A mercury-like component of early Earth: U in the core and high mantle ^{142}Nd

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Recent ^{142}Nd isotope data indicate that the silicate Earth has an Sm/Nd ratio greater than the supposed chondritic building blocks of the planet. This elevated Sm/Nd has been ascribed either to a "hidden" reservoir in the Earth [1,2] or to loss of an early- formed terrestrial crust by impact ablation [3]. Since removal of crust by ablation would also remove the heat producing elements, K, U and Th, the difficulty of balancing terrestrial heat production with heat flow would be severe [3]. The alternative, a "hidden" reservoir is generally assigned to the silicate lower mantle. However a recent study shows that the core is a likely reservoir for some lithophile elements such as Nb [4]. We therefore performed high-pressure experiments using a piston cylinder device to address the question of whether core formation could have fractionated Nd from Sm and also acted as a sink for heat producing elements. Experiments were carried out at 1.5 GPa and temperatures between 1400ºC and 1650ºC using a starting mixtures of ~50wt% (Fe,Ni)S and ~50% of a synthetic silicate, doped with a lithophile trace element mix consisting of Zr, La, Ce, Nd, Sm, Eu, Yb, Th and U. The silicate was a basaltic composition in the system CaO-MgO-Al_2O_3-SiO_2 with variable amounts of FeO. After experiment, charges were analysed by electron microprobe and Laser Ablation ICP-MS. The results we present here show that addition of a reduced Mercury (or enstatite-chondrite)- like body rich in sulfur to the early Earth would generate a superchondritic Sm/Nd in the mantle and $^{142}Nd/^{144}Nd$ anomaly of ~14ppm relative to chondrite. Additionally, the S-rich core would partition U strongly and Th slightly, providing a substantial part of the "missing" heat source for the geodynamo.

[1] Boyet & Carlson (2005). *Science* **309**, 576-581; [2] Boyet & Carlson (2006). *Earth Planet. Sci. Lett.* **250**, 254-268. [3] Campbell & O'Neill (2012). *Nature* **483**, 553-558; [4] Wade & Wood (2001). *Nature* **409**, 75-78.