Correlated Sr and Ba Isotopic Composition of Mainstream SiCs and the ^{13}C Pocket in AGB Models

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In current AGB stellar model calculations, it is unclear what process(es) are responsible for mixing protons from the bottom of the convective envelope to the He-intershell to form ^{13}C, which is the major neutron source for *s*-process nucleosynthesis via $^{13}C(\alpha,n)^{16}O$ [1]. AGB model predictions therefore suffer from uncertainties in the ^{13}C neutron source, in particular, depending on the ^{13}C profile within the so-called ^{13}C pocket and on the pocket mass used in the model calculations [1].

The abundances of most of nuclei in the regions between magic neutron numbers are insensitive to the adopted ^{13}C pocket in AGB models. Neutron magic nuclei, namely ^{88}Sr, ^{138}Ba and ^{208}Pb, however behave as bottlenecks in the *s*-process path due to their extremely small neutron capture cross sections; their predicted abundances strongly depend on the ^{13}C pocket adopted in the AGB models [2].

In order to better constrain the ^{13}C pocket structure in AGB models in this study compared to [2], we measured correlated Sr and Ba isotopic compositions in ~90 acid-cleaned SiC grains from Murchison using the CHARISMA instrument at Argonne National Laboratory. Comparison with previous SiC grain data shows that our acid-cleaning procedure is effective in removing solar Sr and Ba contamination. Comparison of the measured correlation between δ^{88}Sr versus δ^{138}Ba with AGB model predictions with varying ^{13}C pockets indicates that most of the grain data agree with AGB models with a typical decreasing ^{13}C profile, but with a lower pocket mass; a few grains can only be matched with both a flatter ^{13}C profile and a lower pocket mass. For the first time, we have shown that varying ^{13}C pocket structures exist in different parent AGB stars. We also derive stringent constraints on the ^{13}C pocket structure for future simulations of the physical mechanism(s) responsible for the ^{13}C pocket formation in AGB stars.

[1] Gallino *et al* (1998) *ApJ*, **497**, 388; [2] Liu *et al* (2013) *LPS* **44**, #2507