Geophysical Research Abstracts
Vol. 19, EGU2017-7469, 2017
EGU General Assembly 2017

2D and 3D analyses of bubbles and minerals in an Etnean dyke: Insights on turbulence (non-laminar) and solidification during magma ascent

Gabriele Lanzafame (1), Gianluca Iezzi (2,3), Lucia Mancini (1), Federica Lezzi (2), Silvio Mollo (4), and Carmelo Ferlito (5)

(1) Elettra-Sincrotrone Trieste S.C.p.A., SS 14, Km 163.5 in Area Science Park, 34149 Basovizza (Trieste), Italy (gabriele.lanzafame@elettra.eu), (2) Dipartimento di Ingegneria & Geologia, Università G. d'Annunzio, Via dei Vestini 30, 66100, Chieti, Italy, (3) Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, 00143, Roma, Italy, (4) Dipartimento di Scienze della Terra, Sapienza-Università di Roma, P.le Aldo Moro 5, 00185 Roma, Italy, (5) Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università di Catania, Corso Italia 57, I-95129 Catania, Italy

Laminar and turbulent regimes during magma uprise through the plumbing systems of several volcanoes in the world are generally predicted by numerical models. In this work, we investigated a trachybasaltic aphyric 4.3 m thick dyke solidified at shallow depth (100-300 m below the pristine surface level) at Mount Etna (Italy). Two- and three-dimensional imaging analyses have been conducted on bubbles and minerals, in order to attest the non-laminar characteristic of the intruding magma. Seven samples along a cross profile from dyke rim (DK1) to core (DK7) have been analysed by means of i) 2D techniques such as high-resolution scanner, transmission optical microscope and scanning electron microscope imaging with back-scattered electrons and ii) a 3D technique as microfocus X-ray computed tomography. Despite limited changes in textures and compositions of plagioclase, clinopyroxene, titanomagnetite, and olvine, the amount, size and shape of bubbles change irregularly from dyke rim to core. Bubble and plagioclase contents show opposite saw-like trends due to the solidification from different portions of a H_2O-rich magma and vice-versa. Along the cross profile of the dyke, bubbles with anisotropic shapes (average aspects 3:1) are randomly oriented in space, with strong variations in abundance, size and shape. These features could be attributed to transitional to turbulent, i.e. non-laminar, regimes (Reynolds number > 1000). Models to constrain the intrusive conditions of the dyke indicate that the crystal-free magma containing 1 wt.% H_2O intruded and rapidly solidified at depth > 100-300 m, i.e. P > 10 MPa. The sudden and marked crystallization was favoured by the rapid volatile exsolution at very shallow level, coupled with the increase of viscosity and deceleration (a few meters per seconds) or even stop of the magma uprise. The retrieved results indicate that bubbles were frozen in, whereas crystals continued to grow under the effect of an increasing cooling rate from core to rim.