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Tracking volatile evolution at La Fossa volcano (Vulcano Island, Aeolian Arc, Italy) through apatite chemistry

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Volatile elements are important constituents of silicate melts, being able to influence magma differentiation, ascent and eruption. Silicate melt inclusions (MIs) have usually been used to investigate volatile behaviour during magmatic evolution, although suitable MIs are not always present and, importantly, can be subject to post-entrapment re-equilibration processes. Apatite is an excellent petrologic tool to study the evolution of magmatic volatiles, being able to accommodate in its structure major magmatic volatiles (e.g., H_2O, S and Cl), trace elements and rare earth elements (REEs). This has led to the use of apatite F-Cl-OH composition to obtain the H_2O content of silicate melt and to track magma degassing process [1,2]. Apatite trace element content, in particular anomalous concentrations of As, Cd, Bi and Se, are also useful tracers for volatile flux from mafic to felsic reservoir [3].

In this work, we studied apatite in the products of Vulcano, a well-studied volcanic island in the Aeolian Arc (Italy), with the aim to analyse the volatile behaviour during magmatic evolution and to contribute to the investigation of its polybaric plumbing system. We present volatile and trace elements content of erupted products covering a compositional range from shoshonitic to rhyolitic melts by using apatite composition. We calculated the water content of silicate melts in equilibrium with apatite through apatite halogen composition. The results highlight how volatile chemistry is a valuable tool to constrain the pre-eruptive volatile contents of magmas.

Our data also revealed that H_2O saturation and pre-eruptive exsolution processes of a hypersaline aqueous fluid phase occurred at rhyolitic stage of magma differentiation at Vulcano. Whereas, regarding the trace element composition, high As, Bi and Cd contents in apatite suggest that magmatic reservoirs feeding the mafic intermediate composition were characterized by a deep volatile fluxing, released by the deep shoshonitic basalt feeding system.

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[2] Li, Li, Evans, Zhao, Qin, Xie (2021b), Mineral. Deposita 56, 407-415.

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