

Trace elements in silicate melts: Understanding bonding environments at high pressure

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Trace elements are highly fractionated during planetary differentiation events. The resulting mineral-melt partition coefficients are used to constrain a range of geological processes. The dependence of these coefficients on pressure, temperature, and compositional changes in crystalline structures is well understood. By contrast, experimental data on the influence of melt structure on mineral-melt or melt-melt partitioning is lacking due to the difficulty of collecting structural information on trace element bonding environments *in-situ*.

Extended X-ray absorption fine structure spectroscopy (EXAFS) and X-ray diffraction can provide *in-situ* structural data on short to medium range bond environments in melts. Here we present results from both techniques identifying the bonding environment of key trace elements (Lu, Hf, Y, Zr) *in-situ* <10 GPa and <1500°C. The speciation of these elements was determined in both polymerised (granitic) and depolymerised (basaltic) melts in order to explore the effects of compositional variation, pressure and the glass transition on trace element speciation in the melt. We compare the advantages of both techniques for studying trace element bonding in melts and provide insight into whether, in some cases, glasses can provide an accurate representation of melt structure. Understanding these structural properties will help critically assess partitioning models and our understanding of the large scale differentiation and magmatic processes that have shaped rocky planets since their initial formation.