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Fluorophlogopite from Biancavilla (Mt. Etna, Sicily, Italy): Crystal structure and crystal chemistry of a new F-dominant analog of phlogopite

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Abstract

Fluorophlogopite, a new F-dominant mineral of the mica group, was found at Monte Calvario, Biancavilla, lower southwestern flanks of Mt. Etna volcano (Catania, Sicily, Italy). The mineral occurs in autoclasts of gray-red altered benmoreitic lavas, primarily associated with fluoro-edenite, alkali-feldspars, clino- and ortho-pyroxenes, fluorapatite, hematite, and pseudobrookite. It was formed by metasomatism of the original lava rocks from very hot fluid enriched in F, Cl, and other incompatible elements. Fluorophlogopite occurs as very thin laminae with a diameter of 200 to 400 μm. Main physical properties are pale yellow in color; yellowish-white in thin section; vitreous to resinous luster; transparent; non-fluorescent; Mohs' hardness 2–3; brittle and malleable; perfect cleavage on {001}; biaxial (–), α_{calc} = 1.5430(8), β = 1.5682(5), γ = 1.5688(5) (λ = 589 nm); $2V_{meas}$ = 17(2)°; α = acute bisectrix ⊥ (001); nonpleochroic; D_{calc} = 2.830 g/cm^3 (using empirical formula and single-crystal unit-cell parameters), D_{calc} = 2.842 g/cm^3 (using empirical formula and powder cell constants). Infrared spectrum did not show a significant absorption band in the OH-stretching region (3800–3600 cm^{-1}) confirming that the F content of the fluorophlogopite from Biancavilla is close to the stoichiometric value.

Unit-cell parameters from X-ray powder-diffraction data (114.6 mm diameter Gandolfi camera, Cu$K\alpha$) are a = 5.305(2), b = 9.189(3), c = 10.137(4) Å, β = 100.02(3)°. These data agree with those obtained by single-crystal X-ray studies on a very thin (~15 μm) fluorophlogopite crystal, i.e., Monoclinic (1M polytype); Space Group $C2/m$; a = 5.3094(4), b = 9.1933(7), c = 10.1437(8) Å, β = 100.062(5)°, V = 487.51(6) Å^3, Z = 2. Structure refinements using anisotropic displacement parameters converged at R = 3.50, R_w = 4.37, R_{sym} = 3.72%. Electron microprobe analysis performed on the same crystal used for X-ray investigation gave: SiO_2 = 45.75(39), TiO_2 = 1.05(5), Al_2O_3 = 9.60(19), MgO = 27.92(30), MnO = 0.16(3), FeO_{tot} = 1.25(6), BaO = 0.09(5), K_2O = 8.22(11), Na_2O = 0.61(30), Cl = 0.02(1) wt%. Secondary Ion Mass Spectrometry (SIMS) was used to estimate light elements [Li_2O = 0.30(1) and H_2O = 0.16(2) wt%] and fluorine content [F = 8.69(24) wt%]. The new mineral fluorophlogopite and its name were approved by IMA-CNMMN (2006/011).

Keywords: Fluorophlogopite, new mineral, crystal chemistry, IR spectroscopy, SIMS