Abstract

Earth as we know today, externally as well as internally, is a consequence of the planetary evolution subsequent to its formation from the solar nebula at 4.56 Ga. The first five hundred million years of the Earth's history have been critical to this, during which, it differentiated into different density layers forming the core, mantle, crust, and atmosphere. Evidence for these differentiation events and their timings come from short-lived radionuclide systematics such as: ^{182}Hf-^{182}W ($T_{1/2}$ = 9 Ma); ^{146}Sm-^{142}Nd ($T_{1/2}$ = 103 Ma); ^{129}I-^{129}Xe ($T_{1/2}$ = 16 Ma). The timing of core formation has been constrained to within first 30 –50 Ma of the formation of Solar System, however, the early differentiation of the remaining Bulk Silicate Earth still remains enigmatic. Refractory Lithophile Elements (RLEs) like Sm and Nd are tracers of Silicate Earth Differentiation and by using ^{146}Sm-^{142}Nd short-lived isotopic systematics information about early differentiation events can be obtained. Using this tracer, important insights have been gained on the silicate differentiation that took place early in the history of Earth for which there are very few rock records. The signatures of these event(s) are preserved as anomalous $^{142}Nd/^{144}Nd$ isotopic compositions with respect to terrestrial standard that is assumed to possess the same ^{142}Nd isotopic composition as the accessible mantle of Earth. As known to us today, most of these signatures are limited in space to Greenland and Canada, and in time to Hadean-Archean Eons. Questions pertaining to the size of the early formed reservoirs: the EDR (Early Depleted Reservoir) and EER (Early Enriched Reservoir), remains unanswered and so are those on their preservation in time. In an effort to unravel some of these mysteries of the early differentiation of silicate Earth, I worked towards finding ^{142}Nd anomalies in various mantle reservoirs, focusing on rocks from the Indian Shield. In particular, Archean mantle and the non-convective mantle domains were of my interest. I studied several Archean granitoids and alkaline rocks including carbonatites of varying ages for their ^{142}Nd isotope composition. Since the anomalous composition (if present) vary in the sixth decimal for $^{142}Nd/^{144}Nd$ isotopic ratio (defined as $\mu^{142}Nd$), obtaining accurate and precise data is analytically challenging. The analytical procedures developed and adapted for this study reveal important information on the role of analytical methods in the possible generation of artefacts/bias in the measurements. In

addition, commonly used terrestrial standards, Ames Nd and JNdi-1, were found to have dissimilar $^{142}Nd/^{144}Nd$ ratio. This has an important implication to the value of $\mu^{142}Nd$ calculated, as depending on the choice of standard, anomalies may appear or disappear. Through this study I provide a cross-calibration of the two standards, which can be used for comparison of existing and future data. For future studies, I strongly recommend use of a homogeneous standard like JNdi-1. Using the information obtained from the analytical procedures, accurate and precise data were obtained for the TTGs and alkaline rocks of India. My study finds that the non-convecting mantle domains may not be the sites for preservation of the signatures of the EER. However, ^{142}Nd data from Singhbhum suggests that this oldest Archean Craton of India may have preserved evidence of the EDR.