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Joëlbruggerite, $Pb_3Zn_3(Sb^{5+},Te^{6+})As_2O_{13}(OH,O)$, the Sb^{5+} analog of dugganite, from the Black Pine mine, Montana

Stuart J. Mills,[1,*] Uwe Kolitsch,[2] Ritsuro Miyawaki,[3] Lee A. Groat,[1] and Glenn Poirier[4]

[1]Department of Earth and Ocean Sciences, University of British Columbia, 6339 Stores Road, Vancouver, British Columbia V6T 1Z4, Canada
[2]Mineralogisch-Petrographische Abteilung, Naturhistorisches Museum Wien, Burgring 7, A-1010 Wien, Austria
[3]Department of Geology, National Museum of Nature and Science, 3-23-1, Hyakunin-cho, Shinjuku, Tokyo 169-0073, Japan
[4]Mineral Sciences Division, Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario K1P 6P4, Canada

Abstract

Joëlbruggerite, ideally $Pb_3Zn_3(Sb^{5+},Te^{6+})As_2O_{13}(OH,O)$, is a new arsenate mineral (IMA 2008-034) and the Sb^{5+} analog of dugganite, from the Black Pine mine, 14.5 km northwest of Philipsburg, Granite County, Montana. It is usually found perched on mimetite; other species that may be present include malachite, azurite, pseudomalachite, chalcocite, beudantite-corkite, duftite, dugganite, and kuksite, in milky quartz veins. Joëlbruggerite occurs as barrel-shaped or prismatic crystals up to about 50 µm across in various shades of purple. The crystals have an adamantine luster and a white streak. Mohs hardness is about 3. The fracture is irregular, and the tenacity is brittle. Joëlbruggerite crystals are uniaxial (–), with a calculated refractive index of $n = 1.993$, and weakly pleochroic: X = Y = gray, Z = purple; absorption: Z > X = Y. Crystals show straight extinction and are length-fast. The empirical chemical formula (mean of 5 electron microprobe analyses) calculated on the basis of 14 [O + OH] anions is $Pb_{3.112}(Zn_{2.689}Fe^{2+}_{0.185})_{\Sigma 2.874}(Sb^{5+}_{0.650}Te^{6+}_{0.451})_{\Sigma 1.101}(As_{1.551}P_{0.203}Si_{0.160})_{\Sigma 1.914}O_{13.335}(OH)_{0.665}$. Joëlbruggerite is trigonal, space group $P321$, $a = 8.4803(17)$, $c = 5.2334(12)$ Å, $V = 325.94(12)$ Å^3, $Z = 1$. The five strongest lines in the powder X-ray diffraction pattern are [d_{obs} in Å (I) (hkl)]: 3.298 (100) (111), 3.008 (89) (021), 1.905 (39) (122, 131), 2.456 (36) (012, 121, 030), and 1.609 (30) (112, 132, 231, 140). The crystal structure was solved from single-crystal X-ray diffraction data and refined to $R_1 = 0.038$ on the basis of 604 unique reflections with $F > 4\sigma(F)$. It is composed of heteropolyhedral sheets of edge-sharing $(Sb,Te)O_6$ octahedra and PbO_8 disphenoids, oriented parallel to (001). The sheets are cross-linked by AsO_4 and ZnO_4 tetrahedra, which share corners to form an interlinked, two- and three-connected two-dimensional net parallel to (001). The mineral is named for Joël Brugger (born 1967), Swiss-Australian mineralogist, for his contributions to mineralogy.

Keywords: Joëlbruggerite, new mineral, Sb^{5+}, arsenate, Black Pine mine, dugganite, crystal structure, bond valence