

**FLUORVESUVIANITE, $\text{Ca}_{19}(\text{Al}, \text{Mg}, \text{Fe}^{2+})_{13}[\text{SiO}_4]_{10}[\text{Si}_2\text{O}_7]_4\text{O}(\text{F}, \text{OH})_9$,
A NEW MINERAL SPECIES FROM PITKÄRANTA, KARELIA,
RUSSIA: DESCRIPTION AND CRYSTAL STRUCTURE**

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ABSTRACT

Fluorvesuvianite was found in the abandoned Lupikko iron mine, Pitkäranta, Karelia, Russia. It occurs in cavities of chloritized diopside skarn, as radiating aggregates of acicular crystals in calcite. Crystals (up to 1.5 cm long and 5–20 μm across) are elongate along [001]; the dominant forms are {100} or {110}. Associated minerals are sphalerite and clinocllore. Single crystals of fluorvesuvianite are colorless and transparent, aggregates are white with silky luster, and the mineral is non-fluorescent. The Mohs hardness is 6. The mineral is brittle, and no cleavage or parting was observed. D_{meas} is 3.46(3) g/cm³, and D_{calc} is 3.43 g/cm³. In immersion liquids, the mineral is colorless and non-pleochroic. Fluorvesuvianite is uniaxial (–), ω 1.702(1), ϵ 1.699(1) for $\lambda = 589$ nm. Chemical composition (electron microprobe, H₂O by TGA, F by ion-selective electrode, wt.%): CaO 36.1, MgO 1.9, MnO 0.1, FeO 2.8, Al₂O₃ 17.9, SiO₂ 36.6, H₂O 0.5, F 4.6, –O=2F 1.94, Total 98.56. The empirical formula based on 50 cations per formula unit is $\text{Ca}_{19.03}(\text{Al}_{10.38}\text{Mg}_{1.39}\text{Fe}^{2+}_{1.15}\text{Mn}^{2+}_{0.04})_{12.96}\text{Si}_{18.01}\text{O}_{68.00}(\text{F}_{7.16}\text{OH}_{1.64}\text{O}_{0.80})_{29.60}$, which corresponds to the ideal formula $\text{Ca}_{19}(\text{Al}, \text{Mg}, \text{Fe}^{2+})_{13}[\text{SiO}_4]_{10}[\text{Si}_2\text{O}_7]_4\text{O}(\text{F}, \text{OH})_9$. The bands in the IR spectrum are: 3625, 3555, 3400, 3170, 1650, 1575, 1080 shoulder, 1021, 983, 905, 870 shoulder, 800, 710 shoulder, 636, 605, 577, 490, 444, 411, 395 cm^{–1}. The strongest eight lines in the X-ray powder-diffraction pattern [d in Å(hkl)] are: 4.74(20)(202), 3.465(30)(420), 3.040(30)(510), 2.945(35)(004), 2.743(90)(432,440), 2.589(50)(224,522), 2.453(100)(620), and 1.619(30)(526,922). Fluorvesuvianite is tetragonal, space group $P4/nmc$, unit-cell parameters refined from the powder data: a 15.516(2), c 11.772(3) Å, V 2834(1) Å³, $Z = 2$. The crystal structure has been refined to $R_1 = 0.043$, calculated for 1108 unique observed reflections ($|F_o| \geq 4\sigma(F_o)$). The structure refinement demonstrates that most of the fluorine is at the F(11) position [the refined site-occupancy is $\text{F}_{0.72}(\text{OH})_{0.28}$]. The elongate <Si(1)–O> bond length (1.664 Å) and the Si(1) site-occupancy factor, 0.803(8), suggest substitution according to the

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