Stellar Origins of Type AB Grains

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AB grains (~5%) are the presolar SiC group with the most ambiguous stellar origins. Their potential stellar sources include J-type C-stars, born-again Asymptotic Giant Branch (AGB) stars, novae, and type II supernovae (SNeII) [1,2,3]. To better understand the origins of AB grains, we measured Sr, Mo, and Ba isotopes using the CHILI instrument [4] in 50 sub-μm- to μm-sized single AB grains separated from the Murchison meteorite. The AB grains were identified using a nondestructive method [5], and confirmed by NanoSIMS analyses of their C, N, and Si isotopes. We succeeded in obtaining useful Mo isotope ratios (1σ errors<~200 ‰) in 43 of the 50 grains, and Sr and Ba isotope ratios in only a few of the grains.

The Mo isotopic data of the 43 AB grains suggest two populations: ^{15}N-rich AB (^{14}N/^{15}N<solar, AB1) with neutron-capture Mo isotopic signatures that are similar to those of *s* process, and ^{14}N-rich AB (^{14}N/^{15}N≥solar, AB2) with close-to-solar Mo compositions, consistent with our previous results that the ^{26}Al/^{27}Al ratios of AB1 grains are inversely correlated with their ^{14}N/^{15}N ratios and that such a correlation is not seen in AB2 grains [6].

State-of-the-art model calculations and observations suggest that J-type C-stars and born-again AGB stars are most likely to be ^{14}N-rich, SNeII ^{15}N-rich, and novae both ^{14}N- and ^{15}N-rich depending on their initial masses [1,2,3,7]. On the other hand, the neutron capture process seems not to occur in J-type C-stars and novae, but occurs in born-again AGB stars and SNeII. The correlated light and heavy element isotopic data of AB grains, therefore, imply that AB1 grains are from SNeII and AB2 grains from J-type C-stars and/or low-mass ^{14}N-rich novae. The SNeII origin of AB1 grains is also further supported by two additional pieces of evidence: (1) the N-Al isotope trend of AB1 grains is well explained by SNeII models with explosive H burning [6]; (2) an exotic Mo isotopic pattern with pure ^{96}Mo enrichment is found in both one X2 grain from SNeII and also one AB1 grain.

[1] Amari et al. (2001) *ApJ*, **559**, 463–483. [2] Fujiya et al. (2013) *ApJL*, **776**, L29. [3] Liu et al. (2016) *ApJ*, **820**, #140. [4] Stephan (2016) *IJMS*, **407**, 1–15. [5] Liu et al. (2016) *MAPS*, #6094. [6] Nittler et al. (2016) *MAPS*, #6204. [7] Pignatari et al. (2015) *ApJL*, **808**, L43.