

The Abundance of ^{60}Fe in the Early Solar System

R. Trappitsch^a, P. Boehnke^{b,c}, T. Stephan^{b,c}, M. Telus^d, M. R. Savina^a, O. Pardo^{b,c}, A. M. Davis^{b,c}, N. Dauphas^{b,c}, M. J. Pellin^{e,b,c}, and G. R. Huss^f

^aLawrence Livermore National Laboratory, ^bThe University of Chicago, ^cChicago Center for Cosmochemistry, ^dUniversity of California Santa Cruz, ^eArgonne National Laboratory, ^fUniversity of Hawai'i at Mānoa

The abundance of the extinct radionuclide ^{60}Fe (2.62 Myr half-life) in the early Solar System is highly disputed in the literature. On one hand, bulk measurements of early Solar System materials indicate an initial abundance consistent with galactic background [1, 2]. On the other hand, in situ studies by secondary ion mass spectrometry (SIMS) report a variety of ratios, e.g., [3], including some as high as $^{60}\text{Fe}/^{56}\text{Fe} = 1 \times 10^{-6}$, e.g., [4]. Such high ratios are incompatible with galactic background and would require the injection of fresh nucleosynthetic material prior to the birth of the Solar System.

Here we present new resonance ionization mass spectrometry (RIMS) measurements of a Semarkona chondrule (DAP1), which has been previously analyzed in situ by SIMS [3]. Despite improved precision compared to SIMS, our new RIMS measurements show no enhancement in ^{60}Ni that could be attributed to the in situ decay of ^{60}Fe . Our new value for the Solar System initial $^{60}\text{Fe}/^{56}\text{Fe}$ ratio of $(6.4 \pm 11.9) \times 10^{-8}$ (2σ) is consistent with the low value as measured by bulk techniques and as found in some SIMS analyses, and agrees well with the ^{60}Fe expected in galactic background. Our new result also agrees with a reevaluation of the previous SIMS DAP1 measurements. Supernova injection of freshly synthesized ^{60}Fe into the solar nebula just prior to the condensation of the first solids is thus not required to explain our measurement. It is however in agreement with a recent model by [5], which shows that Wolf-Rayet stars could have contributed the other short-lived radionuclides to the solar nebula, especially ^{26}Al , without significantly enhancing ^{60}Fe .

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References

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