Obradovicite-NaNa $[Na_2(H_2O)_{16}Na(H_2O)_6][Mo^{6+}_8As^{5+}_2Fe^{3+}_3O_{33}(OH)_4]$

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(meas.) = 82(2)º
2V(calc.) = 81.4º *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_2O	4.35
K_2O	3.47
CaO	0.07
ZnO	0.04
CuO	0.39
Fe_2O_3	10.93
P_2O_5	0.16
As_2O_5	9.58
MoO_3	53.06
H_2O	[17.95]
Total	100.00

(1) Chuquicamata mine, Antofagasta, Chile; normalized electron microprobe analysis, H_2O calculated; corresponds to $[(Na_{2.20}K_{1.60})_{\Sigma=3.80}(H_2O)_{14.20}(Na_{0.85}Cu^{2+}_{0.11}Ca_{0.03}Zn_{0.01})_{\Sigma=1.00}(H_2O)_6]$ $[Mo_8(As_{1.81}P_{0.05})_{\Sigma=1.86}Fe^{3+}_{2.97}O_{34.16}(OH)_{2.84}]$.

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.