

Heterogeneous Distribution of p-process Sm and Nd Isotopes in the Solar Nebula

R. ANDREASEN¹ M. SHARMA¹

¹ Dept. of Earth Sciences, Dartmouth College, Hanover NH;
rasmus.andreassen@dartmouth.edu;
mukul.sharma@dartmouth.edu

High precision Nd isotope measurements for the carbonaceous and ordinary chondrites show that they have distinct $^{142}\text{Nd}/^{144}\text{Nd}$ ratios that are approximately 30 and 16 ppm lower than those of the terrestrial standards. Assuming that the chondrite Nd isotopes are representative of the bulk earth, this observation has suggested that the earth's mantle contains a hidden enriched reservoir that resulted from a >4.53 Ga global differentiation event [1]. To the extent that both types of chondrites contain exotic pre-solar components, the variations in Nd isotope between the chondrites and terrestrial standards may not represent the bulk silicate earth. This issue is investigated using Sm isotopes in large bulk chondrite samples. The Sm isotopic composition of bulk carbonaceous chondrites is distinctly different from other meteorites and terrestrial standards. The Sm data (see figure) require a deficit in the p-process derived ^{144}Sm , ^{146}Sm and ^{142}Nd in carbonaceous chondrites, which is sufficient to lower their $^{142}\text{Nd}/^{144}\text{Nd}$ ratio by 8 ppm. All primitive meteorites therefore formed with $^{142}\text{Nd}/^{144}\text{Nd}$ ratios 19 ± 4 ppm lower than the terrestrial standards. This confirms the earlier interpretation [1] of an early global terrestrial differentiation. The solar nebula was not homogeneous with respect to p-process derived Sm and Nd isotopes.

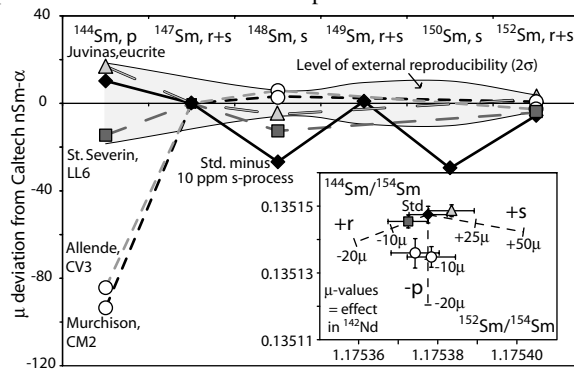


Figure 1: Variations in Sm isotopic composition. Data fractionation corrected using $^{147}\text{Sm}/^{154}\text{Sm}=0.65198$. ^{149}Sm and ^{150}Sm data omitted due to thermal neutron capture. Negative anomalies in ^{144}Sm are seen for carbonaceous chondrites best explained by p-process deficit (Inset).

References

- [1] Boyet M. and Carlson R.W. (2005) *Science* **309**, 577-581.