

Prewittite, $\text{KPb}_{1.5}\text{Cu}_6\text{Zn}(\text{SeO}_3)_2\text{O}_2\text{Cl}_{10}$, a new mineral from Tolbachik fumaroles, Kamchatka peninsula, Russia: Description and crystal structure

ROBERT R. SHUVALOV,¹ LIDIYA P. VERGASOVA,² TATYANA F. SEMENOVA,¹ STANISLAV K. FILATOV,¹
SERGEY V. KRIVOVICHEV,^{1,*} OLEG I. SIIDRA,¹ AND NIKOLAY S. RUDASHEVSKY³

¹Department of Crystallography, Faculty of Geology, St. Petersburg State University, 7/9 University Emb., St. Petersburg 199034, Russia

²Institute of Volcanology, Russian Academy of Science, 9 Bulvar Pyipa, Petropavlovsk-Kamchatsky 683006, Russia

³Mechanobr-Analit Ltd., 6 21st line, St. Petersburg 199026, Russia

ABSTRACT

Prewittite, ideally $\text{KPb}_{1.5}\text{Cu}_6\text{Zn}(\text{SeO}_3)_2\text{O}_2\text{Cl}_{10}$, was found in the fumarole field of the second cinder cone of the North Breach of the Great fissure Tolbachik eruption (1975–1976, Kamchatka peninsula, Russia). It occurs as separate olive-green tabular crystals up to 0.2 mm in maximum dimension. It has vitreous luster and brownish-green streak. Prewittite is orthorhombic, space group $Pn\bar{m}$, $a = 9.132(2)$, $b = 19.415(4)$, $c = 13.213(3)$ Å, $V = 2342.6(9)$ Å³, $Z = 4$, $D_{\text{calc}} = 3.89$ g/cm³, $D_{\text{meas}} = 3.90(2)$ g/cm³. The eight strongest lines of the powder X-ray diffraction pattern are $\{I [d(\text{Å})] hkl\}$: 70 (8.26) 110; 60 (7.53) 101; 90 (4.111) 220, 132, 141; 100 (3.660) 212, 123; 40 (2.996) 223; 50 (2.887) 062; 40 (2.642) 322, 214; 40 (2.336) 073, 180, 244. Prewittite is biaxial (–). The optical orientation is $X = a$, $Y = c$, $Z = b$. The mineral has clear pleochroism: X , Y – olive green, Z – red-brown. The mineral is very brittle with the perfect cleavage on (010) and (101). The most developed crystal forms are $\{010\}$, $\{001\}$, and $\{101\}$. The chemical composition determined by the electron-microprobe is (wt%): K₂O 1.76, PbO 21.18, CuO 33.24, ZnO 8.00, SeO₂ 15.74, Cl 26.06, O=Cl –5.88, total 100.10. The empirical formula derived on the basis of O+Cl = 18 and sum of positive charges of cations equal to 26 is $\text{K}_{0.53}\text{Pb}_{1.33}\text{Cu}_{5.87}\text{Zn}_{1.38}\text{Se}_{1.99}\text{O}_{7.67}\text{Cl}_{10.33}$. The crystal structure was solved by direct methods and refined to an agreement index $R1 = 0.034$ on the basis of 1522 independent reflections with $I \geq 2\sigma$. It is based upon metal oxide selenite chloride layers parallel to (010) and linked through K-Cl and Pb-Cl bonds to the K and Pb atoms located in the interlayer. The mineral name honors Charles T. Prewitt (b. 1933) in recognition of his important contributions to crystal chemistry of minerals and planetary materials.

Keywords: Prewittite, new mineral, crystal structure, copper selenite chloride, fumaroles, Tolbachik volcano, Kamchatka peninsula, Russia