^{142}Nd anomaly confirmed at Isua

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^{146}Sm decays to ^{142}Nd with a half-life of 103 Myr. The existence of the extinct radioactivity of ^{146}Sm in the early Solar System has been demonstrated on chondrites [1] and differentiated meteorites [2] but its presence in one metasediment sample from the 3.8 Gy old Isua terranes [3] received so far no confirmation [4]. International efforts have recently been focused on remapping Isua terranes (W. Greenland), collecting and anlyzing new samples. We measured Nd isotopic composition of exceptionally well preserved Early Archean metabasalts and metagabbros collected in the SW part of the Isua metamorphic belt in 1998-2000.

We used MC ICP MS and a cryo-desolvating nebulizer to measure Nd isotopic compositions precise and accurate to better than 20 ppm. Sm and Ce are essentially eliminated so corrections for isobaric interference are negligible. A new standard-sample bracketing method offers improved control over the isotopic compositions measured during acquisition. Reproducibility is checked and errors improved to better than 15 ppm by repeating the analyses 2-6 times. Most samples were found to have normal ^{142}Nd abundances within errors. Three samples show reproducible excess ^{142}Nd of 0.2-0.4 epsilon unit consistent with the ^{142}Nd anomaly of 0.33 epsilon unit reported by Harper and Jacobsen [3] in a sample of metasediment collected in the eastern part of the belt.

Given the ^{146}Sm/^{144}Sm value of ca. 0.008 ± 1 at 4.566 Ga estimated for different classes of meteorites [1,2], it is unlikely that live ^{146}Sm was still in existence 3.8 Gy ago. We therefore conclude that the ^{142}Nd anomalies observed in some Isua basalts indicate that, at the time of eruption, primordial heterogeneities had not been erased by mantle convection. The presence of these heterogeneities may indicate that the Earth accreted from a number of different planetesimals and that the mantle was never homogenized by a magma ocean. Alternatively it may reflect the very early differentiation of the mantle, in which case a terrestrial magma ocean cannot have survived beyond a few hundreds Ma.

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Interplanetary dust particles

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Introduction

Interplanetary dust particles (IDPs) collected in the stratosphere are derived from asteroids and comets (Brownlee et al., 1997). The cometary subset have properties similar to those inferred from cometary meteors, i.e. they are extremely porous fragile objects. Their mineralogy and petrography differ fundamentally from the those of asteroidal IDPs and meteorites (Bradley & Brownlee, 1986). Such fragile materials are the most cosmically primitive meteoritic objects and the most informative regarding early Solar System and presolar grain forming processes.

Properties of cosmically primitive IDPs

Most collected IDPs span the size range 1 - 35 µm although larger (35-500 µm diameter) IDPs known as “cluster particles” are also collected. Some IDPs contain amorphous and crystalline silicates enstatite ($MgSiO_3$), forsterite (Mg_2SiO_4) and GEMS (glass with embedded metal and sulfides). Other important minerals include FeNi sulfides and carbonaceous material. Huge D/H enrichments associated with a carbonaceous carrier(s) plus the recent discovery of presolar circumstellar silicates establishes that the two most abundant types of dust in the interstellar medium (silicates and carbon) are preserved in IDPs (Messenger 2000, Messenger et al., 2002).

Discussion

Interplanetary dust research has made dramatic progress primarily as a result of the availability of analytical instruments with “nanoprobe” optics. At the same time, observational data (e.g. from the Infrared Space Observatory) are forging new connections between IDP research, astronomy, and astrophysics. In 2006 the STARDUST mission will return the first samples of contemporary interstellar dust and dust from Comet Wild-2.

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