

Variability in Nonradiogenic Stable Hf Isotopes Between Bulk Silicate Earth and Chondrites?

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Valuable information about the evolution of the early solar system and planetary bodies can be provided by the initial Hf isotope composition of solar system materials. By means of the short-lived ^{182}Hf - ^{182}W and the long-lived ^{176}Lu - ^{176}Hf systems, metal-silicate segregation and global-scale silicate differentiation processes can be dated. However, these chronometers can only be exploited for such applications if the initial Hf isotope composition is well constrained: Obtaining absolute ages from the now extinct Hf-W system by comparison with long lived decay systems requires that $^{182}\text{Hf}/^{180}\text{Hf}$ was homogeneous throughout the early solar system and that this ratio has changed only by decay of ^{182}Hf . Similarly, the initial $^{176}\text{Hf}/^{177}\text{Hf}$ is an essential parameter of models concerning the timing and degree of silicate differentiation in planetary bodies. The Earth and other planetary bodies are commonly thought to have accreted from a variety of differentiated and undifferentiated precursors. The resulting planetary bodies are assumed to have chondritic bulk compositions with respect to the concentration ratios of refractory lithophile elements and their respective isotope compositions. This fundamental assumption remains to be rigorously tested. So far, the elemental composition of a planetary body cannot be determined unambiguously. However, recent reports of nucleosynthetic anomalies for other elements in bulk meteorites (e.g., Ni, Ba, Nd, Sm) (e.g., Bizzarro et al. (2007), Carlson et al. (2007)) demonstrate that initial nucleosynthetic heterogeneity among solar system materials can indeed be preserved. We have therefore initiated a study to test for variations in ratios of nonradiogenic stable isotopes of Hf in chondrites and terrestrial rocks. The respective ratios in these two groups must be identical if the composition of chondritic meteorites is to be used as a meaningful proxy for bulk Earth isotope composition.

To ensure a complete digestion, we applied a double digestion: HF-HNO₃ in Savillex vials on a 120°C hotplate, followed by HF-HNO₃ in Parr© Bombs for 5 days at 180°C. Replicate MC-ICP-MS analyses of individual terrestrial rock standards performed during multiple measurement sessions yielded typical external reproducibilities (2 s.d.) of 19-22 ppm on $^{178}\text{Hf}/^{177}\text{Hf}$ and 36-41 ppm on $^{180}\text{Hf}/^{177}\text{Hf}$, for ca. 40 ng Hf and using $^{179}\text{Hf}/^{177}\text{Hf}$ for the mass bias correction. Within these limits, excesses of >94 ppm pure s-process or >64 ppm pure r-process Hf should be resolvable. Among the groups of chondrites analyzed so far, we find no unequivocal deviation in $^{178}\text{Hf}/^{177}\text{Hf}$ or $^{180}\text{Hf}/^{177}\text{Hf}$ from the terrestrial standard.

References

Bizzarro M, Ulfbeck D, Trinquier A, Thrane K, Connelly JN, Meyer BS (2007) Evidence for a Late Supernova Injection of ^{60}Fe into the Protoplanetary Disk. *Science* 316: 1178-1181

Carlson RW, Boyet M, Horan M (2007) Chondrite Barium, Neodymium, and Samarium Isotopic Heterogeneity and Early Earth Differentiation. *Science* 316: 1175-1178

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