

# Nabokoite

# $\text{Cu}_7(\text{Te}^{4+}\text{O}_4)(\text{SO}_4)_5 \cdot \text{KCl}$

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**Crystal Data:** Tetragonal. *Point Group:*  $4/m\ 2/m\ 2/m$ . Crystals are thin tabular on {001}, to 1 mm, showing {001}, {110}, {102}, {014}, in banded intergrowth with atlasovite.

**Physical Properties:** *Cleavage:* Perfect on {001}. *Hardness* = 2–2.5 *D*(meas.) = 4.18(5) *D*(calc.) = 3.974

**Optical Properties:** Transparent. *Color:* Pale yellow-brown, yellow-brown. *Streak:* Yellow-brown. *Luster:* Vitreous.

*Optical Class:* Uniaxial (-).  $\omega = 1.778(3)$   $\epsilon = 1.773(3)$

**Cell Data:** *Space Group:*  $P4/ncc$ .  $a = 9.833(1)$   $c = 20.591(2)$   $Z = 4$

**X-ray Powder Pattern:** Tolbachik volcano, Russia.  
10.35 (10), 2.439 (7), 3.421 (6), 2.881 (5), 4.57 (4), 3.56 (4), 1.972 (4)

## Chemistry:

	(1)	(2)
$\text{SO}_3$	33.66	33.60
$\text{TeO}_2$	13.78	13.40
$\text{V}_2\text{O}_3$	0.07	
$\text{Bi}_2\text{O}_3$	0.49	
$\text{Fe}_2\text{O}_3$	0.09	
$\text{CuO}$	45.25	46.74
$\text{ZnO}$	1.26	
$\text{PbO}$	0.28	
$\text{K}_2\text{O}$	3.94	3.95
$\text{Cs}_2\text{O}$	0.11	
$\text{Cl}$	2.92	2.98
$-\text{O} = \text{Cl}_2$	0.66	0.67
Total	101.19	100.00

(1) Tolbachik volcano, Russia; by electron microprobe, corresponds to  $(\text{Cu}_{6.74}\text{Zn}_{0.18})_{\Sigma=6.92}(\text{Te}_{1.02}\text{Bi}_{0.02}\text{Pb}_{0.01}\text{Fe}_{0.01}\text{V}_{0.01})_{\Sigma=1.07}\text{O}_{4.10}(\text{SO}_4)_{4.98}\text{Cl}_{0.98}$ . (2)  $\text{KCu}_7(\text{TeO}_4)(\text{SO}_4)_5\text{Cl}$ .

**Polymorphism & Series:** Forms a series with atlasovite.

**Occurrence:** A rare sublimate formed in a volcanic fumarole.

**Association:** Atlasovite, chalcocyanite, dolerophanite, chloroxiphite, euchlorine, piypite, atacamite, alarsite, fedotovite, lammerite, klyuchevskite, anglesite, langbeinite, hematite, tenorite.

**Distribution:** From the Tolbachik fissure volcano, Kamchatka Peninsula, Russia.

**Name:** Honoring Sof'ya Ivanovna Naboko (1909– ), Institute of Volcanology, Petropavlovsk-Kamchatskii, Russia, Russian volcanologist who first collected the mineral.

**Type Material:** A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, 87577.

**References:** (1) Popova, V.I., V.A. Popov, N.S. Rudashevskiy, S.F. Glavatskikh, V.O. Polyakov, and A.F. Bushmakin (1987) Nabokoite  $\text{Cu}_7\text{TeO}_4(\text{SO}_4)_5 \cdot \text{KCl}$  and atlasovite  $\text{Cu}_6\text{Fe}^{3+}\text{Bi}^{3+}\text{O}_4(\text{SO}_4)_5 \cdot \text{KCl}$  – new minerals of volcanic exhalations. *Zap. Vses. Mineral. Obshch.*, 116, 358–367 (in Russian with English abs.). (2) (1988) *Amer. Mineral.*, 73, 929 (abs. ref. 1). (3) Pertlik, F. and J. Zemmann (1988) The crystal structure of nabokoite,  $\text{Cu}_7\text{TeO}_4(\text{SO}_4)_5 \cdot \text{KCl}$ : the first example of a  $\text{Te}(\text{IV})\text{O}_4$  pyramid with exactly tetragonal symmetry. *Mineral. Petrol.*, 38, 291–298.

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