Possible source of iron-60 in the early solar system based on recent estimates of its initial abundance

SHOGO TACHIBANA*

[1]Department of Earth and Planetary Science, The University of Tokyo, Hongo, Tokyo, Japan.
tachi@eps.s.u-tokyo.ac.jp (* presenting author)

The former presence of short-lived radionuclides (SLRs) in the early solar system (^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca, ^{53}Mn, ^{60}Fe, ^{107}Pd, ^{129}I, and ^{182}Hf) has been inferred from excesses in the abundances of their daughter nuclides in meteorites, which are linearly correlated with the abundance of a parent element. The SLRs with half-lives ($\tau_{1/2}$) shorter than 5 million years (Myrs) could have been produced either by energetic-particle irradiation in the early solar system or by stellar nucleosynthesis just prior to or shortly after the birth of the solar system. Iron-60 ($\tau_{1/2}$=2.62 Myrs [1]) is effectively formed only by stellar nucleosynthesis, and its initial abundance in the early solar system could constrain the birth environment of the solar system. It has been found that ion microprobe studies on ^{60}Fe in the solar system [2-5] overestimated its initial abundance due to statistical bias for data reduction [6]. Recent studies using MC-ICPMS and MC-TIMS have shown that the initial abundance of ^{60}Fe in the solar system, $(^{60}\mathrm{Fe}/^{56}\mathrm{Fe})_0$, could be as low as 10^{-8} [7-13], which could be comparable or lower than the galactic background. However, recent ion microprobe analyses with a proper data reduction method showed that there are chondrules with solid evidence of live ^{60}Fe and that the inferred initial ratio is in the range of $(3\text{-}5)\times10^{-7}$ [14].

These recent findings imply either that the initial abundance of ^{60}Fe in the solar system could be $\sim10^{-8}$ [10, 11] or that ^{60}Fe was heterogeneously distributed in the early solar system [9, 12, 14]. In this talk, I will discuss a possible source of ^{60}Fe in the early solar system and the birth environment of the solar system based on recent estimates of the abundance and distribution of ^{60}Fe in the solar system.

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Distribution of neodymium in sedimentary planktonic foraminiferal tests and associated mineral phases obtained by NanoSIMS

KAZUYO TACHIKAWA[1]*, TAKASHI TOYOFUKU[2], ISABELLE BASILE-DOELSCH[1], AND THOMAS DELHAYEC[3]

[1]CEREGE, Aix-Marseille Univ, CNRS, IRD, Technopole de l'Arbois, BP 80, 13545 Aix en Provence, France (*correspondance: kazuyo@cerege.fr)
[2] Institute of Biogeosciences (BioGeos) JAMSTEC, Yokosuka, Japan
[3]Université de Rennes 1, Campus de Beaulieu, Batiment 24, Salle 006 (NB:Case 2401 pour courrier) 263 Avenue du General Leclerc CS 74205 35042 RENNES CEDEX, France

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Neodymium isotopic ratios recorded in calcareous foraminiferal tests and associated authigenic minerals have been used to trace past water masses although exact origin of preserved Nd signals is still a matter of debate [1-3]. We determined, for the first time, Nd distribution in two species of planktonic foraminifera (*Globigerinoides ruber* and *Neoquadorina dutertrei*) and coexisting authigenic minerals from a marine sediment core in the Panama Basin. Elemental mapping of Nd, Ca, Fe, Mn, and Si was performed using NanoSIMS and electron probe microanalysis (EPMA) for uncleaned tests from two selected time slices (15.6 kyr and 129 kyr) together with Scanning Electron Microprobe (SEM) imagery. EPMA and SEM images indicate the existence of Fe-rich framboidal minerals inside of test pores and inner chambers, in particular for the older samples. This phase is estimated to be pyrite. The younger sample presents also Fe and Mn-rich patches on the inner test wall that is evaluated to be Mn-Fe oxides. Neodymium intensity in Fe-Mn oxides and oxidized pyrite is much higher than in foraminiferal calcite. For all analyzed samples, Nd distribution in foraminiferal tests is randomly heterogeneous with no systematic feature such as Nd-rich layer, species-specific difference, and primary calcite and crust. Relationship between Nd and Fe, and between Nd and Mn reveals that the most efficient Nd carrier is oxidized pyrites, possibly Fe oxy-hydroxides. This suggests a central role of Fe minerals to Nd cycle during diagenesis. Since Nd related to the authigenic precipitates reflects pore water signal (a mixture of scavenged, bottom water and soluble fraction from bulk sediments), conflicting origin of Nd isotopic signals from sedimentary foraminiferal tests could be at least partly explained by contribution of pore water-derived Nd.

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