

Batagayite**CaZn₂(Zn,Cu)₆(PO₄)₄(PO₃OH)₃·12H₂O**

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)

| Chemistry: | (1) | (2) |
|--------------------------------|---------|--------|
| Na ₂ O | 0.31 | |
| MgO | 1.39 | |
| Al ₂ O ₃ | 0.55 | |
| SiO ₂ | 0.48 | |
| P ₂ O ₅ | 34.37 | 34.33 |
| K ₂ O | 0.17 | |
| CaO | 2.76 | 3.87 |
| MnO | 1.03 | |
| CuO | 5.80 | |
| ZnO | 35.62 | 44.99 |
| CdO | 0.24 | |
| H ₂ 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, H₂O calculated from structure; corresponds to (Zn_{6.22}Cu_{1.04}Ca_{0.70}Mg_{0.49}Mn_{0.21}Al_{0.15}Na_{0.14}K_{0.05}Cd_{0.03}) $\Sigma=9.03$ (P_{6.89}Si_{0.11}) $\Sigma=7.00$ O_{24.91}(OH)_{3.09}·12.10H₂O. (2) CaZn₂(Zn)₆(PO₄)₄(PO₃OH)₃·12H₂O.

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 Verhojansk 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, CaZn₂(Zn,Cu)₆(PO₄)₄(PO₃OH)₃·12H₂O, 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).