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Water and the viscosity of shoshonitic and latitic melts compositions

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In this work we present new results on the hydrous viscosity of two melt compositions characteristic of the products of Campi Flegrei caldera, Italy. Viscosity is the major physical parameter controlling the eruptive behaviour of a volcano and it also plays an important role in the differentiation processes of magmas. Therefore, detailed knowledge of this melt property is essential for understanding magma processes.

It is known that viscosity strongly depends on temperature, chemical composition, crystals, bubbles and volatile content, particularly water.

We performed viscosity measurements on hydrous trachybasaltic and latitic compositions to investigate the viscosity variation caused by varying water contents and compositions. In addition, the activation energy was estimated in order to evaluate the response of viscosity to temperature changes.

Firstly, we synthesised samples with different water content (0.5- 2wt\%) using an Internal Heated Pressure Vessel at 200 MPa and 1473 K. We checked the water content and whether it had a homogenous distribution using Fourier Transform Infrared spectroscopy, before and after the viscosity measurements. To obtain more accurate water content determinations, the molar absorptivity has been calibrated for both compositions (Di Matteo et al., this volume). Viscosity measurements using the micropenetration technique were performed between 883 and 893 K, depending on the glass transition temperature (T_g) of each sample. In order to evaluate the T_g we performed calorimetric measurements using differential scanning calorimetry. For each sample

the cooling rate was unknown and the heating rate 10 K/min. T_g was defined as the onset of the glass transition.

Viscosity strongly decreases with the addition of water, according to the melt structure theory, which places water among the most efficient structural modifiers. The viscosity decrease is greatest at lower temperatures. Addition of water also causes decrease of the activation energy. The results of this study are broadly consistent with existing viscosity models. A detailed comparison of the entire data set is currently being performed.