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Insights into the Iron Isotopic Composition of the Bulk Silicate Earth from Fresh and Fertile Mantle Peridotite Xenoliths from Tariat, Mongolia

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Iron is ubiquitous in all major geochemical reservoirs on Earth and the mechanisms that facilitate mass dependent Fe isotopic fractionation in the mantle are illustrative of evolutionary processes in the bulk silicate portion of planets. Past workers have investigated whether the bulk silicate Earth (BSE) Fe isotopic composition is chondritic and the implications for early planetary accretion and differentiation, but a consensus has still not been reached as to whether the BSE is essentially chondritic with respect to Fe isotopes. Peridotites, ultramafic igneous rocks characterized by high modal amounts of olivine and pyroxene, make up most of Earth's upper mantle, but few mantle peridotites exhumed at Earth's surface have escaped alteration or melt depletion. Here, we examine the Fe isotopic compositions of continental spinel peridotite mantle xenolith samples from Tariat, Mongolia collected and analyzed by Carlson and Ionov (2019) as a proxy for determining the Fe isotopic composition of the BSE. These peridotites are relatively fertile, fresh, and unaltered. Many of them have major element and radiogenic isotopic compositions within ranges predicted for the BSE and/or depleted mid-ocean ridge basalt (MORB) mantle. Thus, they may provide a representative window into the composition of the convective upper mantle and invite new insights into the Fe isotopic composition of the BSE. We selected 25 samples from a 97-sample suite using parameters of minimal or nonexistent alteration and fabric, and by using Al_2O_3 and Mg# fertility indices identified as representative of the BSE. We used sample dissolution and chromatographic separation procedures for Fe isotopes described in previous work. Following this, we analyzed the samples with the University of Florida's Nu Plasma 3D MC-ICP-MS and the University of South Florida's Thermo Neptune Plus MC-ICP-MS to determine their Fe isotopic compositions. We used the AGV-1, BIR-1, DTS-2, and PCC-1 rock standards to calibrate our instruments and ensure the quality of our measurements. We report our results using $\delta^{56,57}$Fe notation, where a $\delta^{56,57}$Fe value of zero is indistinguishable from chondrites, and use sample-standard bracketing to correct for instrumental mass bias. Initial results suggest a BSE that is slightly supra-chondritic with respect to its Fe isotopic composition.