Tracing magma degassing using experimental approaches

N. Le Gall[1], M. Pichavant[2], M. Burton[3], P.D. Lee[1]

[1]Research Complex at Harwell, Rutherford Appleton Laboratory, Harwell Oxford, Didcot, Oxon, OX11 0FA, UK, nolegall@laposte.net, peter.lee@manchester.ac.uk
[2]Institut des Sciences de la Terre d'Orleans, 1A rue de la Ferollerie, 45100 Orleans, michel.pichavant@cnrs-orleans.fr
[3]School of Earth and Environmental Sciences, The University of Manchester, Oxford Road, Manchester, M13 9PL, mike.burton@manchester.ac.uk

By replicating natural conditions of magma ascent, experiments help improving our knowledge of the degassing process. Since a few decades, decompression experiments have been performed to simulate the ascent and degassing of magma, allowing interpretation of textural and geochemical observations. However, this approach most often requires a quench interruption, meaning that some aspects of the degassing history may be missing. Thanks to ongoing technological and synchrotron imaging developments, direct observations under realistic magma conditions are becoming possible, opening up perspectives on better modelling the volatile evolution of magmatic systems.

Here we present two case studies showing these advances. The first case is an *ex situ* study aimed at assisting the interpretation of geochemical data (i.e. glass inclusion and gas data). Decompression experiments were performed, using an internally heated pressure vessel, to constrain the fluid–melt partitioning of volatiles (H_2O, CO_2, S), while simulating basalt magma ascent (1200 °C, 200–25 MPa). It appeared from our observations that the CO_2-rich gases and high melt inclusion CO_2 contents documented at some basaltic volcanoes may result from disequilibrium degassing and the associated generation of CO_2-supersaturated melts. This is alternative to the CO_2-fluxing model, which is mainly used to interpret their occurrence.

The second case refers to the development of 4D *in situ* techniques to quantify degassing in basaltic systems, using synchrotron-based X-ray tomographic microscopy. Temperature and oxygen fugacity control was first achieved, enabling time-resolved experiments to take place at the I12 Diamond Light Source synchrotron beamline (UK). Additionally, the use of a bespoke resistance furnace, in combination with an adapted thermo-mechanical rig, will shortly enable us to perform pressure-controlled experiments, being closer to natural cases.