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Evidence for highly unradiogenic 187Os/188Os in the source of intraplate volcanism

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The most unradiogenic Os isotope ratios found in the ocean basins to date are from abyssal peridotites (187Os/188Os as low as 0.1139; Liu et al., 2008, Nature 452) and peridotitic xenoliths in Hawaiian hotspot lavas (as low as 0.1138; Bizimis et al., 2008, EPSL 257), pointing to early Proterozoic depletion, and from Azores hotspot lavas (as low as 0.110), interpreted to result from recycling of Archean oceanic lithospheric mantle (Schaefer et al., 2002, Nature 420). We have found similar 187Os/188Osin. ratios in samples from the Emperor Seamounts (as low as 0.1124) and even lower ratios from the Manihiki Plateau (as low as 0.1056), indicating that intraplate sources, in contrast to the upper mantle, preserve material having undergone older (Archean) depletion. Radiogenic 187Os/188Osin. isotope ratios were also measured. An Emperor Seamount sample with 122 ppt Os yielded an 187Os/188Osin. of 0.157, whereas a sample from Manihiki with 154 ppt Os produced a ratio of 0.171. The large range in initial Os isotope ratios, extending from very subchondritic to superchondritic ratios, points to intraplate (Large Igneous Province and hotspot) sources with recycled lithospheric materials. In contrast, Re-Os isotope data from Ontong Java and Parana LIPs produce isochrons with ages similar to those from Ar/Ar dating and 187Os/188Osin. ratios of 0.129 (Parkinson and Schaefer, 2001, AGU82(47); Tejada et al., 2013, EPSL 377–378; Rocha-Junior et al., 2012, EPSL 337-338), similar to those found in oridinary chondrites and estimated for the primitive earth (187Os/188Os of ~0.129). Our preliminary Re-Os isotope data from the Etendeka flood basalts yields a similar 187Os/188Osin. isotope ratio. Therefore, LIPs appear to sample both primordial (primitive) sources and sources with recycled lithospheric materials. Seismic data and geodynamic modeling suggests that the Large Low-Shear Velocity Provinces (LLSVPs) may be layered with a primoridal layer overlain by a basaltic layer of recycled material (e.g., Ballmer et al., 2016, G-cubed 17). G-Plates reconstructions suggest that the Ontong-Java and Manihiki LIPs, formed at a similar time and possibly as a single contiguous plateau originally, are likely to have sampled the two different layers of the LLSVP.