

Crystal-chemical and structural characterization of fluorapatites in ejecta from Somma-Vesuvius volcanic complex

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ABSTRACT

The mineralogy and crystal chemistry of apatites occurring in 14 ejecta of historical eruptions (1631 and 1872 A.D.) of the Somma-Vesuvius volcanic complex were investigated by a multi-methodological approach including polarized optical microscopy, scanning electron microscope, electron microprobe analysis in wavelength-dispersive mode, laser ablation inductively coupled plasma mass spectroscopy, and single-crystal X-ray diffraction. Five different groups of apatite, with different mineralogical and crystal-chemical features, were identified. Apatite crystals occur with well-developed hexagonal prismatic habit and, more rarely, with skeletal acicular forms. The crystals are yellow (type 1), transparent and colorless (type 2 and type 3), green (type 4) and aquamarine colored (type 5), with different paragenesis: macro-crystalline aggregates of clinopyroxenes, phlogopite, and apatite (type 1; type 4); clusters of apatite with micro-crystalline clinopyroxene, minerals of the cancrinite group, feldspars, and opaque minerals (type 2); aggregates of apatite, sellaite, wagnerite, gypsum, and phlogopite (type 3); aggregates of davynite, nepheline, mica group minerals, and apatite (type 5). Chemical analyses of apatites show variable amounts of Na, REE, Mg, Sr, and Fe replacing Ca, not negligible amounts of Si and S substituting P, and a significant substitution of Cl and OH instead of F. Five crystals representative of each apatite-type were studied by single-crystal X-ray diffraction. Their crystal structure was refined in the hexagonal $P6_3/m$ space group. A significant variation of the unit-cell parameters with the composition was observed. A comparative crystal-chemical analysis between apatites from Somma-Vesuvius and those from other localities is carried out.

Keywords: Apatite, Somma-Vesuvius volcanic complex, electron microprobe analysis, laser ablation inductively coupled plasma mass spectroscopy, single-crystal X-ray diffraction