^{142}Nd Evidence for Early (>4.53 Ga) Global Differentiation of the Silicate Earth

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Radioactive systems composed of refractory and lithophile isotopes are used to understand the silicate evolution of planetary bodies. Sm-Nd systematics, with its two decay schemes ^{146}Sm-^{142}Nd ($T_{1/2}$=103 Ma) and ^{147}Sm-^{143}Nd ($T_{1/2}$=106 Ga) represents one of the most powerful tracers of the early differentiation.

We present new high precision Sm-Nd data for chondritic meteorites (carbonaceous, ordinary and enstatite). Although our ^{142}Nd/^{144}Nd measurements are in agreement within errors of previous measurements [1,2,3], the high resolution obtained using the new generation of thermal ionization mass spectrometer shows that chondrites have ^{142}Nd/^{144}Nd ratios ~20 ppm lower than most of terrestrial rocks.

The most probable explanation is that all terrestrial rocks derive from a mantle reservoir with a high Sm/Nd ratio formed during the short lifetime of ^{146}Sm, i.e. in the first 300 My of solar system history. These data diminish the importance of a chondritic, or bulk silicate earth (BSE), composition source in the interpretation of the chemical and isotope systematics of the Earth. Coupling both Sm-Nd systematics, the global differentiation of the silicate Earth can be estimated to have occurred within the first 30 My after solar system formation (4.567 Ga) resulting in high-, and complementary, low-Sm/Nd ratio reservoirs that have remained separate over all of Earth history. Mass balance calculations show that most (70-95%) of Earth's mantle is compositionally similar to the incompatible-element depleted source of mid-ocean-ridge basalts. We propose that the complementary enriched reservoir, never sampled so far, is relatively small and could be located at the base of the mantle. A similar model for a deep enriched reservoir and its implications for high heat production and for the rare gas evolution of the Earth has recently been presented [4]. Such an early-enriched reservoir could serve both as a heat source for plume formation and a warm blanket to keep the outer core molten throughout Earth history and provide the energy needed to drive the geodynamo.

***References**: **[1]** Jacobsen S. B. and Wasserburg G. J. 1980. Earth Planet. Sci. Lett. 50:139-155. **[2]** Jacobsen S. B. and Wasserburg G. J. 1984. Earth Planet. Sci. Lett. 67:137-150.**[3]** Prinzhofer, A. et al. 1992. Geochim. Cosmochim. Acta 56:797-815. **[4]** Tolstikhin, I. and Hofmann, A. W. 2005. Phys. Earth Planet. Int. 148, 109-130.*