

Fluoro-edenite from Biancavilla (Catania, Sicily, Italy): Crystal chemistry of a new amphibole end-member

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ABSTRACT

Fluoro-edenite, ideally $\text{NaCa}_2\text{Mg}_3(\text{Si}_7\text{Al})\text{O}_{22}\text{F}_2$, was found both as prismatic or acicular crystals of millimetric size and as fibers in the rock cavities in gray-red altered benmoreitic lavas occurring at Biancavilla (Etnean Volcanic Complex, Catania, Italy). It is associated with feldspars, quartz, clino- and orthopyroxene, fluoro-apatite, ilmenite, and hematite, and probably crystallized from late-stage hydrothermal fluids. Fluoro-edenite is transparent, intense yellow, non-fluorescent, has vitreous to resinous luster, and gives a yellow streak parallel to the *c* axis; Mohs' hardness 5–6, $D_{\text{calc}} = 3.09 \text{ g/cm}^3$, perfect cleavage on {110}, and conchoidal fracture. In plane-polarized light, fluoro-edenite is birefringent (1st order), biaxial negative, $\alpha = 1.6058(5)$, $\beta = 1.6170(5)$, $\gamma = 1.6245(5)$, $2V_{\text{calc}} = 78.09^\circ$, $Y \equiv \beta \perp (010)$, and $\gamma:Z = 26^\circ$. No pleochroism is observed. Fluoro-edenite is monoclinic, space group *C2/m*, $a = 9.847(2) \text{ \AA}$, $b = 18.017(3) \text{ \AA}$, $c = 5.268(2) \text{ \AA}$, $\beta = 104.84(2)^\circ$, $V = 903.45 \text{ \AA}^3$, $Z = 2$; the ten strongest X-ray diffraction lines in the powder pattern are [$d(l, hkl)$]: 3.125(10, 310), 8.403(6, 110), 3.271(5, 240), 2.807(4, 330), 2.703(3, 151), 1.894(2, $\bar{5}10$), 2.938(2, 221), 1.649(2, 461), 3.376(2, 131), 1.438(2, $\bar{6}61$). IR analysis showed absorption bands at 1066, 991, 791, 738, 667, 517, 475 cm^{-1} , and no bands in the OH-stretching region. Structure refinement allowed determination of cation site-preference and ordering. Microprobe analysis of the refined crystal gave SiO_2 52.92, TiO_2 0.29, Al_2O_3 3.53, FeO 2.50, MnO 0.46, MgO 22.65, CaO 10.83, Na_2O 3.20, K_2O 0.84, F 4.35, Cl 0.07 wt%, and the crystal-chemical formula obtained by combining all the available data is: $^{\text{A}}(\text{Na}_{0.56} \text{K}_{0.15})^{\text{B}}(\text{Na}_{0.30} \text{Ca}_{1.62} \text{Mg}_{0.03} \text{Mn}_{0.05})^{\text{C}}(\text{Mg}_{4.68} \text{Fe}_{0.19}^{\text{2+}} \text{Fe}_{0.10}^{\text{3+}} \text{Ti}_{0.03}^{\text{4+}})^{\text{T}}(\text{Si}_{7.42} \text{Al}_{0.58}) \text{O}_{22}^{\text{O}^{3-}}(\text{F}_{1.98} \text{Cl}_{0.02})_2$.