

**THE CARBON-13 POCKETS IN AGB STARS AND THEIR FINGERPRINTS IN MAINSTREAM SiC GRAINS.**

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**Introduction:** Asymptotic giant branch (AGB) stellar model predictions suffer from uncertainties in the major neutron source,  $^{13}\text{C}(\alpha,n)^{16}\text{O}$ . It is unclear what process(es) are responsible for mixing protons from the bottom of the convective envelope into the He-intershell to form the  $^{13}\text{C}$ -pocket [1]. Thus, the concentration and profile of  $^{13}\text{C}$  nuclei within the  $^{13}\text{C}$ -pocket, as well as the  $^{13}\text{C}$ -pocket mass are poorly known [1]. AGB model predictions for  $^{88}\text{Sr}/^{86}\text{Sr}$ ,  $^{138}\text{Ba}/^{136}\text{Ba}$ , and  $^{92}\text{Zr}/^{94}\text{Zr}$  ratios strongly depend on the  $^{13}\text{C}$ -pocket adopted in AGB models, because: 1) neutron-magic nuclei ( $^{88}\text{Sr}$  and  $^{138}\text{Ba}$ ) behave as bottlenecks in the *s*-process path due to their low Maxwellian-averaged neutron-capture cross sections (MACS) [2, 3]; and 2) the  $^{92}\text{Zr}$  MACS deviates from  $1/\nu_{\text{T}}$  rule, while the  $^{94}\text{Zr}$  MACS closely follows the rule at relevant AGB temperatures [4]. Thus, Sr, Zr, and Ba isotope ratios in mainstream SiC grains from low-mass AGB stars can provide stringent constraints on the  $^{13}\text{C}$ -pockets.

**Results:** Acid-cleaned presolar SiC grains from Murchison were used for Ba, and correlated Sr and Ba isotope measurements with CHARISMA at Argonne National Laboratory [2, 3]. Carbon and Si isotopes were measured afterwards by NanoSIMS.

**Discussions:** We compared mainstream grain data with AGB model with varying  $^{13}\text{C}$ -pockets. We found that although small  $^{13}\text{C}$ -pockets with flat  $^{13}\text{C}$  profiles can explain some unusual  $^{138}\text{Ba}/^{136}\text{Ba}$  and  $^{92}\text{Zr}/^{94}\text{Zr}$  ratios in mainstream SiC grains, in most of the cases, it is impossible to distinguish the effect of  $^{13}\text{C}$ -pocket mass from that of  $^{13}\text{C}$  concentration using only one isotope tracer [2, 4]. We therefore simultaneously measured Sr and Ba isotope ratios in mainstream SiC grains [3]. Comparison of AGB model calculations with the grain data shows that  $^{88}\text{Sr}/^{86}\text{Sr}$  predictions strongly depend on the  $^{13}\text{C}$  concentration, while  $^{138}\text{Ba}/^{136}\text{Ba}$  predictions depend on both the  $^{13}\text{C}$  concentration and the  $^{13}\text{C}$ -pocket mass. Correlated  $^{88}\text{Sr}/^{86}\text{Sr}$  and  $^{138}\text{Ba}/^{136}\text{Ba}$  ratios allow us for the first time to resolve the effect of  $^{13}\text{C}$ -pocket mass from that of the  $^{13}\text{C}$  concentration within the pocket, which points towards the common existence of large  $^{13}\text{C}$ -pockets with relatively dilute  $^{13}\text{C}$  concentrations in parent AGB stars. Formation of such large  $^{13}\text{C}$ -pockets requires occurrence of multiple mixing processes, which could be caused by overshoot, gravity waves and/or magnetic buoyancy [e.g., 5, 6, 7] along the boundary between the bottom of the convective envelope and the He-intershell in AGB stars, perhaps related to rotation rate [8].

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