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Constraints on the stellar sources of ^{150}Nd from carbonaceous chondrites

JAMES M. J. BALL, PAUL FROSSARD, MATTIAS EK AND MARIA SCHÖNBÄCHLER

ETH Zürich

The carbonaceous chondrites (CC) inherited their isotopic composition from the outer protoplanetary disc. The isotopic composition of refractory elements is influenced by the presence of CAI's, which formed in a separate reservoir near the young Sun [1]. Step-wise leaching experiments and in-situ measurements show that SiC grains from AGB stars are the primary carrier of Nd isotope variations in bulk chondrites [2][3]. However, Nd isotope data for the carbonaceous reservoir remains sparse. A more robust characterisation of Nd isotope variations in bulk CC is required to elucidate the various stellar sources of dust in the protoplanetary disc.

Here, we present a comprehensive Nd isotope dataset for bulk carbonaceous chondrites consisting of 1-6 CC from most subgroups, obtained on large masses (~1.5 g) to avoid sample heterogeneity. Our data reveals correlated μ^{148}Nd and μ^{150}Nd variations, with μ^{150}Nd representing the largest variations. For instance, variations in μ^{150}Nd for the CV spread across a range of ~40 ppm, whilst the CO display highly positive values of ~45 ppm.

Mass balance calculations indicate that a complex mixture between CAI's and another ^{150}Nd enriched endmember, which is not present in leachate data [e.g. 2], is required to account for the variation in bulk CC. The CAI forming reservoir is enriched in *s*-process isotopes of Nd relative to Earth [4], while the CAI-free carbonaceous reservoir has a positive μ^{148}Nd and μ^{150}Nd composition. Our data shows that a heterogeneously distributed μ^{150}Nd enriched presolar phase influences the isotopic composition of bulk CC. A phase with negative μ^{148}Nd and positive μ^{150}Nd has been suggested based on leachate data from Tagish Lake [5]. We evaluate *s*-process, *i*-process, and CCSNe models as potential sources, considering stellar occurrence rates at the time of the Sun's birth, their contribution to global dust production and other cosmochemical data. Our preliminary findings indicate that the *i*-process is an unlikely source.

[1] Grossman (1972) GCA 36, 597-619 [2] Frossard et al. (2022) Science 377, abq7351 [3] Hoppe & Ott (1997) AIP Conf. Proc. 402, 27-58 [4] Brennecka et al. (2013) PNAS 110 (43), 17241-17246 [5] Saji et al. (2021) ApJL 919, L8