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The rheology of Vesuvius magmas

D. Giordano (1), P. Ardia (2), A. Mangiacapra (3), C. Romano (1), D.B. Dingwell (4), R. Cioni (5), M.W. Schmidt (2), K.-U. Hess (4)

(1) Dip.to Scienze Geologiche, Università di Roma Tre, L.go S. Leonardo Murialdo, 1, 00146 Roma, Italy, (2) Institute of Mineralogy and Petrology, ETH, Zurich, Switzerland, (3) OsservatorioVesuviano, INGV, Napoli, Italy, (4) Earth & Environmental Sciences Dept., Munich University, Munich, Germany, (5) Dip.to Scienze della Terra, Cagliari, Italy. (dgiordano@uniroma3.it)

The Vesuvius volcano, located in Southern Italy, west of the city of Naples, is probably the most famous active volcano in the world because of its record of highly destructive eruptions that affected the surrounding areas, one for all is the famous eruption of Pompei in the 79 AD. Eruptive style at Vesuvius largely varies from effusive to explosive and is strongly controlled by the evolution of the physical and chemical state and properties of the magma at pre-eruptive conditions. However, with exception of previous investigations of products from the 1631 eruption [1, 2], rheological properties of Vesuvius products are still unconstrained. Here, we investigate the viscosity of anhydrous and water-bearing remelted glassy products from the Mercato (plinian) and 1906 (violent strombolian) Vesuvius eruptions that differ for size, eruption styles and chemistry (phonolite vs. phonolitic tephrite). The experimental methods consisted of concentric cylinder techniques for homogenization and determination of viscosities at high temperature (T=1100-1600˚C) anhydrous melts and viscosities between 10^1 and 10^5 Pa s; piston cylinder synthesis of hydrated melts (T=1200˚C; P=10 Kbar); micropenetration viscometry for low T viscosity measurements of anhydrous and hydrous melt at 1 atm (temperature between 320 and 780˚C, viscosities between $10^{9.1}$ to $10^{12.7}$ Pa s), and of FTIR spectroscopy for the sample H_2O content and homogeneity. Compositions were determined using electron microprobe. The results from this study were parameterized by a modified Vogel-Fulcher-Tammann equation, accounting for the effect of water and composition, and compared with previous analysis. These results are crucial for the hazard assessment related to different volcanic scenarios at Vesuvius through numerical simulation tools.

[1] Romano et al., 2003, Chem. Geol. 202, 23-38; [2] Giordano et al., 2006, Chem Geol. 229,42-56