

**Batagayite****CaZn<sub>2</sub>(Zn,Cu)<sub>6</sub>(PO<sub>4</sub>)<sub>4</sub>(PO<sub>3</sub>OH)<sub>3</sub>·12H<sub>2</sub>O**

**Crystal Data:** Monoclinic. *Point Group:* 2. As blades to 2 mm, flattened on {001} and elongated along [100]; often in radial aggregates.

**Physical Properties:** *Cleavage:* Perfect on {001}. *Tenacity:* Brittle. *Fracture:* n.d. *Hardness* = 3 D(meas.) = 2.90(3) D(calc.) = 3.02

**Optical Properties:** Transparent. *Color:* Colorless. *Streak:* White. *Luster:* Vitreous. *Optical Class:* Biaxial (-).  $\alpha = 1.566(2)$   $\beta = 1.572(2)$   $\gamma = 1.573(2)$   $2V(\text{meas.}) = 40(5)^\circ$   $2V(\text{calc.}) = 44.3^\circ$  *Dispersion:* None. *Orientation:*  $Z \perp (001)$ . *Pleochroism:* None.

**Cell Data:** *Space Group:*  $P2_1$ .  $a = 8.4264(4)$   $b = 12.8309(6)$   $c = 14.6928(9)$   $\beta = 98.514(6)^\circ$   $Z = 2$

**X-ray Powder Pattern:** Këster deposit, Arga-Ynnykh-Khai massif, NE Yakutia, Russia. 14.59 (100), 4.864 (37), 6.34 (25), 3.102 (20), 2.411 (16), 4.766 (13), 6.02 (11)

<b>Chemistry:</b>	(1)	(2)
Na <sub>2</sub> O	0.31	
MgO	1.39	
Al <sub>2</sub> O <sub>3</sub>	0.55	
SiO <sub>2</sub>	0.48	
P <sub>2</sub> O <sub>5</sub>	34.37	34.33
K <sub>2</sub> O	0.17	
CaO	2.76	3.87
MnO	1.03	
CuO	5.80	
ZnO	35.62	44.99
CdO	0.24	
H <sub>2</sub> O	[16.83]	16.81
Total	99.55	100.00

(1) Këster deposit, Arga-Ynnykh-Khai massif, NE Yakutia, Russia; average of 12 electron microprobe analyses supplemented by Raman spectroscopy, H<sub>2</sub>O calculated from structure; corresponds to (Zn<sub>6.22</sub>Cu<sub>1.04</sub>Ca<sub>0.70</sub>Mg<sub>0.49</sub>Mn<sub>0.21</sub>Al<sub>0.15</sub>Na<sub>0.14</sub>K<sub>0.05</sub>Cd<sub>0.03</sub>) $\Sigma=9.03$ (P<sub>6.89</sub>Si<sub>0.11</sub>) $\Sigma=7.00$ O<sub>24.91</sub>(OH)<sub>3.09</sub>·12.10H<sub>2</sub>O. (2) CaZn<sub>2</sub>(Zn)<sub>6</sub>(PO<sub>4</sub>)<sub>4</sub>(PO<sub>3</sub>OH)<sub>3</sub>·12H<sub>2</sub>O.

**Occurrence:** A secondary low-temperature mineral formed by alteration of primary minerals (copper and fluorapatite) in a quartz-phosphate mass ~5 m in diameter within greisenized cassiterite-bearing granodiorite.

**Association:** Copper, arsenolite, tobermorite, epifanovite, libethenite, Na-analogue of batagayite, Mg-analogue of hopeite, pseudomalachite, sampleite, fluorapatite, quartz.

**Distribution:** From the Këster Sn-Ta deposit, Arga-Ynnykh-Khai massif, NE Yakutia, Russia.

**Name:** For *Batagay* (administrative center of the Verhoyansk ulus of the Sakha Republic, Russia), ~50 km from the deposit that produced the first specimens.

**Type Material:** Mineralogical Museum, St. Petersburg University, Russia (19,659/1).

**References:** (1) Yakovenchuk, V.N., Ya.A. Pakhomovsky, N.G. Konopleva, T.L. Panikorovskii, A. Bazai, J.A. Mikhailova, V.N. Bocharov, G.Yu. Ivanyuk, and S.V. Krivovichev (2018) Batagayite, CaZn<sub>2</sub>(Zn,Cu)<sub>6</sub>(PO<sub>4</sub>)<sub>4</sub>(PO<sub>3</sub>OH)<sub>3</sub>·12H<sub>2</sub>O, a new phosphate mineral from Këster tin deposit (Yakutia, Russia): occurrence and crystal structure. *Mineral. Petrol.*, 112(4), 591-601. (2) (2018) *Amer. Mineral.*, 103, 2037-2038 (abs. ref. 1).