

Evidence from Hf and Nd isotopes for an old enriched component in abyssal peridotites from Leg 209 (central Atlantic)

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Abyssal peridotites allow valuable insights into small scale mantle heterogeneities that are lost in the record provided by oceanic basalts [e.g., 1]. To address this issue further, we report trace element concentrations and Sr-Nd-Hf isotope compositions for mantle peridotites and gabbroic rocks collected from the 15° N 20' fracture zone in the Atlantic during ODP Expedition 209. The peridotites, previously described by [2], are highly serpentinized and consist of former harzburgites and dunites with variable trace element enrichments and alteration styles. Isotope and trace element analyses were conducted on bulk rock samples and leachates/residues obtained through HCl leaching experiments.

Most samples exhibit ranges for ϵ_{Hf} (+15 to +20) and ϵ_{Nd} (+6 to +11) typical for the depleted upper mantle. However, two dunite bulk samples display anomalously unradiogenic Hf ($\epsilon_{\text{Hf}} \approx -18$) while retaining ϵ_{Nd} values similar to the other samples. Leachate residues from these samples showed similar unradiogenic Hf and, in one case, also unradiogenic Nd ($\epsilon_{\text{Nd}} \approx -12$). These findings suggest the presence of an ancient enriched component in the oceanic mantle with a crustal or melt-like signature. Such a signature was later modified by metasomatic processes that enriched the rocks in rare earth elements (REEs), especially light REEs, but without achieving full chemical equilibrium at the bulk scale. This study highlights the heterogeneity of the oceanic lithosphere, which contains ancient domains with different Hf-Nd signature, from ultra-depleted [e.g., 1] to enriched.

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[1] Sanfilippo et al. 2024 Nat Geosc 17-10, 1046-1052

[2] Paulick et al. 2006, Chem Geol 234-3, 179-210