BARIUM ISOTOPIC COMPOSITION OF MAINSTREAM SILICON CARBIDES FROM MURCHISON: CONSTRAINTS FOR s-PROCESS NUCLEOSYNTHESIS IN ASYMPTOTIC GIANT BRANCH STARS

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We present barium, carbon, and silicon isotopic compositions of 38 acid-cleaned presolar SiC grains from Murchison. Comparison with previous data shows that acid washing is highly effective in removing barium contamination. Strong depletions in delta(Ba-138/Ba-136) values are found, down to -400 parts per thousand, which can only be modeled with a flatter C-13 profile within the C-13 pocket than is normally used. The dependence of d(Ba-138/Ba-136) predictions on the distribution of C-13 within the pocket in asymptotic giant branch (AGB) models allows us to probe the C-13 profile within the C-13 pocket and the pocket mass in AGB stars. In addition, we provide constraints on the Ne-22(alpha, n)Mg-25 rate in the stellar temperature regime relevant to AGB stars, based on delta(Ba-134/Ba-136) values of mainstream grains. We found two nominally mainstream grains with strongly negative delta(Ba-134/Ba-136) values that cannot be explained by any of the current AGB model calculations. Instead, such negative values are consistent with the intermediate neutron capture process (i process), which is activated by the very late thermal pulse during the post-AGB phase and characterized by a neutron density much higher than the s process. These two grains may have condensed around post-AGB stars. Finally, we report abundances of two p-process isotopes, Ba-130 and Ba-132, in single SiC grains. These isotopes are destroyed in the s process in AGB stars. By comparing their abundances with respect to that of Ba-135, we conclude that there is no measurable decay of Cs-135 (t(1/2) = 2.3 Ma) to Ba-135 in individual SiC grains, indicating condensation of barium, but not cesium into SiC grains before Cs-135 decayed.

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