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Viscosity experiments on basaltic and andesitic melts

S.Bertolino, C. Cigolini

Department of Mineralogical and Petrological Sciences, University of Turin, Italy,

via Valperga Caluso 35, 10125 Torino, Italy

sara.bertolino@unito.it / Fax: +390116705128 / +390116705111

We performed a series of viscosity experiments in order to investigate the evolution of the liquid phase of a silicate melts during its crystallization and to quantify the contribution of crystals during the cooling process.

Viscosity has been measured applying the "falling sphere" method at decreasing temperature steps, in a range between 1300 ˚C and 900 ˚C, to basaltic (Stromboli) and andesitic (Arenal, Costa Rica) melts. The starting melts has been obtained from pressed powdered specimen annealed at 1300 ˚C for 24 h in a furnace with oxygen fugacity controlled and then quenched (Bagdassarov & Dorfman, 1998). After each T-step experiment the resulting glass has been analyzed with a SEM-EDS microscope in order to estimate the proportion of melt and crystals along the glass itself. Successively melts are synthetically reproduced with the exactly bulk composition of the previous T-step experiment.

The combination of viscosity measurements and crystal size distribution techniques allow us to reconstruct the crystallisation history of the rocks.

This type of study allows construction of "crystallinity vs. temperature", "viscosity vs. temperature" and "yield strength vs. temperature" graphs.

Moreover we compared experimental results with the ones obtained from applying conventional mathematical models (modified Einstein–Roscoe equations), non conventional model (we derrived a "modified" Tamman-Vogel-Fulcher equation by integrating the model of Giordano and Dingwell (2003) with that of Shaw (1968)), thermodynamic modelling (MELTS) and in situ measurements on rocks with the same (or very similar) bulk composition of the starting glass.