A model for decompression-induced bubble formation and growth in volatile-undersaturated melts

SARAH B. CICHY [1,2] AND ADRIAN FIEGE[3]

[1]Institute of Earth and Environmental Science, University of Potsdam, 14476 Potsdam-Golm, Germany (cichy@uni-potsdam.de)

[2]GFZ German Research Centre for Geosciences, 14473 Potsdam, Germany

[3]American Museum of Natural History, New York, NY 10024-5192, USA (afiege@amnh.org)

Textural and geochemical features of volcanic ejecta can give implications on volcanic degassing processes during magma ascent and on eruption mechanisms in general. A robust experimental database on bubble formation processes (i.e., nucleation, growth, and coalescence as a function of P-T-t-X) is required to calibrate theoretical and empirical models, which derive magma ascent rates from bubble number densities (BND) of volcanic edifices.

We have combined published experimental results and our decompression experiments (andesite; 1030°C; 400 MPa to 150, 100, 70 MPa; 0.1 MPa/s) to evaluate melt compositional effects and the well-established model of Toramaru [1]. The compiled dataset indicates that variations in melt and volatile composition can have a significant effect on the decompression-induced magma vesiculation. Not only the two most abundant volatile species H_2O and CO_2 are relevant, but minor volatiles like Cl and/or S can have notable effects on the BND evolution.

Data inspection reveals significant differences in BND between initially volatile-saturated and initially volatile-undersaturated systems. This is an important but troubling observation, considering that most of the experiments and models focus on volatile-saturated systems, whereas natural magmas are typically undersaturated in volatiles prior to their magma ascent. Therefore, we will present an empirical decompression-rate-meter for initially water-undersaturated melts, linking melt viscosities to ascent rates and BNDs. The proposed geospeedometer was designed to allow modelling of multi-volatile melts of silicic and/or less evolved composition, although more experiments are required to calibrate it more adequately.

[1] Toramaru (2006) *J. Geophys. Res.* **94**, 17523-17542.