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The sulfate-bearing associations of fumarolic environments of Somma-Vesuvius volcano (Italy): A review from historical samples (Royal Mineralogical Museum of Naples)

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Abstract

The sulfate-bearing sublimate samples from Somma-Vesuvius, collected in the Royal Mineralogical Museum of Naples University Federico II (Italy), record historical exhalative events of this volcano, whose products are no longer available in outcrops. The complex associations have been thoroughly investigated using various analytical methods, including SEM-EDS, PXRD, SC-XRD, FTIR, and Raman spectroscopy. Sulfates (Cu-, alkali-Cu-, and Pb-bearing sulfates) are the most widespread group, closely followed by halides and then oxides, phosphates, and arsenates, often occurring as rare mineral associations. Among sulfates, kaliochalcite, $KCu_2(SO_4)_2[(OH)(H_2O)]$, is the most abundant phase, followed by chalcanthite $Cu(SO_4)\cdot 5H_2O$. In some cases, both chalcocyanite, $CuSO_4$, and chalcanthite are found in the same sample, indicating incomplete alteration of the anhydrous phase. Cyanochroite, $K_2Cu(SO_4)_2\cdot 6H_2O$, is also common, in association with other alkali-Cu sulfates, Pb sulfates, and atacamite, $Cu_2(OH)_3Cl$, in sky-blue encrustations. Steklite, $KAl(SO_4)_2$, fedotovite, $K_2Cu_3(SO_4)_3O$, and eleomelanite, $(K_2Pb)Cu_4O_2(SO_4)_4$, are recorded for the first time at the Vesuvius volcano, while eleomelanite represents the second reported worldwide occurrence besides the type locality. Unusual phases containing As, Cd, and/or Tl (i.e., Tl-bearing leucite), as well as N, have also been identified. The presence of both HT and LT sublimates and alteration minerals indicates a progressive cooling of fumaroles, or the variation of genetic conditions at small scales. The presented FTIR and Raman data can be especially relevant in consideration of the potential occurrence of sulfates in planetary bodies.

Keywords: Sulfates, fumaroles, Vesuvius, crystal chemistry, FTIR spectroscopy, Raman spectroscopy