



**HAL**  
open science

## An experimental study of the fluid-melt partitioning of volatiles (H<sub>2</sub>O, CO<sub>2</sub>, S) during the degassing of ascending basalt

Nolwenn Le Gall, Michel Pichavant, Ida Di Carlo, Bruno Scaillet

► **To cite this version:**

Nolwenn Le Gall, Michel Pichavant, Ida Di Carlo, Bruno Scaillet. An experimental study of the fluid-melt partitioning of volatiles (H<sub>2</sub>O, CO<sub>2</sub>, S) during the degassing of ascending basalt. 19th EGU General Assembly, 2017, Vienne, Austria. pp.14022. hal-03552752

**HAL Id: hal-03552752**

**<https://hal.science/hal-03552752v1>**

Submitted on 3 Feb 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License



## **An experimental study of the fluid–melt partitioning of volatiles (H<sub>2</sub>O, CO<sub>2</sub>, 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<sub>2</sub>O, CO<sub>2</sub>, S) in ascending basalt magmas associated with violent eruptions. Experiments were conducted in an internally heated pressure vessel under oxidizing conditions (fO<sub>2</sub>: NNO+1.1) so that all sulphur occurs as sulfate (S<sup>6+</sup>) in the melt. Volatile-bearing (2.72 ± 0.02 wt% H<sub>2</sub>O, 1291 ± 85 ppm CO<sub>2</sub>, 1535 ± 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<sub>2</sub>O-CO<sub>2</sub>-S-bearing basaltic melts, bubbles start to nucleate heterogeneously on Fe sulfides for supersaturation pressures  $\Delta P_{HeN} \leq 1$  MPa and to nucleate homogeneously for  $\Delta P_{HoN} < 50$  MPa ( $\Delta P_{HeN}$  and  $\Delta P_{HoN}$  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<sub>2</sub> supersaturated melts during decompression.

In addition to model the degassing behaviour of sulphur (and also of CO<sub>2</sub> and H<sub>2</sub>O), 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<sub>2</sub>O and S whereas CO<sub>2</sub> concentrations remain elevated. On the other hand, the experimental H<sub>2</sub>O/CO<sub>2</sub> and CO<sub>2</sub>/SO<sub>2</sub> 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<sub>2</sub>-rich fluxes and high CO<sub>2</sub>/SO<sub>2</sub> gas ratios, our experimental observations support a model of low pressure ( $P_f \ll 25$  MPa) explosive degassing of CO<sub>2</sub>-rich melts generated as a result of disequilibrium degassing to generate Strombolian paroxysms.