

SIT041-06

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Metastable melt properties under pressure: a grand challenge of profound importance.

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Melt viscosity, silicate and metallic, at high pressures remains one of the outstanding challenges of earth materials research. The experimental challenges to viscosity determination at extreme pressures are multiple, primarily involving the feasibility of achieving large isothermal domains of liquid silicate where the significant strain involved in most viscometry methods can be adequately observed. Driven by the scientific questions regarding the nature and efficiency of processes at the estimated extreme thermal regime of the deep earth, the experimental progress has been dominated by the superliquidus temperature range of experimental viscosity determinations. The work is certainly delivering increasingly adequate coverage of the very high P high T range of melt viscosity, but it is not and cannot provide a comprehensive picture of melt rheology that is sufficient for the purpose of developing generalisable viscosity-composition relationships. This is because the very strongly non-Arrhenian temperature-dependence of viscosity observed universally for molten silicates at low pressure and anticipated at high pressure as well. Thus I propose that the experimental task of describing melt viscosity at very high pressures. I propose therefore that the experimental strategy to obtain melt viscosity at very high pressures be complemented by lower temperature techniques. In this manner the complete viscosity-temperature relationships of molten silicates at very high pressures may become accessible. This strategy has been the key to the development of recent high-quality multicomponent models of melt viscosity such as the GriD model (Giordano, Russell, Dingwell, EPSL, 2008). I urge the experimental testing of the feasibility of techniques aimed at obtaining glass transition temperatures and relaxation time determinations at temperatures just above this transition. I will present some possible lines of approach for such experimental strategies including the experience gained from lower pressure for handling such materials under what are metastable conditions.

Keywords: melt, silicate, viscosity, pressure