The Sm and Nd isotopic composition of chondrites and the Earth

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The finding of small mass-independent variations in the isotopic composition of different meteorite classes compared to the Earth (*e.g.*, in Ca, Ti, Cr, Ni, Mo, Ru, Nd, Sm, W [1 and therein]) suggests that meteorites – and chondrites in particular – do not represent the building material of the Earth. Thus, the paradigm that for refractory elements chondrites and the bulk Earth have the same isotopic compositions may not always be valid. The small $^{142}Nd/^{144}Nd$ differences observed between the accessible silicate Earth and chondrites [2-5] are particularly important in this respect because their interpretation has a direct bearing on our understanding of the evolution of the (early) Earth. Current scenarios to explain this offset include (i) global fractionation of the silicate Earth within ~30 Myr after the start of the solar system [2] [3], (ii) a super-chondritic Sm/Nd ratio of the Earth [6], possibly through collisional erosion of early-formed crust [7], and (iii) nucleosynthetic isotope variations between the Earth and chondrites [5] [8] [9].

To assess which of these scenarios is correct, and to better constrain the relation of chondrites and the Earth, we initiated a high-precision Sm and Nd isotope study on a variety of ordinary and enstatite chondrites. To avoid artifacts due to undissolved presolar grains or terrestrial weathering, only fresh meteorite falls of petrologic grade 4 or higher were processed. Separation of Sm an Nd was done by ion chromatography in Chicago and Livermore, measurements are preformed on a Triton TIMS at LLNL. The data acquired so far point towards a nucleosynthetic origin of the $^{142}Nd/^{144}Nd$ variations between chondrites and the Earth, however more data and tests are needed before other scenarios can be excluded.

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