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Os isotopic anomalies in acid resistant residues from enstatite chondrites

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Isotope anomalies in bulk chondrites have been extensively investigated in the past 30 years. The discovery of presolar grains in primitive chondrites has dramatically improved our knowledge regarding stellar nucleosynthesis and the origin of the solar system. The majority of previous presolar grain studies have focused on carbonaceous chondrites (CCs) and ordinary chondrites (OCs), yet there has been relatively little work done on presolar grains from enstatite chondrites (ECs). Here we show our preliminary investigation of the Os isotope anomalies in EC acid residues.

Acid residues analyzed in this study were prepared from three ECs (MAC02837, EL3; EET87746, EH3; Indarch, EH4) and one primitive CC (ALH83100, CM1/2) by employing a CsF/HF leaching technique. Osmium isotope analyses were carried out by a TIMS (Thermo-TRITON) at the Univ. of Maryland. The Os isotope ratios, normalized to ^{189}Os, are reported in epsilon-Os units (e-^{184}Os, e-^{186}Os^{i}, e-^{188}Os, e-^{190}Os) which represent relative deviation (parts per 10^4) from the average of bulk chondrite analyses (solar values).

The four residues are characterized by positive e-^{186}Os^{i}, e-^{188}Os and e-^{190}Os values resolvable from the solar (= terrestrial) component, which are suggestive of the enrichment of Os isotopes produced by the s-process. The magnitude of positive Os isotope anomalies in the residue of the CC ALH83100 is nearly twice as large as are present in residues from the CM2 chondrite, Murchison. This is the first direct comparison of Os isotope anomalies in residues from a single chondrite group with different petrologic types. This is clearly due to the lower abundance of s-process-enriched presolar grains in Murchison residues compared with ALH83100, presumably caused by their different parent body histories. This is consistent with our previous observation that the extent of positive e-Os values in the residues from CC and OC is in the order of petrologic grade of the host meteorites (type1> type 2> type 3).

In comparison, the residues from ECs do not conform to this ordering. First, the e-Os values in the residue for EET87746 (EH3) are fairly large, which are at the upper end of those in residues from type 2 CC. Second, the residue from Indarch (EH4) possesses positive e-Os anomalies that are identical to those present in a residue from the OC QUE97008 (L3.05). Some previous studies suggested a radially heterogeneous distribution of presolar grains in the solar nebula. For example, it is reported that presolar Si3N4 appears to be more abundant in Quingzhen (EH3) and Indarch than CCs. However, most presolar Si_3N_4grains are thought to have originated from supernova ejecta, where r-process nuclides are produced. This conflicts with our observation that the residue from EET87746 is more enriched in s-process Os than residues from Murchison. Alternatively, nebular or parent body processes might have acted differently on presolar phases located in regions of the early solar system characterized by different redox conditions. We infer that the relative enrichment of s-process Os in the acid residues from ECs is the result of selective loss of s-process-enriched presolar phases (e.g. graphite or SiC) that occurred under oxidized conditions in CC/OC parent bodies or their formation locations.

Keywords: enstatite chondrite, presolar grain, isotope anomaly, osmium, TIMS