



**HAL**  
open science

## Degassing of basaltic magma: decompression experiments and implications for interpreting the textures of volcanic rocks

Nolwenn Le Gall, Michel Pichavant, Biao Cai, Peter Lee, Mike Burton

### ► To cite this version:

Nolwenn Le Gall, Michel Pichavant, Biao Cai, Peter Lee, Mike Burton. Degassing of basaltic magma: decompression experiments and implications for interpreting the textures of volcanic rocks. 19th EGU General Assembly, 2017, Vienne, Austria. pp.13765. hal-03552753

**HAL Id: hal-03552753**

**<https://hal.science/hal-03552753>**

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

## **Degassing of basaltic magma: decompression experiments and implications for interpreting the textures of volcanic rocks**

Nolwenn Le Gall (1,2,3), Michel Pichavant (3), Biao Cai (1,2), Peter Lee (1,2), and Mike Burton (4)

(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, (4) School of Earth and Environmental Sciences, University of Manchester, Manchester, UK

Decompression experiments were performed to simulate the ascent of basaltic magma, with the idea of approaching the textural features of volcanic rocks to provide insights into degassing processes. The experiments were conducted in an internally heated pressure vessel between NNO–1.4 and +0.9. H<sub>2</sub>O-only (4.9 wt%) and H<sub>2</sub>O-CO<sub>2</sub>-bearing (0.71–2.45 wt% H<sub>2</sub>O, 818–1094 ppm CO<sub>2</sub>) melts, prepared from Stromboli pumice, were synthesized at 1200°C and 200 MPa, continuously decompressed between 200 and 25 MPa at a rate of either 39 or 78 kPa/s (or 1.5 and 3 m/s, respectively), and rapidly quenched. Run products were characterized both texturally (by X-ray computed tomography and scanning electron microscopy) and chemically (by IR spectroscopy and electron microprobe analysis), and then compared with products from basaltic Plinian eruptions and Stromboli paroxysms (bubble textures, glass inclusions).

The obtained results demonstrate that textures are controlled by the kinetics of nucleation, growth, coalescence and outgassing of the bubbles, as well as by fragmentation, which largely depend on the presence of CO<sub>2</sub> in the melt and the achievement in chemical equilibrium. Textures of the H<sub>2</sub>O-only melts result from two nucleation events, the first at high pressure (200 < P < 150 MPa) and the second at low pressure (50 < P < 25 MPa), preceding fragmentation. Both events, restricted to narrow P intervals, are driven by melt H<sub>2</sub>O supersaturation. In contrast, textures of the H<sub>2</sub>O-CO<sub>2</sub>-bearing basaltic melts result from continuous bubble nucleation, which is driven by the generation of melts supersaturated in CO<sub>2</sub>. This persistent non-equilibrium degassing causes the bubbles to evolve through power law distributions, as small bubbles continue to form and grow. This is what is observed in Plinian products. From our results, the evolution to mixed power law–exponential distributions, as found in Stromboli products, is indicative of the prevalence of bubble coalescence and an evolution toward chemical equilibrium. In line with this, a strong correlation was found between experimental and natural bubble textures (bubble number densities, shapes, sizes and distributions), having implications for interpreting bubbles in volcanic rocks and quantifying magma ascent rates.

Next step will be to perform in situ decompression experiments to simulate both degassing and crystallization of basaltic magma during ascent in the shallow volcanic conduit (P < 50 MPa), using synchrotron X-ray imaging. The obtained 4D (3D + time) data will help us refine our understanding of magma ascent processes. This experimental programme requires first technology adaptation and development, which is in progress.