

Obradovicite-NaNa

Crystal Data: Orthorhombic. *Point Group:* 2/m 2/m 2/m. Typically, as doubly terminated, bladed crystals, flattened on {001} and elongated parallel to [010], to ~0.15 mm. Forms include {001}, {110} and {101} with the {001} faces striated parallel to [010]. *Twinning:* None observed.

Physical Properties: *Cleavage:* None. *Tenacity:* Brittle. *Fracture:* Splintery. Hardness = ~2 D(meas.) = n.d. D(calc.) = 2.635

Optical Properties: Transparent. *Color:* Yellowish green. *Streak:* Very pale yellowish green. *Luster:* Vitreous to subadamantine.

Optical Class: Biaxial (+). $\alpha = 1.768(3)$ $\beta = 1.776(3)$ $\gamma = 1.787(3)$ $2V(\text{meas.}) = 82(2)^\circ$ $2V(\text{calc.}) = 81.4^\circ$ *Pleochroism:* None. *Orientation:* $X = a$; $Y = b$; $Z = c$. *Dispersion:* Strong, $r > v$.

Cell Data: *Space Group:* Pnmb. $a = 14.8866(11)$ $b = 11.0880(2)$ $c = 15.0560(3)$ $Z = 2$

X-ray Powder Pattern: Chuquicamata mine, Antofagasta, Chile.

8.954 (100), 10.641 (43), 2.906 (29), 7.487 (21), 2.987 (18), 2.602 (16), 3.716 (15)

Chemistry:	(1)
Na ₂ O	4.35
K ₂ O	3.47
CaO	0.07
ZnO	0.04
CuO	0.39
Fe ₂ O ₃	10.93
P ₂ O ₅	0.16
As ₂ O ₅	9.58
MoO ₃	53.06
H ₂ O	[17.95]
Total	100.00

(1) Chuquicamata mine, Antofagasta, Chile; normalized electron microprobe analysis, H₂O calculated; corresponds to $[(\text{Na}_{2.20}\text{K}_{1.60})_{\Sigma=3.80}(\text{H}_2\text{O})_{14.20}(\text{Na}_{0.85}\text{Cu}^{2+}_{0.11}\text{Ca}_{0.03}\text{Zn}_{0.01})_{\Sigma=1.00}(\text{H}_2\text{O})_6][\text{Mo}_8(\text{As}_{1.81}\text{P}_{0.05})_{\Sigma=1.86}\text{Fe}^{3+}_{2.97}\text{O}_{34.16}(\text{OH})_{2.84}]$.

Mineral Group: Betpakdalite supergroup, obradovicite group.

Occurrence: A rare secondary mineral in the oxidized zone of a Cu-Mo porphyry deposit.

Association: Quartz, muscovite, rutile, jarosite, gypsum, blödite, atacamite.

Distribution: From Chuquicamata, Antofagasta, Chile [TL].

Name: Honors Martin T. *Obradovic*, who provided the studied material. Two suffixes correspond to the dominant cations in the two different types of non-framework cation sites.

Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA (63313 and 63314).

References: (1) Finney, J.J., S.A. Williams, and R.D. Hamilton (1986) Obradovicite, a new complex arsenate-molybdate from Chuquicamata, Chile. *Mineral. Mag.*, 50, 283-284. (2) (1987) *Amer. Mineral.*, 72, 1026 (abs. ref. 1). (3) Kampf, A.R., S.J. Mills, M.S. Rumsey, M. Dini, W.D. Birch, J. Spratt, J.J. Pluth, I.M. Steele, R.A. Jenkins, and W.W. Pinch (2012) The heteropolymolybdate family: structural relations, nomenclature scheme and new species. *Mineral. Mag.*, 76, 1175-1207.