Geophysical Research Abstracts
Vol. 17, EGU2015-14678, 2015
EGU General Assembly 2015

Laboratory Modelling of Volcano Plumbing Systems: a review

Olivier Galland (1), Eoghan P. Holohan (2), Benjamin van Wyk de Vries (3), and Steffi Burchardt (4)

(1) University of Oslo, Physics of Geological Processes (PGP), Oslo, Norway (olivier.galland@fys.uio.no), (2) GFZ Helmholtz Zentrum Potsdam, Potsdam, Germany, (3) Observatoire de Physique du Globe de Clermont-Ferrand, Blaise Pascal University, Clermont-Ferrand, France, (4) University of Uppsala, Uppsala, Sweden

Earth scientists have, since the XIX century, tried to replicate or model geological processes in controlled laboratory experiments. In particular, laboratory modelling has been used study the development of volcanic plumbing systems, which sets the stage for volcanic eruptions. Volcanic plumbing systems involve complex processes that act at length scales of microns to thousands of kilometres and at time scales from milliseconds to billions of years, and laboratory models appear very suitable to address them. This contribution reviews laboratory models dedicated to study the dynamics of volcano plumbing systems (Galland et al., Accepted).

The foundation of laboratory models is the choice of relevant model materials, both for rock and magma. We outline a broad range of suitable model materials used in the literature. These materials exhibit very diverse rheological behaviours, so their careful choice is a crucial first step for the proper experiment design.

The second step is model scaling, which successively calls upon: (1) the principle of dimensional analysis, and (2) the principle of similarity. The dimensional analysis aims to identify the dimensionless physical parameters that govern the underlying processes. The principle of similarity states that "a laboratory model is equivalent to his geological analogue if the dimensionless parameters identified in the dimensional analysis are identical, even if the values of the governing dimensional parameters differ greatly" (Barenblatt, 2003). The application of these two steps ensures a solid understanding and geological relevance of the laboratory models. In addition, this procedure shows that laboratory models are not designed to exactly mimic a given geological system, but to understand underlying generic processes, either individually or in combination, and to identify or demonstrate physical laws that govern these processes.

From this perspective, we review the numerous applications of laboratory models to understand the distinct key features of volcanic plumbing systems: dykes, cone sheets, sills, laccoliths, caldera-related structures, ground deformation, magma/fault interactions, and explosive vents.

Barenblatt, G.I., 2003. Scaling. Cambridge University Press, Cambridge.
Galland, O., Holohan, E.P., van Wyk de Vries, B., Burchardt, S., Accepted. Laboratory modelling of volcanic plumbing systems: A review, in: Breitkreuz, C., Rocchi, S. (Eds.), Laccoliths, sills and dykes: Physical geology of shallow level magmatic systems. Springer.