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Major element composition of Early Enriched Reservoir: Constraints from ^{146}Sm-^{142}Nd system and melting experiments of primitive peridotite

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Present Accessible Silicate Earth (ASE) has higher ^{142}Nd/^{144}Nd than most chondrites, and the difference between ASE and chondrites can be explained by the existence of a low ^{142}Nd/^{144}Nd reservoir, which formed as melt in the early Earth (Early Enriched Reservoir, EER) [1] and has been missing. The major element composition of EER has been still unclear, though it is crucial to estimate its chemical and physical properties, and essential to understand the origin and destiny of EER, which affect present composition of the Earth. In order to determine the major element composition of EER, we estimated the age and pressure-temperature condition of EER formation that can explain the Nd isotopic characteristics of EER, on the basis of the Sm-Nd partitioning and its dependence on pressure, temperature, and melting phase relation. We determined the major element composition of EER at the estimated pressure-temperature condition, by performing high-pressure melting experiments of the primitive peridotite with the method of Modified Iterative Sandwich Experiment proposed by Hirschmann and Dasgupta (2007) [2]. Then we calculated density of EER, and constructed a probable model for the origin of EER.

From the constraints of ^{146}Sm-^{142}Nd and ^{147}Sm-^{143}Nd systems, the EER was estimated to have formed at near-solidus temperature at a shallow upper mantle pressure, within 33.5 Myr after the formation of the solar system. The result of our experiments and previous studies indicate that the near-solidus melt is Fe-rich komatiitic at 7 GPa (this study), and picritic to basaltic at pressures less than 3 GPa [3,4]. The estimated density of the near-solidus melt is smaller than that of the primitive peridotite, suggesting that EER ascended in the mantle, and formed crust. Because the mantle potential temperature would have been high in the Hadean, EER should have formed at high pressure, and therefore its composition would have been Fe-rich komatiitic to picritic. Because the EER formation precedes to the Moon forming

last giant impact within 60-125 Myr after the formation of the solar system [5], EER, the Hadean komatiitic-picritic crust, was probably spattered from the Earth before or at the last giant impact. Thus EER has been lost, leaving the present Earth non-chondritic.

References:

[1] Boyet M and Carlson RW (2005) Science 309(5734):576-581

[2] Hirschmann MM and Dasgupta R (2007) Contrib Mineral Petrol 154(6): 635-645

[3] Davis FA et al. (2011) Earth Planet Sci Lett 308(3):380-390

[4] Falloon TJ et al. (2008) J Pet 49(4): 591-613

[5] Boyet et al. (2015) Geochim Cosmochim Acta 148: 203-218