

The crystal chemistry and crystal structure of kuksite, $\text{Pb}_3\text{Zn}_3\text{Te}^{6+}\text{P}_2\text{O}_{14}$, and a note on the crystal structure of yafsoanite, $(\text{Ca,Pb})_3\text{Zn}(\text{TeO}_6)_2$

**STUART J. MILLS,^{1,*} ANTHONY R. KAMPF,² UWE KOLITSCH,^{3,4} ROBERT M. HOUSLEY,⁵
AND MATI RAUDSEPP¹**

¹Department of Earth and Ocean Sciences, University of British Columbia, Vancouver, British Columbia V6T 1Z4, Canada

²Mineral Sciences Department, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, U.S.A.

³Mineralogisch-Petrographische Abt., Naturhistorisches Museum, Burggring 7, A-1010 Wien, Austria

⁴Institut für Mineralogie und Kristallographie, Geozentrum, Universität Wien, Althanstrasse 14, A-1090 Wien, Austria

⁵Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125, U.S.A.

ABSTRACT

New discoveries of kuksite, $\text{Pb}_3\text{Zn}_3\text{Te}^{6+}\text{P}_2\text{O}_{14}$, from the Black Pine mine, Montana, and Blue Bell claims, California, have enabled a detailed crystal-chemical study of the mineral to be undertaken. Single-crystal X-ray structure refinements of the structure indicate that it is isostructural with dugganite, $\text{Pb}_3\text{Zn}_3\text{Te}^{6+}\text{As}_2\text{O}_{14}$, and joëlbruggerite, $\text{Pb}_3\text{Zn}_3(\text{Sb}^{5+}, \text{Te}^{6+})\text{As}_2\text{O}_{13}(\text{OH}, \text{O})$. Kuksite from the Black Pine mine crystallizes in space group $P321$, with unit-cell dimensions $a = 8.392(1)$, $c = 5.204(1)$ Å, $V = 317.39(8)$ Å³, and $Z = 1$ ($R_1 = 2.91\%$ for 588 reflections [$F_o > 4\sigma F$] and 3.27% for all 624 reflections), while Blue Bell kuksite has the unit cell $a = 8.3942(5)$, $c = 5.1847(4)$ Å, and $V = 316.38(4)$ Å³ ($R_1 = 3.33\%$ for 443 reflections [$F_o > 4\sigma F$] and 3.73% for all 483 reflections). Chemical analyses indicate that solid-solution series exist between kuksite, dugganite, and joëlbruggerite. Raman spectroscopic and powder X-ray diffraction data are also presented for samples from both occurrences.

The crystal structure of the chemically related species yafsoanite, $(\text{Ca,Pb})_3\text{Te}_2^{6+}\text{Zn}_3\text{O}_{12}$, from the type locality (Delbe orebody, Kuranakh Au Deposit, Aldan Shield, Saha Republic, Russia), has been refined to $R_1 = 2.41\%$ for 135 reflections [$F_o > 4\sigma F$] and 3.68% for all 193 reflections. A garnet-type structure has been confirmed and significantly improves upon the results of an earlier structure determination.

Keywords: Kuksite, dugganite, joëlbruggerite, Black Pine, Blue Bell, tellurate, yafsoanite, Delbe orebody, crystal structure