Geophysical Research Abstracts
Vol. 17, EGU2015-6380-1, 2015
EGU General Assembly 2015

The magma storage capacity of Mt. Etna's feeding system constrained by four decades of alkali enrichment in erupted lavas

Patrick Allard (1), Rosanna Corsaro (2), and Nicole Métrich (1)
(1) IPGP, CNRS UMR7154, PARIS, France (pallard@ipgp.fr), (2) INGV, Sezione di Catania, Catania, Italy

Deciphering the magma plumbing system of volcanoes is fundamental to improved understanding of their behaviour and forecasting of their eruptions. Mount Etna, in Sicily, is one of the most active basaltic volcanoes on Earth, built upon a 20-km thick continental crust at the collision boundary between the African and Eurasian plates. Seismic tomography and inversion of natural seismic data have revealed a complex feeding system that includes a huge vertical plutonic body and magma ponding zones in coincidence with the main lithological discontinuities in the crust (at ca. 8-10 km and 2-3 km depth b.s.l.). However, limitations in spatial resolution hamper accurate size estimate of these magma ponding zones. Here we use the remarkable trend of alkali enrichment observed in Etnean lavas since the early seventies and their cumulated erupted volumes to provide an updated estimate of the magma storage capacity of the volcano feeding system. The temporal evolution of K2O/Th and Rb/Th ratios - unaffected by magma differentiation processes - tracks the replenishment of Etna's plumbing system by a new, more alkaline trachybasaltic magma that has gradually mixed with the former resident magma. In a few occasions (e.g. 1974, 1998, 2001-2002) this new magma could reach the surface without pre-eruptive homogeneization in the mixing cell, producing highest eruption rates. Such variations indicate a complex storage system, made of sills and dykes, in which long-term mixing processes but also separate storage or upraise of some magma batches can happen. Combining with the co-erupted magma volumes, we estimate an overall magma storage capacity beneath Etna that is larger than previously inferred from radioactive disequilibria in lavas or SO_2 gas fluxes. Our new estimate could be usefully compared with the results from recent seismic tomography realized within the framework of the European MED-SUV project (Mediterranean Supersite Volcanoes).