Geophysical Research Abstracts
Vol. 13, EGU2011-2312, 2011
EGU General Assembly 2011


# Determining Magma Reservoir Compressibility From Co-eruptive Strain Changes: Hekla and Montserrat

Alan Linde and Selwyn Sacks
Department of Terrestrial Magnetism, Carnegie Institution of Washington, DC 20015 United States (alinde@dtm.ciw.edu)

Borehole strainmeters have the capability of providing continuous (50 sps) monitoring of deformation with a sensitivity that, for durations up to many days, is much greater than any other measurement type currently available (e.g. roughly 1000 times that for GPS observations). Thus, by installing small arrays of such instruments close enough to an active volcano, it is possible to record deformation due to otherwise undetectable small subsurface magma movement. We examine here data recorded during the 2000 eruption of Hekla, Iceland and a small explosion in 2004 at Soufriere Hills, Montserrat. In both cases a small network of Sacks-Evertson borehole dilatometers recorded strain changes before and following the surface manifestation of the activity. For the Hekla eruption, we also have deformation data from campaign GPS, dry tilt and InSAR. From these data we constrain the subsurface geometry of the magmatic system including the reservoir and conduit or dike that forms to connect the reservoir to the surface. Additionally, for the interval preceding surface release of material, we can apply conservation rules for a closed system: we use the relation dV/V= -dP/K (dV is volume change, V is volume, dP pressure change, K is incompressibility). From the data we can estimate values for the dike (or conduit) volume which is also (assuming constant density) the change in reservoir volume and also for the product dP*V for the reservoir. This allows calculation of the bulk modulus (more correctly a lower limit). Our results indicate that for Montserrat the bulk modulus of the reservoir is quite low (implying a few volume percent of gaseous phases); for Hekla the modulus is very high implying a gas poor (free?) reservoir. The somewhat surprising result for Hekla is consistent with having all the free gas moving into the magma filled conduit that persists during the short ($\sim$10 years) interval between eruptions.