Nucleosynthetic Yb isotope anomalies in meteorites

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Recent studies on high precision isotope analyses for bulk meteorites discovered the existence of planetary scale nucleosynthetic isotope variabilities for multiple elements (e.g., Cr, Sr, Mo, Ru), although some elements (Hf and Os) do not show such anomalies [e.g., 1-4]. The processes responsible for generating the isotopic heterogeneity in the early Solar System are not fully resolved yet. At present, two plausible models have been proposed to account for the isotopic characteristics recorded in meteorites; nebular thermal processing which caused selective destruction of presolar grains, and the injection of isotopically anomalous materials from a nearby core-collapse supernova. Yb is an intriguing element which would provide a strong constraint on the origin of planetary scale isotope anomalies. The $T_{50\%}$ for Yb (1487 K) is lower than those of the other heavy-REEs (1659 K) and is comparable to that of Sr. Thus, the thermal processing would lead to heterogeneous Yb isotope distribution in the Solar System. Here we report preliminary results on Yb isotope compositions in two meteorites (Olivenza, LL5; NWA 753, R3.9).

The Yb isotope ratios for meteorite samples are reported as μYb notations which represent the parts par 10^6 deviations from the terrestrial isotope ratios. The ordinary and rumuruti chondrites possess large negative anomalies for μ^{168}Yb (–2500 ppm) and μ^{170}Yb (–130 ppm) exceeding analytical uncertainties of the standard material, whereas the $\mu^{171,173,176}$Yb values are indistinguishable from the terrestrial component. The μYb patterns for the chondrites are not consistent with that of the *s*-process deficits relative to the terrestrial component. Therefore, the negative anomalies in in $\mu^{168,170}$Yb are attributed either to the deficit of *p*-process nuclides, or to the analytical artifact due to the overcorrection of interferences from Er. By contrast, the absence of anomalies for $\mu^{171,173,176}$Yb is consistent with the marginal isotope anomalies in ordinary chondrites for Mo and Ru isotopes synthesized by the *s*- and *r*-processes, which are significantly smaller than those observed in carbonaceous chondrites and iron meteorites [3-4].

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