Geophysical Research Abstracts
Vol. 19, EGU2017-14022, 2017
EGU General Assembly 2017

An experimental study of the fluid–melt partitioning of volatiles (H_2O, CO_2, S) during the degassing of ascending basalt

Nolwenn Le Gall (1,2,3), Michel Pichavant (3), Ida Di Carlo (3), and Bruno Scaillet (3)

(1) School of Materials, University of Manchester, Manchester, UK, (2) Research Complex at Harwell, Rutherford Appleton Laboratories, Didcot, UK, (3) CNRS/ISTO, Université d'Orléans, Orléans, France

We performed decompression experiments to constrain the fluid–melt partitioning of volatiles (H_2O, CO_2, S) in ascending basalt magmas associated with violent eruptions. Experiments were conducted in an internally heated pressure vessel under oxidizing conditions (fO_2: NNO+1.1) so that all sulphur occurs as sulfate (S6+) in the melt. Volatile-bearing (2.72 $\pm$ 0.02 wt% H_2O, 1291 $\pm$ 85 ppm CO_2, 1535 $\pm$ 369 ppm S) melts, prepared from Stromboli pumice, were synthesized at 1200°C and 200 MPa, decompressed between 150 and 25 MPa at constant rates of 39 and 78 kPa/s (or 1.5 and 3 m/s), and rapidly quenched. Run products were characterized both chemically (by IR spectroscopy and electron microprobe analysis) and texturally (by scanning electron microscopy), and then compared with Stromboli pumice products (glass inclusions, volcanic gases).

In H_2O-CO_2-S-bearing basaltic melts, bubbles start to nucleate heterogeneously on Fe sulfides for supersaturation pressures ΔPHeN $\leq$ 1 MPa and to nucleate homogeneously for ΔPHoN < 50 MPa (ΔPHeN and ΔPHoN are the difference between the saturation pressure and the pressure at which heterogeneous and homogeneous bubble nucleation are observed, respectively). Bubble growth, coalescence and outgassing occur in addition to continuous bubble nucleation, which is sustained by the preservation of CO_2 supersaturated melts during decompression.

In addition to model the degassing behaviour of sulphur (and also of CO_2 and H_2O), our experiments aim to assist in the interpretation of geochemical observables. On the one hand, the volatile degassing trend recorded by Stromboli natural glasses (unsealed glass embayments) was closely experimentally simulated, with a coupled decrease of H_2O and S whereas CO_2 concentrations remain elevated. On the other hand, the experimental H_2O/CO_2 and CO_2/SO_2 fluid molar ratios, calculated by mass balance, both reproduced or closely approached the lower ranges of gas ratios measured at Stromboli for quiescent magma degassing and explosive activity. Compared to models that attribute a deep origin to CO_2-rich fluxes and high CO_2/SO_2 gas ratios, our experimental observations support a model of low pressure (Pf « 25 MPa) explosive degassing of CO_2-rich melts generated as a result of disequilibrium degassing to generate Strombolian paroxysms.