

**Crystal Data:** Monoclinic. *Point Group:* 2/m. As crusts of irregularly-shaped grains to 50 μm.

**Physical Properties:** *Cleavage:* {100}, perfect. *Tenacity:* Brittle. *Fracture:* Uneven. Hardness = 2-3 D(meas.) = n.d. D(calc.) = 3.298 Water soluble.

**Optical Properties:** Transparent. *Color:* Emerald-green, pale green in transmitted light.

*Streak:* Greenish. *Luster:* Vitreous.

*Optical Class:* Biaxial (+).  $\alpha = 1.562(2)$   $\beta = 1.591(2)$   $\gamma = 1.634(2)$  2V(meas.) = Moderately large. 2V(calc.) = 80.7° *Pleochroism:* Very weak.

**Cell Data:** *Space Group:* C2/c.  $a = 17.3885(13)$   $b = 9.4009(8)$   $c = 14.4045(11)$   $\beta = 112.039(2)^\circ$  Z = 8

**X-ray Powder Pattern:** Glavnaya Tenoritovaya fumarole, Tolbachik volcano, Kamchatka, Russia. 8.058 (100), 3.839 (33.89), 2.854 (29.15), 6.466 (28.47), 6.675 (18.88), 4.247 (17.37), 2.724 (14.95)

| Chemistry:        | (1)   | (2)    |
|-------------------|-------|--------|
| Na <sub>2</sub> O | 9.98  | 11.46  |
| K <sub>2</sub> O  | 0.63  |        |
| CuO               | 43.21 | 44.13  |
| ZnO               | 0.66  |        |
| SO <sub>3</sub>   | 44.33 | 44.41  |
| Total             | 98.81 | 100.00 |

(1) Glavnaya Tenoritovaya fumarole, Tolbachik volcano, Kamchatka, Russia; average of 10 electron microprobe analyses; corresponds to (Na<sub>1.76</sub>K<sub>0.08</sub>)<sub>Σ=1.84</sub>(Cu<sub>2.97</sub>Zn<sub>0.04</sub>)<sub>Σ=3.01</sub>(SO<sub>4</sub>)<sub>3.02</sub>O<sub>0.92</sub>.

(2) Na<sub>2</sub>Cu<sub>3</sub>O(SO<sub>4</sub>)<sub>3</sub>.

**Occurrence:** As a sublimate around an active fumarole.

**Association:** Lammerite-β, tenorite, hematite, anhydrite.

**Distribution:** From Glavnaya Tenoritovaya fumarole, Second scoria cone, Northern Breakthrough of the Great Fissure Eruption, Tolbachik volcano, Kamchatka, Russia.

**Name:** Honors crystallographer, Professor Yuri Olegovich Punin (1941-2014), St. Petersburg State University, Russia.

**Type Material:** Mineralogical Museum, Department of Mineralogy, St. Petersburg State University, St. Petersburg, Russia (19638).

**References:** (1) Siidra, O.I., E.V. Nazarchuk, A.N. Zaitsev, E.A. Lukina, E.Y. Avdontseva, L.P. Vergasova, N.S. Vlasenko, S.K. Filatov, R. Turner, and G.A. Karpov (2017) Copper oxosulphates from fumaroles of Tolbachik volcano: puninite, Na<sub>2</sub>Cu<sub>3</sub>O(SO<sub>4</sub>)<sub>3</sub> - a new mineral species and structure refinements of kamchatkite and alumoklyuchevskite. *Eur. J. Mineral.*, 29(3), 499-510. (2) (2018) *Amer. Mineral.*, 103, 661-662 (abs. ref. 1).