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The role of fluids in HFSE fractionation

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High field strength elements are important geochemical indicators in many geological settings, in particular in subduction zones. The HFSE signature of arc magmas is depleted relative to MORB, and there is much debate about the cause of this. Interaction between crustal and mantle rocks, and fluids liberated during metamorphism are critical for the transport of elements within the Earth, and the generation of diverse geochemical signatures. Relative depletions in HFSE have been attributed to the immobility of Ti in crustal fluids, and hence the retention of Ti and HFSE in rutile within the subducted slab. A fundamental premise of most mass-flux calculations in fluid transport is that Ti is essentially immobile in these metamorphic systems due to its low solubility in fluid, coupled with strong retention in Ti-bearing minerals such as rutile, ilmenite and titanite. As a consequence, the 'constant Ti' frame of reference is widely used with evaluation of metasomatism and open-system behaviour, supported by experiments that have demonstrated quite low Ti solubility in aqueous fluids [1-3].

We have performed novel experiments in saline fluids, which indicate that F (and Cl) greatly enhances the solubility of rutile, and hence increases the mobility of Ti. We will show that this has implications for the mobility of the other HFSE, which are strongly sequestered into Ti-phases such as rutile [4,5]. The experimental run products have been analysed using isotope dilution ICP-MS techniques [6,7] to estimate rutile/fluid partition coefficients which may be used to determine the relative mobility of HFSE in some potential metamorphic fluids. We will show that fluids may have a strong fractionating influence on the HFSE budget of metamorphic rocks, and may influence our interpretation of the global Nb/Ta budget.

References

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