

# Piypite

# $K_2Cu_2O(SO_4)_2$

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**Crystal Data:** Tetragonal. *Point Group:* 4. As acicular to columnar crystals, elongated along [001], to 3 cm, square in section and commonly hollow, in mosslike aggregates.

*Twinning:* Assumed found in crystal structure analysis.

**Physical Properties:** *Cleavage:* Perfect, parallel to elongation. *Tenacity:* Brittle. Hardness = 2.5 D(meas.) = 3.0–3.10 D(calc.) = 3.0–3.22 Soluble in  $H_2O$ , leaving an insoluble residue.

**Optical Properties:** Transparent to translucent. *Color:* Emerald-green, dark green, black. *Streak:* Yellowish green. *Luster:* Vitreous to greasy. *Optical Class:* Uniaxial (+). *Pleochroism:* Distinct; *O* = pale green, yellowish green; *E* = deep green, pale yellowish green. *Orientation:* Positive elongation.  $\omega = 1.583\text{--}1.598$   $\epsilon = 1.695\text{--}1.711$

**Cell Data:** *Space Group:* *I4*.  $a = 13.60\text{--}13.67$   $c = 4.94\text{--}4.98$   $Z = 4$

**X-ray Powder Pattern:** Tolbachik volcano, Russia. 9.63 (100), 3.039 (70), 6.79 (40), 3.006 (30), 4.305 (20), 2.666 (20), 1.924 (20)

<b>Chemistry:</b>	(1)	(2)	(3)		(1)	(2)	(3)
SO <sub>3</sub>	34.2	35.88	38.73	F	0.6		
CuO	34.72	41.45	38.48	Cl	3.01	3.91	
ZnO	0.62			H <sub>2</sub> O <sup>-</sup>	1.7		
PbO	0.27			insol.	0.85		
Cu <sub>2</sub> O	3.67			–O = (F, Cl) <sub>2</sub>	0.93	0.88	
Na <sub>2</sub> O	1.12	2.89		Total	[99.86]	100.63	100.00
K <sub>2</sub> O	20.03	17.38	22.79				

(1) Tolbachik volcano, Russia; Na<sub>2</sub>O, K<sub>2</sub>O by flame photometry, CuO, PbO, ZnO by AA; F by fluorine selective electrode, (SO<sub>4</sub>)<sup>2-</sup> confirmed by IR, original total given as 99.94%; after deduction of CuCl as nantokite, NaCl as halite, F, H<sub>2</sub>O, and insoluble tenorite, corresponds to (K<sub>1.97</sub>Na<sub>0.01</sub>Pb<sub>0.01</sub>)<sub>Σ=1.99</sub>(Cu<sub>2.02</sub>Zn<sub>0.04</sub>)<sub>Σ=2.06</sub>O(SO<sub>4</sub>)<sub>1.98</sub>. (2) Vesuvius, Italy; by electron microprobe, average of four analyses. (3) K<sub>2</sub>Cu<sub>2</sub>O(SO<sub>4</sub>)<sub>2</sub>.

**Occurrence:** A rare fumarolic sublimate, formed above 500 °C.

**Association:** Halite, sylvite, langbeinite, tenorite, hematite, tolbachite, dolerophanite, urusovite, apthitalite, ponomarevite, cotunnite, chalcocyanite, sofiite, euchlorine, averievite, fedotovite, alarsite, alumoklyuchevskite, nabokoite, lammerite (Tolbachik volcano, Russia); paratacamite (Vesuvius, Italy).

**Distribution:** From the Tolbachik fissure volcano, Kamchatka Peninsula, Russia. On Vesuvius, Campania, Italy,

**Name:** Honors Boris Ivanovich Piyp (1906–1966), Russian volcanologist, Director of the Far Eastern Institute of Volcanology, Petropavlovsk-Kamchatskii, Russia.

**Type Material:** Mining Institute, St. Petersburg, Russia, 1331/1.

**References:** (1) Vergasova, L.P., S.K. Filatov, Y.K. Serafimova, and G.L. Starova (1984) Piypite, K<sub>2</sub>Cu<sub>2</sub>O(SO<sub>4</sub>)<sub>2</sub>, a new mineral of volcanic sublimates. Doklady Acad. Nauk SSSR, 275, 714–717 (in Russian). (2) (1985) Amer. Mineral., 70, 437–438 (abs. ref. 1). (3) Clark, A.M., E.E. Fejer, and A.G. Couper (1984) Caratiite, a new sulphate-chloride of copper and potassium, from the lavas of the 1869 Vesuvius eruption. Mineral. Mag., 49, 537–539. (4) Effenberger, H. and J. Zemann (1984) The crystal structure of caratiite. [= piypite] Mineral. Mag., 48, 541–546. (5) Filatov, S.K. and L.P. Vergasova (1989) Discrediting of caratiite and priority for piypite. Zap. Vses. Mineral. Obshch., 118(3), 88–90 (in Russian).

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