Canutite $NaMn_3[AsO_4][AsO_3(OH)]_2$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As tapering prismatic to bladed crystals, to ~0.2 mm, elongated along $[20\bar{1}]$; in radial aggregates of intergrown, thin to thick, diamond-shaped tablets, flattened on {102}, to 0.5 mm.

Physical Properties: *Cleavage*: Perfect on {010} and {101}. *Fracture*: Splintery. *Tenacity*: Brittle. Hardness = ~ 2.5 D(meas.) = n.d. D(calc.) = 4.112 Slowly soluble in dilute HCl.

Optical Properties: Transparent. *Color*: Reddish brown; light reddish brown in transmitted light. *Streak*: Pale tan. *Luster*: Vitreous.
Optical Class: Biaxial (+). $\alpha = 1.712(3)$ $\beta = 1.725(3)$ $\gamma = 1.756(3)$ 2V(meas.) = 65.6(4)°
Orientation: $Z = b$; $X \wedge a = 18°$ in obtuse β. *Dispersion*: Slight, $r < v$. *Pleochroism*: Imperceptible.

Cell Data: *Space Group*: *C*2/*c*. $a = 12.3282(4)$ $b = 12.6039(5)$ $c = 6.8814(5)$ $\beta = 113.480(8)°$ $Z = 4$

X-ray Powder Pattern: Torrecillas mine, Salar Grande, Iquique Province, Chile.
2.740 (100), 3.296 (57), 2.819 (42), 6.33 (34), 1.5364 (31), 3.608 (29), 3.150 (28)

Chemistry:	(1)	(2)	(3)
Na_2O	3.82	5.54	5.11
CaO	0.52	0.04	
MgO	2.91	2.31	
MnO	27.88	31.80	35.08
CoO	2.52	0.43	
CuO	1.40	1.88	
As_2O_5	60.27	58.45	56.84
H_2O	[3.59]	[2.48]	2.97
Total	102.91	102.93	100.00

(1) Torrecillas mine, Salar Grande, Iquique Province, Chile; average of 5 electron microprobe analyses, H_2O calculated for charge balance; corresponding to $Na_{0.71}Ca_{0.05}Mn_{2.25}Mg_{0.41}Co_{0.19}Cu_{0.10})_{\Sigma=3.71}As_3O_{12}H_{2.28}$. (2) Torrecillas mine, Salar Grande, Iquique Province, Chile; average of 25 electron microprobe analyses, H_2O calculated for charge balance; corresponding to $(Na_{1.05}Mn_{2.64}Mg_{0.34}Co_{0.03}Cu_{0.14})_{\Sigma=4.20}As_3O_{12}H_{1.62}$. (3) $NaMn_3[AsO_4][AsO_3(OH)]_2$.

Occurrence: A secondary mineral from the oxidation of native arsenic and other As-bearing primary phases, followed by later alteration by saline fluids derived from evaporating meteoric water under hyperarid conditions.

Association: Anhydrite, halite, lavendulan, magnesiokoritnigite, pyrite, quartz, scorodite.

Distribution: From three separate sites at the Torrecillas mine, Salar Grande, Iquique Province, Chile.

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Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA (64065, 64098).

References: (1) Kampf, A.R., S.J. Mills, F. Hatert, B.P. Nash, M. Dini, and A.A. Molina Donoso (2014) Canutite, $NaMn_3[AsO_4][AsO_3(OH)]_2$, a new protonated alluaudite-group mineral from the Torrecillas mine, Iquique Province, Chile. Mineral. Mag., 78(4), 787-795. (2) (2016) Amer. Mineral., 101, 1242 (abs. ref. 1).