Influence of tectonics on magma residence times at Mt. Etna volcano

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Trace element zoning in plagioclase from the historic (pre-1971 AD) and recent (post-1971 AD) activity of Mt. Etna volcano was here used to evidence changes in the feeding system dynamics during the last 250 years. The observed textural characteristics of crystals include both near-equilibrium and disequilibrium textures [1]. The An variation along core-to-rim profiles on selected crystals with different types of textures was evaluated particularly versus the Sr/Ba ratio. At rather comparable average An contents, plagioclase crystals representative of near-equilibrium crystallization from the magma display very distinct Sr/Ba ratios through time (~6 and ~17 in historic and recent lavas respectively). Recent plagioclases also exhibit generally higher potassium contents than the historic ones at the same evolutionary degree. Although contamination due to wall-rock assimilation may have played a role, we suggest here that the features are dominated by input of a K-rich and Ba-poor end-member into the feeding system that becomes evident particularly after the 1971 AD eruption. Magma residence times, which have been calculated through Sr diffusion modeling on plagioclases, are also related to the distinct geochemical signature observed. Calculations give average residence times of ~40 years for crystals of the historic activity and of ~20 years for the post-1971 AD plagioclases. Our estimations strongly agree with geophysical data that highlight an increased E-W directed extension rate within the upper 10 km of the crust before major eruptive events of the last two decades. Differences in the timescales of magma storage observed over the last 250 years can be therefore attributed to the dominant role played by volcano-tectonics on the uppermost part of the feeding system.

[1] Viccaro *et al.* (2010), Lithos 116, 77-91.

Insights into the magmatic processes leading to the Holocene caldera eruption of Rinjani, Indonesia

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The cataclysmic caldera-forming eruption at Rinjani volcanic complex (Lombok, Indonesia) ranks among the largest explosive eruptions of the Holocene, and is possibly associated to the largest stratospheric release of volcanic sulfur over the past 7 ka [1]. It produced a succession of plinian fallout and pyroclastic flow deposits. Whole-rock analysis of juvenile pumices from plinian fallout units indicates a range of trachyandesitic to trachytic magma batches (61-64 wt% SiO_2). These magmas display variable enrichments in both major and trace elements indicative of a dominant process of crystal fractionation and of the presence of a zoned (or complex) magma chamber. They also share Nb/Th (0.9) and Nb/Zr (0.04) ratios with those of Rinjani high alumina basaltic scoriae, suggesting that they belong to the same suite. As a whole the compositional range of our samples matches that of the Rinjani calc-alkaline suite [2].

The mineral paragenesis consists of plagioclase (An_{41} to An_{80}), clinopyroxene (Mg# 0.75), orthopyroxene (Mg# 0.71), amphibole (pargasitic Hbl/magnesio Hbl) and Fe-Ti oxides. Biotite is rarely found. Apatite shows a wide range of volatile contents: F 1.8-0.25 wt%, Cl 0.9-0.45 wt% and S 1300-<100 ppm. Melt inclusions analyzed in plagioclase handpicked from a basal fallout unit represent the most evolved trachytic term (65-70 wt% SiO_2, on anhydrous basis). They contain 3.3-5.1 wt% of H_2O, 2200-3700 ppm of Cl, 440-600 ppm of F, and <100-490 ppm of S. CO_2 is below FTIR detection limit. The erupted magma was thus rich in H_2O and Cl but relatively depleted in sulfur. The estimated P_{H2O} for this range of water contents is 180-100 MPa [3] that is consistent with prolonged magma ponding at crustal level.

We provide the very first constraints on the pre-eruptive magma conditions and discuss the processes controlling sulfur behavior.

[1] Lavigne *et al.* (2013) *PNAS*, submitted. [2] Foden (1983) *J. Petrol.* 24, 98-130. [3] Moore *et al.* (2008) *Rev. Mineral. Geochem.* 69, 333-358.

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