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Are presolar materials preserved in coarse-grained CAIs from Allende? Insights from step-leaching experiments.

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CAIs preserve direct clues to the earliest processes within the solar nebula. Texturally, CAIs come in two flavours: fine-grained (fg-) CAIs, which have condensate-like textures and were never molten, and coarse-grained (cg-) CAIs, which are igneous in origin. Despite their distinct origins and histories, both types retain a component of presolar nucleosynthetic origin, measurable as anomalies in the isotopic compositions of a number of heavy elements. Recent work on fg-CAIs has revealed that some of these presolar materials were not fully destroyed and homogenized before incorporation [1,2]. In contrast, although cg-CAIs have likely been homogenized by the melting events they experienced, nucleosynthetic variations from precursor materials may be preserved in some of them depending on the melting processes.

To test whether presolar materials are preserved in cg-CAIs, we subjected six cg-CAIs to a step-leaching protocol. We measured trace element and Sr isotopic data for residues of leachates from mineral separates (pyroxene, melilite) as well as two bulk size fractions for a suite of six cg-CAIs, including the forsterite-bearing Type B (FoB) inclusion 'Alvin'. All six CAIs exhibit flat, chondritic REE profiles (i.e., no type II volatility pattern), sometimes with positive Eu anomalies (and corresponding negative anomalies in residues). $\mu^{84}Sr$ anomalies (deviations in abundance of the *p*-process only nuclide ^{84}Sr from the standard) show good homogeneity between different fractions within individual CAIs and among five out of six CAIs, yield a weighted mean of +143±21 ppm (95% CI, MSWD = 0.36). All fractions from 'Alvin' are consistently higher, with $\mu^{84}Sr$ = +220±19 ppm ppm. Measured $^{87}Sr/^{86}Sr$ for some samples are extremely unradiogenic (~0.69895) and will yield precise values for $^{87}Sr/^{86}Sr_i$ after decay correction for low Rb concentrations, and/or from isochron relationships.

Unlike fg-CAIs, our results indicate that the carriers of Sr nucleosynthetic anomalies in cg-CAIs were efficiently homogenized and did not survive the multiple melting events these inclusions experienced. Measurements of the *p*-process only nuclides ^{130}Ba and ^{132}Ba are underway to complement those for ^{84}Sr.

References

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