

## Effect of Water on Trace Element Partitioning in Komatiitic Melts

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### Introduction

Erupting in the Archean, komatiites are high-MgO ultramafic rocks which are a key constraint of compositional and thermal evolution in the mantle. The origin of komatiites is increasingly controversial for a number of reasons. The most basic debate comes down to what model best fits komatiites: an upwelling plume, a MOR-equivalent, volcanic arc setting, or a magma ocean within the mantle. A related, and equally debated issue is that of water content in komatiites. Some proponents [1] suggest very low to negligible water content with high temperatures ("dry") for melting regimes, while others [2] advocate moderate to even very high amounts of water with lower temperatures ("wet").

Recent studies [3] have suggested that the effects of water and temperature on trace element partitioning can be isolated from each other. For example, it appears that certain HFSE partition differently than REE with varying water contents and temperatures, such as Sc/Lu. Thus, we are investigating the effects of water on trace element partitioning in komatiitic liquids to see if certain trace elements can be used as indicators of the presence or absence of water. Certainly, this would have implications not only for the "wet/dry" komatiite debate, but could potentially be used as a tool to look for the presence of magmatic water in any system.

### Experimental Procedure

**Starting Materials:** The starting materials are a modification of Walter's [4] melt and solid phase compositions, in which the melt composition is very similar to a Gorgona komatiite [5]. Our starting material alters the ratios of the components so that there is a 7:3 ratio of melt to solid phases. The hydrous starting material has the same dry analysis as the anhydrous, but contains ~10 wt% H<sub>2</sub>O.

**Apparatus and Assembly:** All experiments will be done in a Walker-style multi-anvil apparatus at the University of Bristol, using an 18/11 pressure assembly. Preliminary experiments are underway looking at crystal-liquid partition coefficients in clinopyroxene and garnet at 4 Gpa. We expect to show trace element partitioning data for both wet and dry runs in the pressure range of 4-7 GPa.

### References

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## Immobilization of metals at the cell wall of subsurface bacteria during anaerobic respiration

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*Geobacter sulfurreducens*, an obligate anaerobe and *Shewanella putrefaciens*, a facultative aerobe, are important in subsurface marine and terrestrial environments due to their abundance and their ability to respire metals by dissimilatory processes that result in reduced metal species. The fate of the reduced metals is poorly understood; post-reduction pathways for Fe lead to the formation of FeII minerals (Glasauer et al., 2003), but little is known about other metals. Technetium, uranium and vanadium are elements of concern at several U. S. Department of Energy sites. Reduction of Tc(VII) and U(VI), the common higher oxidation states, could potentially immobilize the metals by the formation of insoluble Tc(IV) and U(IV); little is known about transformations of V, which has three common oxidation states.

Both *G. sulfurreducens* and *S. putrefaciens* form dense accumulations of fine-grained metal precipitates in the periplasmic space during reduction of soluble Fe, V, Tc and U. The ability to reduce soluble metals is attributed to periplasmic proteins including small, low-redox-potential c-type cytochromes and hydrogenases for both *Geobacter* and *Shewanella* species (Lloyd et al., 2003; Tsapin et al., 2001). Indeed, when soluble metals were reduced by these organisms, insoluble metal oxide precipitated in the periplasm. In contrast, when mineral-bound metals (metal oxides) served as electron acceptors the membrane or periplasm did not accumulate metals during reduction, shown by extensive TEM-EDS studies. This behavior may reflect differences in the sites of metal reduction according to the location of reductases within the cell envelope. With respect to mineral formation, metal immobilized in the periplasm during reduction of soluble metal species appeared to remobilize during cell senescence; the reduction of metal oxides resulted in the direct formation of insoluble extracellular precipitates. The results have implications for the remediation of sites contaminated with these metals as well as for their global cycling.

### References

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