Geophysical Research Abstracts
Vol. 17, EGU2015-15035, 2015
EGU General Assembly 2015

Mixing-to-eruption timescales: an integrated model combining numerical simulations and high-temperature experiments with natural melts

Chiara Montagna (1), Diego Perugini (2), Christina De Campos (3), Antonella Longo (1), Donald Bruce Dingwell (3), and Paolo Papale (1)

(1) Istituto Nazionale di Fisica e geologia, Sezione di Pisa, Italy, (2) Dipartimento di Fisica e Geologia, Università di Perugia, Italy, (3) Department of Earth and Environmental Sciences, Ludwig-Maximilian-University, Germany

Arrival of magma from depth into shallow reservoirs and associated mixing processes have been documented as possible triggers of explosive eruptions. Quantifying the timing from beginning of mixing to eruption is of fundamental importance in volcanology in order to put constraints about the possible onset of a new eruption. Here we integrate numerical simulations and high-temperature experiment performed with natural melts with the aim to attempt identifying the mixing-to-eruption timescales.
We performed two-dimensional numerical simulations of the arrival of gas-rich magmas into shallow reservoirs. We solve the fluid dynamics for the two interacting magmas evaluating the space-time evolution of the physical properties of the mixture.
Convection and mingling develop quickly into the chamber and feeding conduit/dyke. Over time scales of hours, the magmas in the reservoir appear to have mingled throughout, and convective patterns become harder to identify. High-temperature magma mixing experiments have been performed using a centrifuge and using basaltic and phonolitic melts from Campi Flegrei (Italy) as initial end-members. Concentration Variance Decay (CVD), an inevitable consequence of magma mixing, is exponential with time. The rate of CVD is a powerful new geochronometer for the time from mixing to eruption/quenching. The mingling-to-eruption time of three explosive volcanic eruptions from Campi Flegrei (Italy) yield durations on the order of tens of minutes. These results are in perfect agreement with the numerical simulations that suggest a maximum mixing time of a few hours to obtain a hybrid mixture.
We show that integration of numerical simulation and high-temperature experiments can provide unprecedented results about mixing processes in volcanic systems. The combined application of numerical simulations and CVD geochronometer to the eruptive products of active volcanoes could be decisive for the preparation of hazard mitigation during volcanic unrest.