A mantle origin for Columbia River flood basalts from combined Os-Sr-Nd isotope systematics

EMILY A. PRINGLE[1], JAMES M. D. DAY[1], BRENDON MENDENHALL[1]

[1]Scripps Insitition of Oceanography, University of California-San Diego, La Jolla, CA, USA, eapringle@ucsd.edu, jmdday@ucsd.edu, bmendenh@ucsd.edu

Continental flood basalt (CFB) provinces represent large-volumes of intraplate magmatism occuring over short time-spans (typically <2 Ma). The Columbia River basalt group (CRBG), associated with the Yellowstone hotspot, NW USA, is one of the youngest (mid to late Miocene) and best-studied CFB provinces. The origin of CRBG volcanism is debated; it has been variously attributed to upwelling of a deep-seated plume capable of penetrating the continental lithosphere, a subduction component, or to shallow mantle melting processes. The Steens basalt group in SE Oregon is the oldest unit of the CRBG, with an initial eruption ~16.7 Ma [1]. The age and mafic compositions (up to 9 wt.% MgO) of Steens basalts makes them ideal samples with which to examine the onset of CRBG volcanism and to quantify the degree of crustal interaction with mantle-derived melts.

We report Re-Os, Sm-Nd, and Rb-Sr isotope data, as well as highly siderophile element (HSE: Re, Pd, Pt, Ru, Ir, Os) abundances in Steens and Imnaha basalts. Previous studies of CRFB, particularly on later formed units, have observed incompatible element enrichment and Os-Sr–Nd isotope variations attributable to crustal contamination. When normalized to primitive mantle, Steens basalt HSE patterns show depletions in the more compatible HSE (Ru, Ir, Os) compared to Re, Pd, and Pt. Due to their differing compatibilities, Re/Os and $^{187}Os/^{186}Os$ values are elevated in the crust compared to the mantle, which is relatively Os rich. Although a few Steens samples display age corrected $^{187}Os/^{188}Os$ values that are sub-chondritic (<0.128) and suggest a lithospheric component, most display values that are unradiogenic (0.1290-0.1307). Age corrected $^{87}Sr/^{86}Sr$ (0.7034-0.7039) and $^{143}Nd/^{144}Nd$ (0.5128-0.5129) values for Steens basalts are negatively correlated and fall on a trend between values for primitive mantle and mid-ocean ridge basalts. Together, the Os-Sr-Nd isotope data for Steens basalts show a geochemical signature of mantle material that is minimally contaminated by crust and support a model of a deeper mantle origin for CRFB without strong influence from subducted slab materials.

[1] Jarboe et al, 2008, *Geochemistry Geophysics Geosystems*