Geophysical Research Abstracts, Vol. 9, 01838, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01838

Rheological Behavior of Monte Nuovo Magma (Phlegrean Field, Italy)

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The rheology of a natural magma from the Monte Nuovo eruption has been investigated using different experimental techniques. The dependence of the viscosity of the trachytic matrix on temperature (658-1769 K) and water content (0-4 wt. %) has been characterized utilizing the concentric cylinder and micro-penetration techniques (Giordano et al., 2004). A series of torsion deformation-experiments have been performed in an internally heated Paterson-type apparatus to quantify the effect of crystals on the rheology of this magma. The porosity present in the collected scoriaceous samples has previously been removed, annealing the samples at 300 MPa confining pressure and 1073 K. The degree of crystallinity (50 vol. %) of the samples, before and after the experiments, was determined by image analysis of back-scattered electron images from electron microprobe. In the temperature and strain rate range investigated (525-630 ˚C, 10^{-6}-$9\cdot10^{-5}$ sec.$^{-1}$) the interstitial melt phase behaves Newtonian according to Webb and Dingwell (1990), allowing the distinction of non-Newtonian effects produced by the presence of crystals. The viscosity is about two orders of magnitude higher than the melt matrix alone; no yield strength was observed and shear-thinning behavior occurred at a strain rate around $3*10^{-4}$ sec.$^{-1}$. In an additional experiment the deformation direction was inverted, after the material reached constant flow stress. This inversion produced a strong decrease of the crystal size, and, consequently a decrease of the crystal size distribution that, in turn, caused

an increase of viscosity.

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