ISOTOPIC EVIDENCE OF LIVE CESIUM-135 IN THE EARLY SOLAR SYSTEM.

H. Hidaka[1], Y. Ohta[1], S. Yoneda[2], and J. R. DeLaeter[3], [1]Department of Earth and Planetary Systems Science, Hiroshima University, Higashi-Hiroshima 739-8526, Japan (hidaka@hiroshima-u.ac.jp), [2]Department of Science and Engineering, National Science Museum, Tokyo 169-0073, Japan (s-yoneda@kahaku.go.jp), [3]Department of Applied Physics, Curtin University of Technology, P.O. Box U1987, Perth, Western Australia 6001.

Introduction: ^{135}Cs ($T_{1/2}$ = 2.0 Ma) is known as one of extinct nuclides which were possibly present in the early solar system. Precise determination of Ba isotopic composition in the early solar materials may allow us to detect excess ^{135}Ba decayed from ^{135}Cs, but previous isotopic studies of Ba in meteorites show no strong evidence of ^{135}Ba excess as a decay product of ^{135}Cs. The FUN inclusion C1 of Allende indicates ^{135}Cs deficits due to condensation of Ba before decay of ^{135}Cs in the early solar system [1]. On the other hand, some other isotopic results for CAIs and bulk of carbonaceous chondrites provide contributions of r-process nucleosynthesis on ^{135}Ba and ^{137}Ba [2–4]. Thus far, however, no strong evidence of ^{135}Ba excess have been shown in isotopic studies of Ba in meteorites. We performed Ba isotopic analyses for chemical leaching fractions of the Beardsley chondrite (H5) and the Allende CAIs, respectively, to search ^{135}Ba excess and obtain chronological constraints on ^{135}Cs in the early solar system.

Experimental: Beardsley is a unique meteorite which contains higher amount of Rb (14 ppm) than other H chondrites have (1.8 to 3.9 ppm) [5]. We expected the high content of Cs and large Cs/Ba abundance ratio in the Beardsley meteorite. However, its Cs/Ba abundance ratio, 0.0868, is not significantly different from those in other chondrites (e.g., 0.0799 for CI), and it seems not to have an advantage to find isotopic excess on ^{135}Ba in the bulk sample. In this study, powdered Beardsley sample was leached by 0.1M CH_3COOH-CH_3COONH_4, 0.1M HCl, 2M HCl, and aqua regia, successively, and then the residue was decomposed by HF-$HClO_4$ in order to find a high Cs/Ba fraction in the sample.

One of four CAIs, NSM-2, is a Type A inclusion taken from a 0.4 kg specimen of the Allende meteorite. The other three samples, NSM-3, -4 and -5, are Type B CAIs from another 1.2 kg of specimen. Each sample was leached by aqua regia, and the residue was decomposed by HF-$HClO_4$. An aliquot of each leachate fraction was used for Ba isotopic determination with TIMS, and another aliquot was used to determine Cs/Ba abundance ratio by using ICP-MS.

Results and Discussions: The leachates with 0.1M CH_3COOH-CH_3COONH_4 and 0.1M HCl for Beardsley have high Cs/Ba ratios, 19.8 and 3.43, respectively, and show excesses of ^{135}Ba with +39±18 and 1.0±0.5 (in ε-unit), respectively. The isotopic excesses of ^{135}Ba in these two fractions correlate with the Cs/Ba ratios. The other leaching fractions show low Cs/Ba ratio from 0.011 to 0.82, and no ^{135}Ba excesses within analytical errors. This result leads to $^{135}Cs/^{133}Cs = (1.1 \pm 0.1) \times 10^{-5}$ as an initial ratio at the Beardsley formation. Assuming that an initial solar system abundance of $^{135}Cs/^{133}Cs$ is 1.6×10^{-4} [1], the initial $^{135}Cs/^{133}Cs$ of Beardsley corresponds to 9 Ma of interval from CAI formation.

Ba isotopic compositions of CAIs are variable. NSM-4 and -5 show isotopic excesses on ^{135}Ba and ^{137}Ba due to r-process contribution, which are consistent with previous studies of CAIs [3,4]. Isotopic deviations of ^{135}Ba and ^{137}Ba are not necessarily constant, and range 1.4~1.9 and 0.9~2.3 (in ε-unit), respectively. NSM-2 has no isotopic deviations of Ba within analytical precision. On the other hand, only excess of ^{135}Ba was observed in the leachate of NSM-3. These data from CAIs suggest that the isotopic excesses of Ba are not only due to r-process contribution but from decay products of live ^{135}Cs in the early solar system .

References: [1] McCulloch M. T. and Wasserburg G. J. (1978) *Ap. J., 220,* L15–L19. [2] Loss R. D. et al. (1994) *Ap. J., 436,* L193–L196. [3] Harper C. L. (1990) *Meteoritics, 26,* 341–342. [4] Harper C. L. et al. (1991) *Meteoritics, 27,* 230–231. [5] Kaushal S. K. and Wetherill G. W. (1969) *JGR, 74,* 2717–2726.