

increased melt polymerization and therefore higher viscosity. The behaviour of quartz and sapphire dissolving in a melt was examined in the CAS system (CaO = 32.50, Al₂O₃ = 17.50, and SiO₂ = 50.00 weight percent). Experiments, two with quartz and two with sapphire, were carried out for 300 and 1800 seconds at 1600 °C and 1.5 GPa. The rate constants, determined by mass balance, are 2.2 m/s^{0.5} and 0.73 m/s^{0.5} for quartz and sapphire respectively.

Quartz dissolution results in a smooth diffusion profile for SiO₂ and CaO. However, Al₂O₃ shows unusual behaviour as there is a distinct peak in Al₂O₃ values, i.e., ~0.5% enrichment over the composition of the solvent which is not expected given that the dissolving phase is silica. For sapphire dissolution all profiles are as expected, i.e., Al₂O₃ decreases outward while SiO₂ and CaO increase outward.

Calculations of the variation in viscosity give an indication of the effect of the added components on melt structure. As expected, addition of SiO₂ leads to significant increase in the viscosity of the interface melt compared to the solvent i.e. 50–60 Pa s at the interface compared to ~1 Pa s in the solvent. Previous studies indicate that as the CaO/(CaO + Al₂O₃) ratio (Ca#) of melt decreases, there is a marked increase in viscosity. The data indicates that contrary to expectations, viscosity decreases by two orders of magnitude as the Ca# decreases inward. These experiments cover a different range of composition than those in the literature – (Ca# 60–77, compared to 40–62 in the literature). Preliminary data suggest that Al₂O₃ may have a different structural role in the melts produced in these experiments (acting as network modifiers rather than network formers).

**A comparison of the behaviour of SiO₂ and Al₂O₃
during dissolution of quartz and sapphire in a
CaO-Al₂O₃-SiO₂ melt at 1600 °C and 1.5 GPa**

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Since silicon and aluminium are considered to be network forming cations in silicate melts, their addition should result in