Fluorcarmoite-(BaNa) $Ba\square Na_2Na_2\square CaMg_{13}Al(PO_4)_{11}(PO_3OH)F_2$

Crystal Data: Monoclinic. *Point Group*: *m.* As equant platy prismatic crystals to 15 mm.

Physical Properties: *Cleavage:* None. *Tenacity*: Brittle. *Fracture*: n.d. Hardness = ~7.5 VHN = 1236 D(meas.) = 3.40 D(calc.) = 3.394

Optical Properties: Translucent. *Color*: Yellow-orange. *Streak*: Yellow-orange. *Luster*: Vitreous. *Optical Class*: Biaxial (+). α = 1.6240(5) β = 1.6255(5) γ = 1.6384(5) 2V(meas.) = 35(2)° 2V(calc.) = 37.9° *Pleochroism*: Weak, pale yellow to colorless.

Cell Data: *Space Group*: *Cc*. a = 16.4013(3) b = 9.9487(1) c = 24.4536(8) β = 105.725(2)° Z = 4

X-ray Powder Pattern: Maremola Creek, near Isallo, Magliolo municipality, Savona, Liguria, Italy. 3.012 (100), 2.682 (39), 2.735 (32), 3.188 (28), 2.818 (28), 2.526 (25), 4.959 (25)

Chemistry:

	(1)	(2)
Na_2O	5.83	6.92
K_2O	0.36	
CaO	2.64	3.13
SrO	0.46	
BaO	7.12	8.56
MnO	2.01	
FeO	17.68	
MgO	15.12	29.26
Al_2O_3	2.57	2.85
P_2O_5	44.96	47.55
F	2.14	2.12
$- O = F_2$	0.90	0.89
H_2O	[0.33]	0.50
total	100.32	100.00

(1) Maremola Creek, near Isallo, Magliolo municipality, Savona, Liguria, Italy; average of 15 electron microprobe analyses supplemented by Raman spectroscopy, H_2O calculated from stoichiometry, P_2O_5 reduced to 95% to obtain 12 P apfu; corresponds to $(Na_{3.77}Ca_{0.94}Ba_{0.93}K_{0.15}Sr_{0.09}\square_{0.12})_{\Sigma=6.00}(Mg_{7.52}Fe^{2+}_{4.93}Mn^{2+}_{0.57})_{\Sigma=13.02}Al_{1.01}(PO_4)_{11}(PO_3)(OH_{0.74}F_{0.26})F_2$. (2) $BaNa_2Na_2CaMg_{13}Al(PO_4)_{11}(PO_3OH)F_2$.

Mineral Group: Arrojadite group.

Occurrence: In a river pebble derived from phosphate-bearing quartzites.

Association: Quartz, almandine, fluorapatite.

Distribution: In a pebble from the riverbed of the upper Maremola Creek, near Isallo, Magliolo municipality, Savona, Liguria, Italy.

Name: For Monte *Carmo* di Loano, the highest peak in the area where the mineral was found. A member of the arrojadite group with Mg^{2+} dominant at the *M* sites and suffixes for dominant Ba at the *A*1 and Na at the *B*1 sites. The prefix "*fluor*" indicates dominant F in the *W* site.

Type Material: Regional Science Museum, Torino, Italy (M/15940).

References: (1) Cámara, F., E. Bittarello, M.E. Ciriotti, F. Nestola, F. Radica, F. Massimi, and R. Bracco (2019) Fluorcarmoite-(BaNa), the first Mg-dominant mineral of the arrojadite group. Eur. J. Mineral., 31(4), 823-836. (2) (2021) Amer. Mineral., 106, 160 (abs. ref. 1). (3) Chopin, C., R. Oberti, and F. Cámara (2006) The arrojadite enigma: II. Compositional space, new members, and nomenclature of the group. Amer. Mineral., 91, 1260-1270.