

In situ measurement of viscosity of liquids in the Fe-FeS system at high pressures and temperatures

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ABSTRACT

The viscosity of liquid FeS and Fe-FeS eutectic was measured at pressures between 0.5 and 5.0 GPa using a synchrotron-based falling sphere technique. We obtain viscosities of 2×10^{-2} to 4×10^{-3} Pa-s in FeS at 1450 to 1700 °C and 2×10^{-2} to 8×10^{-3} Pa-s in Fe-S_{eut} at 1150 to 1380 °C. These results are consistent with recent viscosity measurements in Fe-S_{eut} at 5 to 7 GPa (Urakawa, in preparation), measured diffusivities (Dobson 2000) and ab initio simulated viscosity (Vočadlo et al. 2000). The results are also similar to the values for pure iron at low pressure (Shimoji and Itami 1986). A systematic increase in viscosity and activation energy is seen with increasing sulfur content. Interpolation between the data presented yields a viscosity of 1.4×10^{-2} Pa-s for an outer core composition with ~10 wt% S at the melting temperature. There is good evidence of homologous behavior for Fe-S liquids which implies that the liquid alloy at the inner core boundary may have a similar viscosity.