$^{142}Nd/^{144}Nd$ variations do not require Hadean recycling of early continents

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The short-lived ^{146}Sm-^{142}Nd system, decays with a half-life of about 100 Myr and is a tracer for early Earth silicate differentiation events. Recently, Rosas & Korenaga [1] proposed that the ^{146}Sm-^{142}Nd isotope evolution of the early Earth may be best interpreted as the result of extremely rapid early continental crustal growth combined with extremely high early continental crustal recycling rates. However, as discussed by Jacobsen & Harper [2], recycling of continental crust only acts to reduce the magnitude of $\mu^{142}Nd$ in the depleted mantle. A Hadean Earth with no recycling is most effective in growing large $\mu^{142}Nd$ anomalies in the Hadean depleted mantle. We compare the $\mu^{142}Nd$ depleted mantle evolutions for the continental crustal growth and recycling curves of Rosas & Korenaga [1] with those of Jacobsen & Harper [2], which jointly use the long-lived and short-lived $^{147\text{-}146}Sm$-$^{143\text{-}142}Nd$ systems. It is the fractionation of the Sm/Nd ratio in the mantle (quantified by the $f^{Sm/Nd}$-value) that is needed to generate a positive $\mu^{142}Nd$-value in the depleted mantle. The Jacobsen & Harper [2]-type model with no recycling during the Hadean generates half the continental crust in the first ~100 Myr with an $f^{Sm/Nd}$ growing to +0.12 during this time. In contrast, the Rosas & Korenaga [1] model results in $f^{Sm/Nd}$ growing to +0.23 in the first 100 Myr by generating the full continental volume in the first ~100 Myr. These two extreme scenarios result in very similar depleted mantle $\mu^{142}Nd$-evolution during the Hadean, as well as for the rest of Earth's history. The reason is that with no recycling, an $f^{Sm/Nd}$-value of 0.12 is sufficient for the growth of $\mu^{142}Nd$ anomalies, while when there is major recycling, this value needs to be doubled to make up for recycling working against $\mu^{142}Nd$ growth. During the post-Hadean, the $\mu^{142}Nd$ evolution is no longer sensitive to Sm/Nd fractionation and is only affected by recycling and remixing of reservoirs with positive and negative $\mu^{142}Nd$-values. It is clear from these considerations that the $\mu^{142}Nd$-data of Archean rocks cannot be used to unequivocally argue for either a high rate of continental recycling, or necessarily any continental recycling during the Hadean.

[1] Rosas & Korenaga (2018) *Earth & Planet. Sci. Letts.* **494**, 42-49. [2] Jacobsen & Harper (1996) *AGU Geophys. Monograph* **95**, 47-74.