Geophysical Research Abstracts
Vol. 17, EGU2015-12171, 2015
EGU General Assembly 2015


# Periodic input of primitive magmas in a complex plumbing system revealed by noble gas geochemistry: the case of Mt Etna (Italy)

Antonio Paonita, Antonio Caracausi, Mauro Martelli, and Andrea Rizzo
Istituto Nazionale di Geofisica e Vulcanologia - Sezione di Palermo, Palermo, Italy (antonio.paonita@ingv.it)

A long-term series of noble gas compositions (He and Ar isotope abundances plus elemental Ne) coming from geochemical monitoring of five peripheral gas emissions at the base of Mt Etna, integrated by some fumaroles located in the rim of the summit crater, have allowed to put constraints on the magmatic system feeding the volcano. The peripheral gas emissions seem to be released by magmatic degassing occurring at depths of 200-400 MPa, while the crater fumaroles receive contributes coming from magmas residing at shallower levels (up to 130 MPa), which mix to the fluids from the deep levels. These estimations are in good agreement with the depth of the two main magma ponding zones (i.e. 5-12 km and 2-3 km b.s.l.) inferred by petrological and geophysical studies. The long-term monitoring of 3He/4He ratios from both peripheral and crater gases has allowed us to recognize phases of increase of the isotope ratios, occurred at all the sampled emissions some months before the onset of eruptive activities. This behaviour has been systematic for all the main eruptive phases occurred at Mt Etna since 2001 (i.e. 2001, 2002-2003, 2006, 2008-2009, 2011-2012, 2013, and 2014, except for the 2004-2005 eruption), making this parameter a very powerful tool in evaluating the activity level of the volcano and in eruption forecast. A detailed investigation of the 3He/4He time series displays that there is no defined time gap between the isotope ratio increase and the onset of the eruptive activity, this interval ranging from one to several months. After examination of shape and duration of the isotope increases versus main features of the eruptive events (e.g. duration, amount of erupted material, eruption rate), no systematic relationships emerge. It seems only that the rate of 3He/4He increase was anomalously high (by almost 10 times) during the only two eccentric eruptions since 2001 (i.e. 2001 and 2002-2003).
The differences among He isotopic composition between the peripheral sites, as well the summit fumaroles, highlight compositional gradients in the plumbing systems, addressing to a complex structure of scarcely connected dike and sill magma bodies. In this framework, the phases of 3He/4He increase would be related to refill of the deep storage levels by 3He-rich magmas, the latter being very primitive and rising directly from the mantle. This process would in fact cause pressure increase in these deep reservoirs and a consequent major release of 3He-rich volatiles, until the magma input event finishes and the pressure increase is exhausted. A quantitative modelling of this process is attempted.