Geophysical Research Abstracts,
Vol. 11, EGU2009-9594, 2009
EGU General Assembly 2009

Transient effects of magma ascent dynamics along a geometrically variable dome-feeding conduit

M. de' Michieli Vitturi (1), A.B. Clarke (2,1), A. Neri (1), and B. Voight (3)

(1) Istituto Nazionale di Geofisica e Vulcanologia, sezione di Pisa, Pisa, Italy, (2) School of Earth and Space Exploration, Arizona State University, Tempe, Arizona, USA, (3) College of Earth and Mineral Sciences, Pennsylvania State University, University Park, Pennsylvania, USA

The transient dynamics of magma ascent during dome-forming eruptions are investigated to understand the influence of variable conduit geometry. The numerical model developed, named DOMEFLOW, is a transient 1.5D isothermal two-phase flow model of magma rising from the magma chamber through an axisymmetric conduit of variable radius. The 1.5D feature allows modelling of vertical changes in flow dynamics while also considering the effects of the variable 2D cross-section geometry on the ascent dynamics. The model also accounts for gas exsolution, bubble growth, crystallization induced by degassing, permeable gas loss through overlying magma and through conduit walls (above a magma porosity threshold), as well as viscosity changes due to crystallization and degassing during magma ascent.

The model allows quantification of the non-linear relationships between boundary conditions, magma ascent dynamics and conduit geometry. The variations of the fundamental flow variables along the conduit, as well as at the surface, are investigated by changing the boundary conditions at depth. In particular, the effects of sudden chamber pressure increases or decreases are illustrated as a function of all variables; the results are interpreted by dimensional analysis to reveal a universal relationship which predicts the temporal evolution of magma effusion rate for a given change in chamber conditions. The parameters controlling the transition time and magnitude are conduit geometry (volume and shape), magma compressibility (affected by bubble content) and magnitude of pressure change.

This relationship can be used to interpret observed variations of dome growth and other monitoring signals at active volcanoes.