Geophysical Research Abstracts
Vol. 17, EGU2015-2469, 2015
EGU General Assembly 2015

Finite element method algorithm for the magma-rock interaction problem

Deepak Garg and Antonella Longo
National institute of Geophysics and Volcanology, Italy (deepak.garg@ingv.it)

Magma dynamics in magma chamber causes new stress forces and deformations of rocks along the magma-rock interface. As a result rocks deform and elastic waves propagate, that are recorded at the earth surface as ground deformations and seismic signals. Interpretation of the recorded data is important for the quantitative assessment of volcanic processes and short-term risk evaluation.

We are aiming to make a two way coupled finite-element method (FEM) for the simulation of dynamics of magma and the surrounding rocks. Magma is treated as a multicomponent and multiphase compressible fluid mixture. Its dynamics is characterised by Navier-Stokes equations for compressible flows in arbitray Lagrangian Eularian (ALE) frame of work. The nodes of magma mesh are considered as elastic solids and the motion of unstructured mesh is computed by solving the elastostatic equation. The mesh distortion is controlled by Jacobian-based stiffening method. Rocks are treated as elastic isotropic materials. Their dynamics are characterised by the elastodynamics equation for solids in Lagrangian frame of work. The partial differential equations are numerically discretized by the space-time Galerkin FEM. The linear equations leaded by the FEM are solved by
the LSQR solver. The coupling between the magma and the rock at the interface is done iteratively at each time step by setting the equality of velocities and traction forces in the boundary conditions.

The simulation results of this method will help us to understand the link between the deep volcanic processes and the ground geophysical signals registered by the monitoring network.