The mantle source of the early stages of island arc magmatism: evidence from Hf isotopes in rutile from the Kohistan complex

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Island arcs are one of the primary sites of generation of new continental crust, and are also key locations to understand the proportion of subducted sediment incorporated into the source of arc lavas versus recycled deep into the mantle. The Kohistan complex (northeastern Pakistan) preserves a ~50 km thick cross-section through a Jurassic–Cretaceous island arc that is renowned as one of the best-exposed and most complete sections through an exhumed island arc. It affords a rare opportunity to study the chemical and isotopic evolution of island arc magmatism, from subduction initiation, through intra-oceanic subduction, to arc–continent collision.

In this study, we investigate the ultramafic–mafic Jijal Complex, which preserves part of the plutonic roots of the Kohistan island arc complex formed over ~20 Ma of intra-oceanic subduction. We characterise its mantle source using *in situ* LA-MC-ICPMS determination of the Hf isotope composition of rutile from mafic lithologies, which are zircon-free. This work exploits the superior sensitivity of the Neptune Plus, coupled with an improved analytical protocol, to improve precision of this novel technique and permit *in situ* analysis of rutile with only ~10–30 ppm Hf.

The analysed Jijal Complex samples are garnet-bearing gabbros and garnet-hornblendites with variable development of paragonite–quartz–epidote reaction textures attributed to interaction with residual hydrous melts. Rutile occurs included in early-formed minerals such as clinopyroxene and garnet, indicating crystallisation at high pressures and temperatures. Rutile from all samples has indistinguishable Hf isotope compositions close to depleted mantle, irrespective of the degree to which samples have interacted with residual melt. The new Hf isotope data for Jijal Complex rutile will be integrated with existing zircon Hf isotope data for other parts of the arc and published whole rock Nd–Sr–Pb isotope data. We aim to constrain the quantity and source of the limited enriched component in these arc magmas through time, documenting the evolution of the mantle source of this classic island arc complex during the early phases of subduction.