4] AND BRENT THORNE[5]

[1]Mineral Sciences Department, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, California 90007, U.S.A.
[2]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125, U.S.A.
[3]Department of Earth and Ocean Sciences, University of British Columbia, Vancouver, British Columbia V6T 1Z4, Canada
[4]3457 E. Silver Oak Road, Salt Lake City, Utah 84108, U.S.A.
[5]3898 S. Newport Circle, Bountiful, Utah 84010, U.S.A.

ABSTRACT

Ottoite, Pb_2TeO_5, is a new tellurate from Otto Mountain near Baker, California. Most of the mining on Otto Mountain occurred between 1940 and 1970 and is attributed to Otto Fuetterer, for whom the mountain is now named. The new mineral occurs on fracture surfaces and in small vugs in brecciated quartz veins, which intersect granitic rocks. Ottoite is directly associated with acanthite, bromine-rich chlorargyrite, gold, iodargyrite, khinite, wulfenite, and four other new tellurates: housleyite, mark-cooperite, thorneite, and timroseite. Various other secondary minerals occur in the veins, including two other new secondary tellurium minerals, paratimroseite and telluroperite. Ottoite and most other secondary minerals of the quartz veins are interpreted as having formed from the partial oxidation of primary sulfides and tellurides during or following brecciation of the veins. A later generation of quartz mineralization then recemented the breccias, effectively isolating and protecting the secondary mineralization from further alteration. Ottoite is monoclinic, space group $I2/a$, with the unit cell: $a = 7.5353(6)$, $b = 5.7142(5)$, $c = 10.8981(12)$ Å, $\beta = 91.330(6)°$, $V = 469.13(8)$ Å³, and $Z = 4$. The mineral occurs as complex spear-shaped crystals in subparallel to divergent intergrowths. It is yellow and transparent to translucent, with a pale yellow streak and adamantine luster. Mohs hardness is estimated at 3. The mineral is brittle, with an irregular fracture and two cleavages in the [100] zone at ~90°—possibly on {010} and {001}. The calculated density is 8.721 g/cm³. Ottoite is biaxial (–), with a large $2V$, but indices of refraction are too high to be measured. The optic orientation could only partially be determined: $Y \approx \mathbf{a}$. No pleochroism was observed. Electron microprobe analyses provided the following averages: PbO 68.88 and TeO₃ 28.03, total 96.95 wt%; the empirical formula (based on O = 5) is $Pb_{1.96}Te^{6+}_{1.01}O_5$. The strongest powder X-ray diffraction lines are [d_{obs} in Å (*hkl*) *I*]: 3.131 ($\overline{2}$02) 64, 3.055 (013) 90, 3.015 (211) 100, 2.112 ($\overline{2}$22) 29, 1.810 (006, $\overline{2}$15) 21, 1.773 ($\overline{4}$11, 402) 43, 1.686 (033, 231) 20. The crystal structure ($R_1 = 0.020$) consists of straight chains of *trans*-corner-sharing $Te^{6+}O_6$ octahedra parallel to $\mathbf{a}$, which are joined by bonds to Pb atoms. The Pb atom exhibit markedly lopsided 11-coordination, typical of Pb^{2+} with stereoactive 6s² lone-pair electrons. The powder X-ray diffraction pattern of ottoite is very similar to that reported for girdite. Examination of girdite type material suggests that its description was based upon data obtained from at least two and possibly three different phases, one of which may correspond to ottoite.

Keywords: Ottoite, girdite, new mineral, tellurate, crystal structure, stereoactive lone-pair, Otto Mountain, California