TITANIUM ISOTOPE HETEROGENEITIES IN THE SOLAR SYSTEM.

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Introduction: The solar system, as sampled by meteorites, is relatively homogeneous isotopically, indicating efficient mixing of the material from the precursor molecular cloud. Usually, the preservation of isotopic heterogeneities is attributed to lack of equilibration of presolar grains and / or some refractory condensates with gas and dust of average solar composition. Nucleosynthetic isotope anomalies in bulk chondrites have been measured for O, S, Ti, Cr, Mo, Ru, Ba, Sm, Nd, and some noble gases. However, among these elements, Ti forms one of the most refractory oxides and is therefore well suited for studies of early solar system heterogeneities.

Experimental: Sample preparation, chemical separation, and MC-ICPMS measurements follow the procedure described in [1]. We studied 5 lunar whole rock samples and various mineral separates from high Ti-mare basalts, a lunar norite, a forroan anorthosite and an olivine-normative mare basalt. In addition we studied bulk samples from four carbonaceous chondrites, three ureilites, two eucrites, one ordinary chondrite, one mesosiderite, and one martian meteorite. Finally, we analyzed leachates from Allende and mineral separates from Renazzo.

Results: The Ti data for lunar whole rock samples and mineral separates are, except one, normal within the uncertainties, indicating that Earth and Moon have the same Ti isotope composition. Normal Ti isotope compositions are also observed for the martian meteorite, the mesosiderite, the ordinary chondrite, the eucrites, and the ureilites, indicating that all these objects (together with Earth and Moon) formed from material with a homogeneous Ti isotope composition. This result is consistent with Zr data, for which also no anomalies were found [2]. However, a variety of authors have reported variations in Cr, Mo, Ba, Sm, and Nd in bulk rock meteorites, although some of the variations are restricted to p-nuclides and some are not yet well defined, e.g., [3-9]. In contrast to the data for ordinary chondrites, eucrites, ureilites, and mesosiderites the results for whole rock samples from the carbonaceous chondrites Allende (CV), Orgueil (CI), and Renazzo (CR) clearly indicate that large-scale heterogeneity exists in the Ti isotope composition in the solar system. Since leach experiments and mineral separation have shown that anomalous Ti is not confined in phases in refractory inclusions we propose scenarios in which presolar grains were not homogeneously distributed in the solar nebula.

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