NEODYMIUM ISOTOPES IN ENSTATITE CHONDRITES

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Introduction: One of the key problems in planetary science is the identification of the building blocks of Earth, and whether they exist within our current collection of meteorites. Stable mass independent isotopic anomalies are a key tool in fingerprinting material coming from different accretionary regions within the protoplanetary disk. For a number of isotopic systems such as O[1], Ni[2], Ti and Cr [3], enstatite chondrites (EC) appear to be the strongest candidates for Earth's building blocks, despite their low Mg/Si ratios relative to the bulk Earth. It has been proposed that Earth, the Moon-forming impactor and enstatite chondrites all were originally sourced from the same reservoir in the protoplanetary disk, but later had divergent chemical evolution pathways [4]. However, [5] recently used the correlation between Mo and Nd isotopes in bulk meteorites to argue that such a reservoir does not exist as the isotopic composition of enstatite chondrites is resolvable from Earth. In detail, while the Mo data for EC are clearly resolvable from Earth, the Nd ratios show more variability and significant overlap with the isotopic composition of bulk Earth. The variability in ^{142}Nd/^{144}Nd in EC has been previously identified by [6] and they observed that it appeared to be related to whether the EC was equilibrated or unequilibrated. However, [6] only focused on collecting high precision ^{142}Nd/^{144}Nd, which also has contributions from the decay of the short-lived ^{146}Sm nuclide ($t_{1/2}$ ~103 Myr), making identification of nucleosynthetic anomalies less clear. While the study of [5] reports high precision ^{145}Nd/^{144}Nd, ^{148}Nd/^{144}Nd, and ^{150}Nd/^{144}Nd in addition to ^{142}Nd/^{144}Nd, only equilibrated EC were analysed. Therefore with the currently published data it is unclear to what extent petrologic grade in the EC is responsible for the variation observed in the stable Nd isotopic ratios. In order to better understand the genetic relationship between enstatite chondrites and the Earth we are carrying out a more systematic study including both equilibrated and unequilibrated enstatite chondrites focusing on high precision analysis of all the stable Nd isotopic ratios.

Method: Antarctic meteorites are valuable resource for such studies as they are particularly well preserved from the effects of terrestrial alteration. Approximately 1.8 g of sample was dissolved using acid digestion with the Nd being separated using ion exchange chromatography. A TIMS was used for the isotopic analysis with Nd analyzed as Nd^+ using a multi-static routine after [7].

Results and Discussion: Our initial data for five enstatite chondrites are consistent with [5-6,8] in showing that equilibrated enstatite chondrites are resolvable from Earth in their ^{142}Nd/^{144}Nd ratios. However, unlike in [6], the ^{142}Nd/^{144}Nd ratios of the unequilibrated enstatite chondrites are not similar to the terrestrial values, weakening the arguments for ascribing ^{142}Nd/^{144}Nd variations to petrologic grade and the associated processing. We also observe significant variability in the stable ratios such as ^{145}Nd/^{144}Nd and ^{148}Nd/^{144}Nd, which does not appear to correlate with petrologic grade. While our initial data would argue against the model of [4], where the Earth and enstatite chondrites share an isotopic reservoir, it is clear that precise stable isotopic composition of enstatite chondrite reservoir for Nd has yet to be properly understood and constrained.

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