Mongolian Peridotite Xenoliths and the Composition of the MORB Mantle

RICHARD W. CARLSON[1], DMITRI A. IONOV[2]

[11]Carnegie Institution for Science, Department of Terrestrial Magnetism, Washington, DC, USA, rcarlson@carnegiescience.edu

[22]Geosciences Montpellier, Universite de Montpellier Dmitri.Ionov@gm.univ-montp2.fr

The mantle that melts to fuel volcanism along the global ocean ridges has long been suspected to be the chemical complement to continental crust (e.g. Hofmann, EPSL, 1988). Various attempts to reconstruct the composition of the MORB source mantle (DMM) use a combination of MORB and abyssal peridotite data. We pursue the composition of DMM with data for a newly collected suite of spinel peridotite xenoliths from Quaternary basaltic volcanoes in the Tariat region, Central Mongolia. The xenoliths are extremely fresh and dominated by samples with fertile (Al2O3 > 3.5%) compositions. The majority of samples, however, have radiogenic isotopic compositions in the range of modern MORB (0.7022< 87Sr/86Sr < 0.7035; 0.5129 < 143Nd/144Nd < 0.51335; 0.2831 < 176Hf/177Hf < 0.2834; 0.116< 187Os/188Os < 0.13) with flat whole rock BSE normalized incompatible element patterns for elements less incompatible than Sr, but increasingly depleted for more highly incompatible elements. Using abundance correlations versus Al2O3, the major element composition of the xenoliths at an assumed fertile Al2O3 content of 4.5 wt% provides major element abundances indistinguishable from the Salters and Stracke (G3, 2004) DMM estimate. The fertile Mongolian peridotites display a flatter slope of the mid- to heavy-REE suggesting that the approach used by Salters and Stracke may overestimate the role of garnet during the melting that produces MORB. The DMM composition calculated from the Mongolian xenoliths has Rb/Sr, Sm/Nd, and Lu/Hf ratios that would evolve the observed isotopic compositions starting from a BSE mantle in 2.3-2.9 Ga, consistent with estimates of the mean age of continental crust. Adding back 1.2 wt% average continental crust (Rudnick and Gao, TOG, 2014) to this DMM composition produces BSE-like concentrations of all elements with the exception of strong depletions in Nb and Ta and smaller depletions in Ti, supporting the observation of Hofmann (1988) that the HFSE depletion of the MORB source is not primarily due to continental crust extraction.