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Os isotopic constraints on the identification of pyroxenite in the source of OIBs

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The Re-Os isotope system has become increasingly used as a tracer of lithological heterogeneity in the convecting mantle, with radiogenic 187Os/188Os in high-Os oceanic basalts and picrites widely interpreted as evidence of a melt contribution from ancient recycled oceanic crust. When combined with 206Pb/204Pb and O isotopes, 187Os/188Os ratios have been used to identify distinct lithological units (i.e. sediments, gabbros and basalts). We report new 187Os/188Os for basalts with high Os (>40 ppt) and MgO from Galápagos, which range from near primitive mantle values (0.130) to highly radiogenic (0.155). While co-variations in 187Os/188Os and 206Pb/204Pb for some Galápagos basalts (Floreana-type) are HIMU like, and consistent with melting of ancient recycled oceanic crust, others have variable 187Os/188Os ratios and primitive to depleted mantle like 206Pb/204Pb. Similar variations in Os and Pb isotopic space have been interpreted in other OIB suites as melts from recycled ancient oceanic gabbros, entrained by upwelling mantle plumes. Nevertheless, a marked east-west spatial variation in 187Os/188Os of Galápagos basalts does not correlate with postulated lithological variations in the Galápagos plume based on trace element contents of olivine (Vidito et al., 2013). We show that basalts in eastern Galápagos with elevated 187Os/188Os and positive Sr anomalies occur in the vicinity of over-thickened 10 Ma gabbroic crust, that formed when the Galápagos plume was on-axis. We propose the elevated 187Os/188Os of Galápagos basalts are due to in-situ assimilation of young gabbroic lower crust, with high Re/Os, rather than melting of ancient recycled material in the Galápagos plume. In western Galápagos recent plume accreted crust is thick but more mafic, the melt flux higher and assimilation more sporadic.

The contamination thresholds of Os and MgO in Galápagos basalts occur at higher contents than for many global OIBs (Azores, Iceland, Hawaii) and may reflect both a relatively low melt flux into the crust from the weak Galápagos plume (Tp=1400 oC) and excess thickness of ridge-formed gabbro in the east of the archipelago. Similar in-situ assimilation of lower oceanic crust by high-Os and MgO-rich OIBs suites may have been overlooked in the quest for establishing melting of ancient recycled oceanic gabbro in hotspots and heterogeneity in the convecting mantle.