Fate of immobile elements in subduction systems: a Hf isotope study of southern Sardinia

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Miocene subduction-related basalts and basaltic andesites from southern Sardinia provide geochemical evidence for derivation from an enriched mantle source, with virtually no crustal contamination [1]. The rocks show remarkable correlation between SiO_2 and $^{87}Sr/^{86}Sr$, contrasting with most other arcs, including the Aeolian. Sardinian rocks appear to form a baseline trend from which other arcs diverge, intermediate between primitive Aeolian arc and lithosphere-derived, Tuscan potassic volcanics. The distribution is thought to reflect different styles of mantle wedge enrichment, e.g. sediment melt vs aqueous fluid. While it has been argued that Hf isotopes offer a useful isotopic tool for "seeing through" the subduction process into the nature of the sub-arc mantle wedge, recent studiees have shown that this may not be the case for all tectonic settings, e.g. during subduction of young (hot) oceanic crust and/or when continent collision has slowed subduction rates so that slab temperatures increase to levels suitable for sediment melting. Here we use Hf isotopes and REE/Hf and LILE/Hf ratios to investigate the case of southern Sardinia.

Results

In Nd-Hf isotope space the samples plot within the Terrestrial Array, but at higher εHf for a given εNd ratio than other subduction-related rocks of central Italy; εHf values range from –7.4 to 8.4. The data form steep, near vertical arrays in Sm/Hf and Th/Hf vs εHf. High Th/Hf ratios (~2), combined with low Hf-isotope ratios, indicate relatively high sediment melt addition. Relatively low Sm/Hf ratios (down to 1.2) suggest detrital sand-rich sediments rather than pure pelagic clays. The data are consistent with the geodynamic evolution of the western Mediterranean proposed by [2] in which Miocene orogenic volcanism accompanied by marked steepening of the subducted slab during late stages of convergence resulted in higher temperatures and sediment melting. Hence, in southern Sardinia, Hf did not behave as a "conservative" element during subduction and was mobilized by sediment melting.

[1] Downes *et al* (2001) *J Volc Geotherm. Res.* **106**, 1-21 [2] Beccaluva *et al* (2011) *Lithos*, **123**, 218-224