Geophysical Research Abstracts, Vol. 9, 02407, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02407

Numerical simulations of the time-space evolution of convection and mixing of volatile-rich magma in magma chambers and dikes

M. Vassalli (1,2), A. Longo(1), D. Barbato(1), P. Papale(1), M. Barsanti(1,3)
(1) INGV Pisa, (2) Dip.to Fisica - Univ. Bologna, (3) Dip.to Matematica Applicata - Univ. Pisa

The fluid-dynamics and compositional space-time evolution in subsurface environments of magmas with different bulk composition, water and carbon dioxide content, is computed using the GALES finite element code (Longo et al., 2006, doi: 10.1029/2006GL027760), which employs a multicomponent non-ideal volatile saturation model (Papale et al., 2006, doi: 10.1016/j.chemgeo.2006.01.013). Stability and robustness of the numerical algorithm are achieved through Galerkin least-squares and discontinuity capturing terms. Two volcanic system configurations are considered: a vertical dike filled with compositionally stratified basaltic magma, and a closed phonolitic magma chamber connected to a refilling dyke hosting trachite. Both vertical density distributions are gravitationally unstable, resulting in the ascent of light volatile rich magma and onset of convection and mixing. Parametric studies are carried out on the volatile content, system geometry, and refilling conditions. Numerical results show the main role of the gravitational force in triggering convection, and highlight the critical role of carbon dioxide in enhancing convection and mixing efficiency. Complex patterns of flow variables are found to characterize the convection dynamics, with transients in pressure distributions and development of multiple vortexes previously never described. Depending on the specific simulation conditions, the convection and mixing dynamics can result in compositional distributions where one of the two original compositions dominates or disappears from the system as a separate, well-identified compositional term.