

SYNOPSIS

MINERALOGICAL MAGAZINE, SEPTEMBER 1977, VOL. 41, PP. 389-90

Motukoreaite, a new hydrated carbonate, sulphate, and hydroxide of Mg and Al from Auckland, New Zealand

K. A. RODGERS

Department of Geology, University of Auckland, Auckland, New Zealand

J. E. CHISHOLM, R. J. DAVIS

Department of Mineralogy, British Museum (Natural History), London, England

C. S. NELSON

Department of Earth Sciences, University of Waikato, Hamilton, New Zealand

MOTUKOREAITE occurs as relatively abundant, white, clay-like cement in both beach-rock and basaltic volcanic tuffs on the flanks of a small, extinct, late Pleistocene, basaltic cone at Brown's Island (Motukorea), within Waitemata Harbour, Auckland, New Zealand ($36^{\circ} 50' S.$, $174^{\circ} 35' E.$). The occurrence was originally recorded by Bartrum (1941) as 'beach limestone' found at two places of the island's shore. The beach-rock consists of a grain-supported fabric

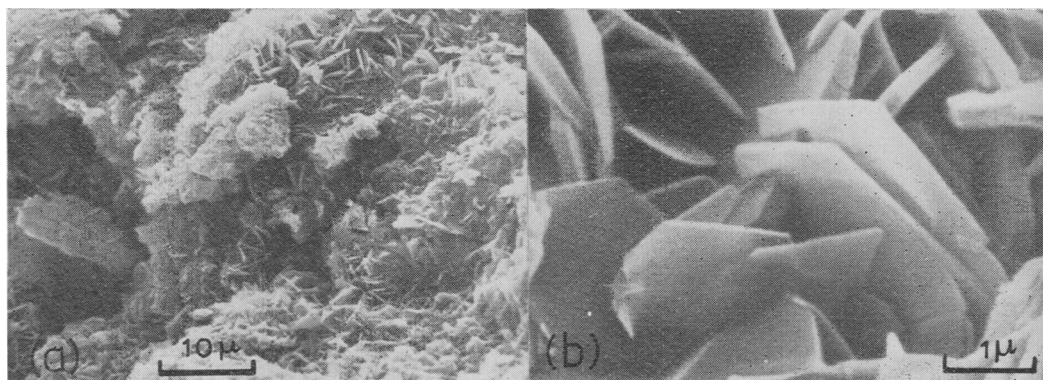


FIG. 1. Electron micrograph showing box-work of plate-like hexagonal crystals of motukoreaite forming cement in beach-rock.

of poorly sorted, well-rounded, alkali-olivine basalt pebbles and granules, subangular to sub-rounded fresh olivine sand and abraded sand- and gravel-sized bioclasts in a colourless to pale yellow-green aphanocrystalline matrix of motukoreaite. Additional detritals include quartz, feldspar, and sedimentary rock fragments. Stereoscan examination of the surface of pieces of the cement prised from the beach-rock showed a box-work of plate-like crystals with a hexagonal form in which individuals measured about $3 \times 3 \times 0.02$ microns (fig. 1).

Wet-chemical analysis of a separate of the cement containing some 5 % quartz and traces of calcite and goethite gives SiO_2 5.55, Al_2O_3 17.87, Fe_2O_3 0.73, CaO 0.92, MgO 22.98, MnO 0.70, ZnO 0.56, Na_2O 0.71, K_2O 0.10, CO_2 9.32, SO_3 10.00, H_2O+ 19.62, H_2O- 10.35,

sum 99.41 %. The unit-cell formula using obtained unit-cell constants and measured specific gravity (1.43) is $(\text{Na}_{0.73}\text{K}_{0.07})_{\Sigma 0.80}(\text{Mg}_{18.13}\text{Mn}_{0.32}\text{Zn}_{0.21})_{\Sigma 18.66}\text{Al}_{11.15}(\text{CO}_3)_{6.22}(\text{SO}_4)_{3.97}(\text{OH})_{51.19}27.20\text{H}_2\text{O}$. Of several idealized formulae that may be proposed $\text{NaMg}_{18}\text{Al}_{12}(\text{CO}_3)_{6.5}(\text{SO}_4)_4(\text{OH})_{54}.28\text{H}_2\text{O}$ is preferred.

An X-ray single crystal study could not be carried out owing to the fine grain size of the material. The X-ray powder diffraction lines are indexed on a hexagonal cell with a 9.336 Å, c 44.72 Å, $Z = 1$. The strongest lines are 11.32 (vvs) 004, 5.58 (s) 008, 4.59 (s) 108, 3.72 (s) 0.0.12, 2.578 (s) 305, 2.386 (s) 1.1.16, 1.0.18, 2.158 (s) 1.0.20, 1.921 (s) 3.1.12. Electron diffraction patterns show only reflections corresponding to $a = 5.2$ Å or $a = 3.0$ Å hexagonal sub-cells in the basal plane. Under the electron beam the 5.2 Å lattice reflections disappear within 1–2 minutes, leaving the 3.0 Å hexagonal cell pattern, which is gradually replaced by three powder rings corresponding to MgO over a period of 10 minutes. The crystal structure is probably based on brucite-type layers and interlayers similar to those of the pyroaurite-sjögrenite group, but with one brucite-type layer and a sulphate-carbonate-water double interlayer in the repeat unit.

Optical properties are determined with difficulty due to the mineral's fine grain size. The approximate refractive index is about 1.51. Nearly isotropic. It is white to pale yellowish green in colour, lustre dull with a clay-like appearance. Hardness (Mohs) 1–1½. Specific gravity 1.48–1.53 (meas. on somewhat impure material by Berman balance), 1.478 (calc. on the ideal formula). The value 1.43 used for the unit cell formula calculation was obtained from 1.48 after the correction for 5.55 % quartz, 0.80 % goethite, and 1.64 % calcite, all taken as having a specific gravity of 2.65.

Thermogravimetric analysis showed a large and continuous weight loss from 75 to 1100 °C with a total weight loss over this range of 40 %. Increases in the gradient of the TGA curve correspond, in the main, to a series of broad endotherms in the corresponding differential thermal analytical pattern. Minima for these endotherms occur at 115, 260, 410, 565, and 1050 °C.

The species and name have been approved by the I.M.A. Commission on New Minerals and Mineral Names. The name is from the Maori name of the type locality—Motukorea—meaning 'island of cormorants' and is pronounced MŌ.TŪ.KŌ.RĒ.Ā. Type material is deposited at Department of Mineralogy, British Museum (Natural History) and Department of Geology, University of Auckland, New Zealand.

Fuller details of the physical and chemical characters of the mineral will be published in the Miniprint section of this journal (p. M18).

Acknowledgements. We are grateful to Mr. A. J. Easton of the British Museum (Natural History) for chemical analyses and to Drs. M. H. Hey and A. Kato for advice and counsel. K. A. R. would particularly like to thank the Nuffield Foundation whose Fellowship funding led him to the BM (NH).

REFERENCE

Bartrum (J. A.), 1941. *N.Z. Journal of Science and Technology*, **23B**, 92–6.

[Manuscript received 7 April 1975; revised 7 December 1976]

© Copyright the Mineralogical Society.