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Recycled material in OIB sources: Os isotopes and HSE in the fossil Galapagos Rise Lavas

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There is now growing evidence from trace elements and lithophile-element based isotopes (e.g. Sr, Nd, Pb) that enriched lithologies (e.g. pyroxenites) are significant contributors to the heterogeneous signatures of the Earth's mantle and a major source component in enriched basaltic melts such as the E-MORBs or OIB [1, 2].
Owing to the opposite geochemical behaviour of Re and Os during partial melting, the Re-Os isotopic system may be most sensitive to trace recycling and thus provide further insights into the mantle heterogeneity and its origin. We have analysed N-MORBs and E-MORBs from the fossil Galapagos Rise for 187Os/188Os ratios and highly siderophile elements (HSE). The distinct signatures in trace elements and Sr-Nd-Pb isotopic systems between these N- and E-MORBs have been attributed to variable contributions of a pyroxenitic source component due to variable mantle melting degrees and the ceasing of the spreading [3].
Both E- and N-MORBs show the overall positive-sloped HSE patterns, typical of partial melts. However, the E-MORBs are generally richer in Os, Ir, Ru Pt and Pd but contain less Re than the N-MORBs. E-MORBS contain 3.5 to 38 ppt Os and 117-230 ppt Re (Re/Os=6-33) while the N-MORBs have <1-4.5 ppt Os and 230-1190 ppt Re (Re/Os=115-690). N-MORBs have slightly radiogenic to radiogenic initial 187Os/188Os ratios (0.19-0.74) while the E-MORBs have extremely radiogenic initial 187Os/188Os ratios (0.90-0.99). Strikingly, the Galapagos Rise MORBs define a positive trend between Os concentrations and initial 187Os/188Os ratios, opposite to what is usually observed in OIB [4]. This trend suggests that the extremely radiogenic signatures of the E-MORBs may be a primary feature revealing a MORB source reservoir with a long-term Re-enrichment (i.e. high Re/Os).
Whole-rock pyroxenites and eclogites as well as their sulfides and platinum group minerals are likely candidates as source materials since they can develop similarly radiogenic signatures especially if residing in the mantle for a few billion years [5].

[1] Stracke and Bourdon (2009), GCA 73, 218-238. [2] Sobolev et al., (2007) Science 316, 412-417.[3] Haase et al., (2011) G3, 12, Q0AC11. [4] Widom (1997), Physica A 244, 484-49. [5] Luguet et al., (2008), Science 319, 453-456.