Ramazzoite $[Mg_8Cu_{12}(PO_4)(CO_3)_4(OH)_{24}(H_2O)_{20}][(H_{0.33}SO_4)_3(H_2O)_{36}]$

Crystal Data: Cubic. *Point Group*: $\bar{4}$ 3*m*. As cubes to 0.15 mm on edge. *Twinning*: Merohedral indicated by the structure refinement.

Physical Properties: *Cleavage*: Perfect on {100}. *Fracture*: Conchoidal. *Tenacity*: Very brittle. Hardness = 2.5 D(meas.) = 1.98 D(calc.) = 1.962 Soluble with mild effervescence in dilute HCl.

Optical Properties: Transparent. *Color*: Blue to greenish blue. *Streak*: Pale blue.
Luster: Vitreous to oily.
Optical Class: Isotropic. n = 1.491(1)

Cell Data: Space Group: $P\bar{4}$ 3*m*. a = 13.3887(10) Z = 1

X-ray Powder Pattern: Monte Ramazzo mine, near Genova, Liguria, Italy.
13.37 (100), 9.43 (24), 4.043 (11), 3.252 (9), 2.857 (9), 4.224 (8), 2.730 (5)

Chemistry:

	(1)	(2)	(3)
MgO	22.61	16.73	10.75
CuO	30.30	22.43	31.84
P_2O_5	3.38	2.50	2.37
SO_3	11.51	8.52	8.01
CO_2		[6.21]	5.87
H_2O		[43.60]	41.16
Total		99.99	100.00

(1) Monte Ramazzo mine, Liguria, Italy; average of 5 electron microprobe analyses supplemented by Raman spectroscopy, H_2O calculated based on 36 H_2O in the interstitial unit to approximate the measured density, CO_2 calculated from structure; corresponds to $[(Mg_{8.00})(Cu_{8.00}Mg_{3.78})(PO_4)(CO_3)_4(OH)_{24}(H_2O)_{20}][(H_{0.65}S_{1.01}O_4)_3(H_2O)_{36}]$. (2) Do.; normalized.
(3) $[Mg_8Cu_{12}(PO_4)(CO_3)_4(OH)_{24}(H_2O)_{20}][(H_{0.33}SO_4)_3(H_2O)_{36}]$.

Occurrence: A late-stage, secondary mineral hosted in serpentinite in contact with basalt dikes and pillow lavas. Likely crystallized from a low-temperature, aqueous solution.

Association: Magnetite, chlorartinite, chrysotile, dypingite, goethite, lepidocrocite, nesquehonite, an unidentified Mg sulfate-carbonate.

Distribution: From the Monte Ramazzo mine, near Genova, Liguria, Italy.

Name: For the locality, the Monte Ramazzo mine.

Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA. (66691 and 66692).

References: (1) Kampf, A.R., G.R. Rossman, C. Ma, D. Belmonte, C. Biagioni, F. Castellaro, and L. Chiappino (2018) Ramazzoite, $[Mg_8Cu_{12}(PO_4)(CO_3)_4(OH)_{24}(H_2O)_{20}][(H_{0.33}SO_4)_3(H_2O)_{36}]$, the first mineral with a polyoxometalate cation. Eur. J. Mineral., 30(4), 827-834. (2) (2019) Amer. Mineral., 104(12), 1869 (abs. ref. 1).