MTT38-07 Room:201A Time:May 22 15:45-16:00

^{142}Nd isotope anomaly in chondrite revisited

Tetsuya Yokoyama[1*], Hirokazu Takahashi[1], Hiroshi Yamazaki[1]

[1]Department of Earth and Planetary Sciences, Tokyo Institute of Technology

A variety of isotope anomalies have been documented in chondrites and differentiated meteorites for some elements such as Cr, Ti, Mo and Ru, suggesting heterogeneous isotope distribution in the early Solar System. For Nd, chondrites are known to have ^{142}Nd/^{144}Nd ratios 20 ppm lower than terrestrial materials. The finding most likely suggests the occurrence of large scale silicate differentiation that fractionated Sm-Nd in early history of the Earth when short-lived ^{146}Sm existed. However, most of the Nd isotope data in chondrites were determined by incomplete sample digestion which could not dissolve acid resistant, isotopically anomalous presolar grains. Thus, the origin of ^{142}Nd/^{144}Nd anomalies in chondrites is still debated.

To resolve this issue, we have developed a new method for determining Nd isotope ratios in meteorites with ultra-high precision using thermal ionization mass spectrometry (TIMS: TRITON plus at Tokyo Tech), coupled with complete sample decomposition technique using a pressure digestion system (DAB-2, Berghof, Germany). Meteorite samples were put in Teflon inserts together with a mixture of HF, HNO_3 and H_2SO_4. The insert was placed in a stainless jacket, tightly sealed and heated at 240 ^oC for 12 hours under high pressure. The existence of H_2SO_4 facilitates digestion of acid resistant presolar SiC. Subsequently, the insert was opened and dried at 120 ^oC for 12 hours to evaporate HF and HNO_3. Then the solution was transferred to a quartz glass beaker and completely dried at 300 ^oC. The dried sample was dissolved in 1M HCl and passed through cation exchange resin and Ln spec to isolate Nd. The separation efficiency was Ce/Nd $<$ 2.1x10^{-4} and Sm/Nd $<$ 1.0x10^{-9}, respectively. In the TIMS analysis, we have modified three points; chemical form of sample loaded on filament, temperature control of filaments and determination of Ce interference. The improved method increased $^{142}Nd^+$ beam intensity from 2 V to 20 V, resulting in an excellent analytical precision of ^{142}Nd/^{144}Nd (2 ppm, 2SD) for repeated analysis of 500 ng of JNdi-1.

Using the techniques, we determined Nd isotope compositions in four chondrites; Murchison (CM2), Saratov (L4), Chergach (H5) and NWA4814 (R4), as well as terrestrial samples. These chondrites have ^{142}Nd/^{144}Nd ratios of 23 +/- 3ppm lower than the terrestrial samples, although the ^{145}Nd/^{144}Nd, ^{148}Nd/^{144}Nd and ^{150}Nd/^{144}Nd ratios were not resolvable from the terrestrial. This indicates that Nd isotopes were homogenously distributed in the early Solar System, and the deficit of ^{142}Nd/^{144}Nd is the result of the ^{146}Sm decay in the depleted mantle produced by silicate differentiation in the early Earth. Our result supports the existence of enriched hidden reservoir whose chemical composition is complementary with depleted mantle that formed early history of the Earth while ^{146}Sm existed.

Keywords: chondrite, isotope anomaly, ^{142}Nd, presolar grain, complete sample decomposition