Hf-isotopes in subduction settings: The plot thickens

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In many branches of Science innovation is often driven, at least in part, by the development of new analytical technologies e.g., the recent advent of MC-ICPMS instrumentation has resulted in a worldwide resurgence of interest in the Lu-Hf isotope system. In the subduction environment Hf-isotope analyses potentially offer new perspectives on mantle reservoir evolution, HFSE depletion, and slab fluxes. Although results obtained to date certainly reveal a remarkable (and often unexpected) level of variation, as yet many questions remain unanswered.

One early result was that many arc lavas are significantly displaced from their co-existing backarc spreading centres, which can be considered to sample local mantle. This appears true not only of arcs in which direct sediment melting or AFC-like processes in the crust are implicated but also in low-K tholeiitic arcs where hydrous fluids were thought to be the dominant medium of transport. Studies of back-arc settings have now revealed additional complexity with isotopic compositions apparently far more variable than those observed in the arcs themselves!

In the light of these results many early conclusions may require re-evaluation. Can Nd-Hf relationships still be used to infer mantle parentage (i.e Indian or Pacific MORB)? Is Hf a 'conservative' element in subduction zones and how representative is Hf of the HFSE in general? Are so-called 'fluid moderated' arcs still showing a predominantly sedimentary signature, or can Hf be transported in slab-derived aqueous fluids under subduction zone conditions? To what extent are field observations at odds with experimental results? These questions will be considered in the light of both new and literature Hf-isotope data.

Some isotopic constraints on fluid versus melt transfer from slab to wedge: Hf isotope evidence from the South Sandwich arc

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Whilst we know that arc magmatism derives from the mantle wedge and that the wedge becomes enriched during slab dehydration, there remains considerable debate regards whether the transfer medium for enrichment is a hydrous fluid or a silicate melt. Furthermore, arcs appear to vary in terms of whether the recycled material is dominantly altered oceanic crust or its overlying sediment. HFSE, such as Hf, provide a powerful tool for investigating these questions, due to their relative immobility during slab dehydration. In the geologically simple intra-oceanic South Sandwich subduction system we find evidence for Hf immobility *and* mobility, depending upon the setting within the subduction system. In slab-end proximal and rear-arc volcanoes Hf behaves mobile reflecting contribution from a sediment melt. The main arc does not show Hf mobility but instead clearly demonstrates derivation from a source dominantly influenced by fluid-driven enrichment. The nature of the fluid contribution can be spatially divided into two areas: the northern part of the main arc is dominated by oceanic crust-derived fluids whereas the southern part is dominated by sediment-derived fluids.