Geophysical Research Abstracts
Vol. 14, EGU2012-4706-1, 2012
EGU General Assembly 2012

Deep-level magma dehydration and ascent rates at Mt. Etna (Sicily, Italy)

P. Armienti (1), C. Perinelli (1), and K. Putirka (2)

(1) Dipartimento di Science della Terra, Università di Pisa, Pisa, Italy (armienti@dst.unipi.it), (2) Department of Earth and Environmental Sciences, California State University, Fresno , USA (kputirka@csufresno.edu)

Magma ascent velocity, v (*dH/dt*; H = depth, t = time),can be determined from ascent rate (*dP/dt*), and rate of cooling (*dT/dt)*: *v= 1/(r*gpg) *(dP/dT)(dT/dt)* where r is magma density, P is pressure, T is temperature and g is the acceleration of gravity. This equation for v provides a key to investigating the relationships between initial ascent rate of magma and the depths of magma dehydration, and v can be calculated using pressure and temperature ($P - P_{H2O} - T$) estimates from mineral-liquid thermobarometry, and cooling rates inferred from Crystal Size Distribution (CSD) theory. For recent Mt. Etna lava flows, both *dP/dT* and *dT/dt* have been well characterized based, respectively, on clinopyroxene thermobarometry, and clinopyroxene CSDs (the latter yields *dT/dt* = 2x10^{-6} $^{\circ}$C/s). Deep-level ($>$20 km) magma ascent rates range from practically 0 (where clinopyroxene $P - T$ estimates form a cluster, and so *dP/dT* $\approx$ 0), to about 10 m/hr for flows that yield very steep $P - T$ trajectories. Many lava flows at Mt. Etna yield $P - T$ paths that follow a hydrous (about 3% water) clinopyroxene saturation surface, which closely approximates water contents obtained from melt inclusions. Independent assessments of deep level water content yield ascent rates of $\sim$1 m/hr, in agreement with the slowest rates derived for magma effusion or vapor-driven ascent ($\sim$0.001 to $>$0.2 m/s, or 3.6 to 720 m/hr). Changes in $P - T$ slopes, as obtained by pyroxene thermobarometry, indicate an upward acceleration of magma, which may be due to the onset of deep-level magma dehydration linked to the non-ideal behavior of water and CO_2 mixtures that induce a deep-level maximum of water loss at $P \approx$ 0.4 MPa at T $\approx$ 1200 $^{\circ}$C for a CO_2 content $>$1000ppm. Melt inclusion data on CO_2 and H_2O contents are successfully reproduced and interpreted in a context of magma dehydration induced by a CO_2 flux possibly deriving by decarbonation reaction of the carbonate fraction of the Capo D'Orlando flysch.