Nucleosynthetic barium isotopic anomalies in carbonaceous chondrites

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Isotopic anomalies of carbonaceous chondrites provide hints to consider the nucleosynthetic sources of solar system materials. Nucleosynthetic isotope anomalies of several elements such as Zr, Mo and Ba have been found in carbonaceous chondrites [1-3]. Barium is one of promising elements to address the details of nucleothentesis and presolar grain formation of the solar system [3]. In addition, possible detection of ^{135}Ba isotopic excesses from the decay of ^{135}Cs ($t_{1/2}$=2.3 Ma) may lead to develope a new chronometer for early solar system. Here we report barium isotopic compositions from acid leachates of carbonaceous chondrites.

Twelve carbonaceous chondrites were used in this study: Orgueil (CI), Mighei (CM2), Murchison (CM2), Murray (CM2), Sayama (CM2), NWA801 (CR2), Allende (CV3), Efremovka (CV3), Isuna (CO3), Kainsaz (CO3), Karronda (CK4), and Maralinga (CK4). A mass of 0.2-0.3 g of each powdered sample was sequentially leached by 0.1 M acetic acid, 0.1 M HCl and 2 M HCl. The residue was finally decomposed by HF-$HClO_4$. Ba isotopic compositions and elemental concentrations of Ba and Cs in individual leachates were determined by thermal ionization mass spectrometry and ICP-MS, respectively.

The barium isotopic data in most of leachates show variable isotopic deviations of ^{135}Ba correlated with ^{137}Ba, suggesting the presence of nucleosynthetic components for s- and r-processes in the solar system. The isotopic anomalies treated in this study are generally small ($-3<\varepsilon<+3$) except in the case of acid residues of CI and CM samples. Large deviations of ^{135}Ba (ε=-18.9~-5.0) and ^{137}Ba (ε=-8.6~-1.2) observed in the acid residues from Orgueil and four CM2 meteorites show evidence for enrichments of s-process isotopes derived from presolar grains. The leachates from acetic acid in CI and CM samples show higher Cs/Ba elemental ratios (0.05~0.13) and larger ^{135}Ba deviations than other fractions, which suggest isotopic excesses decayed from ^{135}Cs.

References

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