Dynamic effects of magma degassing at open vent volcanoes

L. PIOLI [1] , B.J. AZZOPARDI [2]

[1]Department of Earth Sciences, University of Geneva, (Switzerland), laura.pioli@unige.ch
[2] Faculty of Engineering, University of Nottingham, (United Kingdom)
Barry.Azzopardi@nottingham.ac.uk

The conduit dynamics at open vent mafic volcanoes is marked by separate two-phase (gas-melt) flow dynamics. Separate two-phase flow allows for gas segregation and is driven by the rise and interaction of gas bubbles within the melt. It generates peculiar flow patterns (i.e. bubbly, slug, churn and annular). Separate two-phase flows are also strongly affected by both the melt and gas properties and the conduit diameter and geometry; more specifically these parameters controls not only the average properties of flow in the conduit but also the stability of bubbly, slug, churn and annular flows. Each flow pattern controls the magma bubble size and spatial distributions, flow characteristics, and hence the dynamics of outgassing, eruption style and magma properties. Regardless of the deep magmatic input, each pattern is also marked by definite periodicities resulting in oscillations of the conduit flow (pressure, flow rates), and magma (vesicularity and distribution) properties, which, in turn, control the eruption style and fragmentation dynamics.

The quantification of these periodicities and their interpretation in terms of conduit properties and dynamics is of fundamental relevance not only to quantify conduit flow, but it has also great potential for the interpretation of geophysical and geochemical monitoring signals. We compare experimental results and theoretical models to define stability and properties of flow patterns during outgassing and eruptions of mafic magmas, quantify characteristic oscillations of the condut properties (pressure, bubble fraction), their speed of propagation and variations with magma rheology. Finally, we discuss our results in terms of expected outgassing patterns at open vent volcanoes and the interpretation of conduit dynamics in Hawaiian and Strombolian eruptions.