isotopic composition of igneous rocks. Current models deal with the geochemical and thermal evolution of such systems but ignore a fundamental variable: is enough time available for assimilation of the solid into the magma before it solidifies? Incorporation of cations from a dissolving mineral will, unless mineral and melt have the same composition, lead to a change in the structure of the melt adjacent to the crystal and to the development of chemical potential gradients in the melt. If network forming cations such as silica or alumina are added, the interface melt should become more viscous than the solvent. If the proportion of network modifying cations added is greater than that of network formers then the interface melt should become less viscous. In both cases, melt viscosity can be used as a proxy for the degree of polymerization. The difference in the degree of polymerization from interface to far field, measures the degree of change needed to equilibrate the solvent with the interface melt. Since the network forming cations are generally considered to be the slowest diffusing by virtue of their strong bonds with oxygen it is expected that dissolution rates of minerals should be related to the degree of resistance to change in the network structure of the melt. Tests of this hypothesis using literature data show that there is a direct correlation between the dissolution rates constant measured in experiments and the difference in viscosity, and therefore melt structure, between the solvent melt and the melt at the dissolving crystal interface. For dissolution of olivine in andesite and quartz in synthetic melts in the CMAS system, the dissolution rate constant increases as the viscosity difference between interface and solvent melt decreases. The data indicate that there is a maximum possible dissolution rate when the viscosity difference is zero and no structural rearrangement is required. This should correspond to the rate of interface reaction. The observed relationships suggest that it may be possible, given knowledge of the viscosity of the melts and experimentally determined rate constants, to compute assimilation rates as a function of temperature.

First steps in the development of a predictive model for xenolith assimilation rates: the link between melt structure, viscosity, and mineral dissolution rates

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Assimilation has significant effects on the trace element and

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