Geophysical Research Abstracts
Vol. 19, EGU2017-14551, 2017
EGU General Assembly 2017

Petrological study of the products of 2011-2012 paroxysmal eruptions: new insight of the intensive variables of the Mt. Etna magmatic system

Pier Paolo Giacomoni (1), Massimo Coltorti (1), Silvio Mollo (2), Carmelo Ferlito (3), Mirko Braiato (1), and Piergiorgio Scarlato (4)

(1) Department of Physics and Earth Sciences, University of Ferrara, Italy, (2) Department of Earth Science, University of La Sapienza, Italy, (3) Department of Biological, Environmental and Geological Sciences, University of Catania, Italy, (4) HP-HT Laboratory, National Institute of Geophysics and Volcanology (INGV-Italy)

Mt. Etna activity from January 2011 to April 2012 was characterized by 24 paroxysmal short-lasting (few to several hours) eruptions from the New South East summit crater. Despite the violence of the activity, no appreciable geophysical signals were recorded during this period, except for an increase in the seismic tremors just minutes/hours before the occurrence of the paroxysm. This type of activity represents a significant shift from the mainly effusive eruptions of 2004; 2006; 2008/2009 and from the lateral rift-related event of 2001 and 2002/2003. The 2011-2012 paroxysmal activity thus represent a unique opportunity to investigate the effects of magmatic chemical-physical intensive variables (P-T-fO_2) on the crystallization and fractionation processes occurring in the Mt. Etna open conduit feeding system. We investigated the petrographic and geochemical features of lava and scoria clasts from 10 paroxysmal events. Whole rock compositions plot inside the trachy-basalt field with the typical etnean intraplate chondrite normalized trace element distribution characterized by positive U, Th and La and negative Rb, K, Nb anomalies.

MELTs and mass balance fractional crystallization modelling suggest that most of the eruptive events were fed by magma differentiating along the conduit and by a deep basic magma recharge during the 4/3/2012 event.

Olivine (Ol), clinopyroxene (Cpx) and plagioclase (Plg) crystal-melt equilibrium conditions were checked before applying thermo-barometric, oxy-fugacity and hygrometer equations by comparing the composition of phenocrysts with those of whole rock, glass and reconstructed primitive magma. Results show that the erupted products are made up of a mixture of phenocrysts in equilibrium with the whole rock or disequilibrated toward more basic or more evolved compositions.

Thermobarometric calculations indicate that ol is the first phase on the liquidus (1270 °C, up to 1200 MPa). Cpx crystallizes from 1200 °C, at 700 Mpa in most basic melt (4/3/2012), to 1100 °C at 100 Mpa. Plg nucleation is constrained by the dissolved amount of H_2O in the melt and mostly occur above 250 Mpa. Hygrometer determinations indicate that basic magma contains up to 3.7 wt% of dissolved H_2O.

The overall dataset suggests that the magmatic feeding system of 2011-2012 eruptive events was vertically extended without any significant ponding zone. The conduit is periodically filled with a H_2O-rich basic magma at +2 [U+F044]FMQ average oxidation condition. The H_2O degassing in the shallower portion of the magmatic column (<200 Mpa) induce a vertical differentiation. The deeper portion of the magmatic column at a pressure >300 Mpa) and low undercooling degree present a more femic geochemical features. The intermediate portion (300-200 Mpa) is repeatedly pushed above the H_2O exsolution depth which promotes the plagioclase saturation and nucleation. In the shallower portion (>200 Mpa) the efficient H_2O exsolution result in a strong undercooling and promote the massive plg nucleation and differentiation.