Motukoreaite $Na_2Mg_{38}Al_{24}(SO_4)_8(CO_3)_{13}(OH)_{108}\cdot 56H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}\,2/m$. As tabular hexagonal crystals, showing rounded {0001} and possible {$11\overline{2}0$}, {$10\overline{1}1$}, {$10\overline{1}4$}, to 0.2 mm, forming rosettes, boxworks, and subparallel aggregates, and as a claylike cement.

Physical Properties: *Cleavage:* Good on {0001}, perhaps a parting. *Tenacity:* Sectile, flexible. Hardness = 1–1.5 D(meas.) = 1.43–1.53 D(calc.) = 1.478 Partial dehydration readily occurs.

Optical Properties: Semitransparent. *Color:* Colorless, white, pale yellow, pale yellow-green. *Luster:* Dull.
Optical Class: Uniaxial (+), nearly isotropic. n = ∼1.51, birefringence ∼0.012. ω = n.d. ϵ = n.d.

Cell Data: *Space Group:* $R\overline{3}m$. $a = 9.172(2)$ $c = 33.51(1)$ Z = 3

X-ray Powder Pattern: Brown's Island, New Zealand; may exhibit preferred orientation. 11.32 (vvs), 5.58 (s), 4.59 (s), 3.72 (s), 2.578 (s), 2.386 (s), 2.158 (s)

Chemistry:

	(1)	(2)		(1)	(2)
SO_3	10.00	10.65	CaO	0.92	
SiO_2	5.55		Na_2O	0.71	1.03
CO_2	9.32	9.52	K_2O	0.10	
Al_2O_3	17.87	20.35	H_2O^+	19.62	
Fe_2O_3	0.73		H_2O^-	10.35	
MnO	0.70		H_2O		32.97
ZnO	0.56		Total	99.41	100.00
MgO	22.98	25.48			

(1) Brown's Island, New Zealand; contains estimated quartz 5%, traces of calcite and goethite; after removal of probable impurities, and with $(OH)^{1-}$ calculated for charge balance, corresponds to $(Na_{1.50}K_{0.14})_{\Sigma=1.64}Mg_{37.36}Al_{22.97}(SO_4)_{8.18}(CO_3)_{13.81}(OH)_{101.29}\cdot 58.36H_2O$. (2) $Na_2Mg_{38}Al_{24}(SO_4)_8(CO_3)_{13}(OH)_{108}\cdot 56H_2O$.

Occurrence: Relatively common in assemblages formed by reaction of basalt volcanoclastics with sea-water; in cavities in a haüyne-nephelinite.

Association: Olivine, pyroxene, calcic feldspar, magnetite, calcite, gypsum, barite, hisingerite, zeolites, "limonite", quartz (Brown's Island, New Zealand); hydrotalcite, nordstrandite, montmorillonite, phillipsite, gismondine, chabazite, calcite, apatite (Stradner Hill, Austria).

Distribution: From Brown's Island (Motukorea), Waitemata Harbour, Auckland, New Zealand. On the Island of Surtsey, and the Great Meteor and Josephine seamounts, North Atlantic, and along the mid-Atlantic Ridge. Northwest of the Emile Baudot Bank, western Mediterranean. Along the Axial Rift, Red Sea. On Stradner Kogel, south of Gleichenberg, Austria.

Name: From Motukorea, *island of cormorants*, the Maori name for Brown's Island, New Zealand.

Type Material: University of Auckland, Auckland, New Zealand; The Natural History Museum, London, England, 1977,422; National Museum of Natural History, Washington, D.C., USA, 142971.

References: (1) Rodgers, K.A., J.E. Chisholm, R.J. Davis, and C.S. Nelson (1977) Motukoreaite, a new hydrated carbonate, sulphate, and hydroxide of Mg and Al from Auckland, New Zealand. Mineral. Mag., 41, 389–390. (2) (1978) Amer. Mineral., 63, 598 (abs. ref. 1). (3) Rius, J. and F. Plana (1986) Contribution to the superstructure resolution of the double layer mineral motukoreaite. Neues Jahrb. Mineral., Monatsh., 263–272. (4) Zamarreño, I., F. Plana, A. Vazquez, and D.A. Clague (1989) Motukoreaite: a common alteration product in submarine basalts. Amer. Mineral., 74, 1054–1058. (5) Bryner, V., K.A. Rodgers, S.F. Courtney, and W. Postl (1991) Motukoreaite from Brown's Island, New Zealand, and Stradner Kogel, Austria: a scanning electron microscope study. Neues Jahrb. Mineral., Abh., 163, 291–304.