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Silicon Carbide Grains of Type X and Supernova Nucleosynthesis

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Content
Silicon carbide grains of type X, constitute ~1% of all presolar SiC grains found in primitive meteorites. These grains have 15N and 28Si excesses, mostly light C, high inferred 26Al/27Al ratios, and evidence (from 44Ca and 49Ti excesses) for the initial presence of the short-lived radioisotopes 44Ti and 49V [e.g. 1].
These main isotopic signature clearly indicate an origin in the ejecta of Type II supernovae and material from different SN zones [2] had to contribute to the mix from which the grains formed: He/N (26Al), He/C (12C and 15N), and the Si/S zone (28Si, 44Ti, 49V). However, in detail there are many discrepancies between grain data and theoretical predictions from SN models [3]. One major discrepancy concerns the distribution of the Si isotopic ratios. In a Si 3-isotope plot, most grains plot along a line, which points to a primary isotopic composition with 29Si/28Si = ~1/3×solar and almost no 30Si. However, such a composition is not produced by any of the SN models. Another set of discrepancies involve the correlation between C, N and Al isotopic ratios: 12C/13C and 15N/14N ratios are high in the He/C and low in the He/N zone, whereas the 26Al/27Al ratios shows the opposite behavior. As a consequence, mixing between these zones results in negative correlations between these ratios, in contrast to the grain data [4]. Another example is the lack of large 54Fe excesses in X grains [5]. While mixing with material from the Si/S zone, rich in 28Si, is necessary to explain the 28Si excesses in these grains, the 54Fe, abundant in this zone, must have been separated from the 28Si before grain condensation by a process still not understood. We will discuss these discrepancies and solicit suggestions for solutions.

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