LIGHT AND HEAVY ELEMENT ISOTOPIC COMPOSITIONS OF MAINSTREAM SiC GRAINS*

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DISCLAIMER

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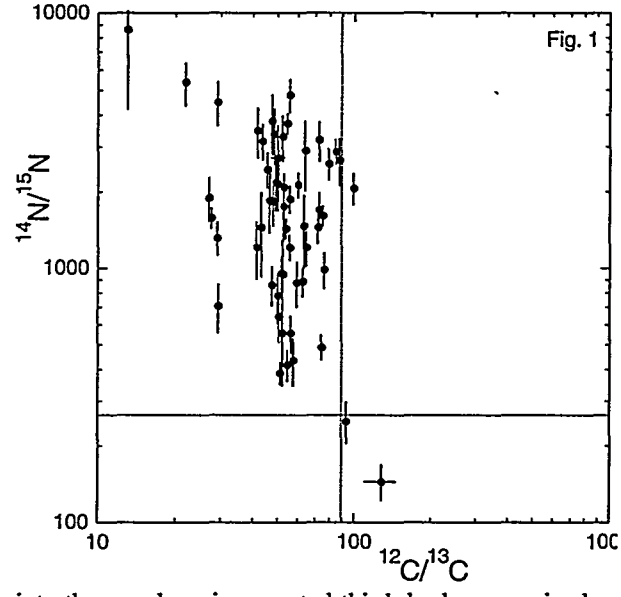
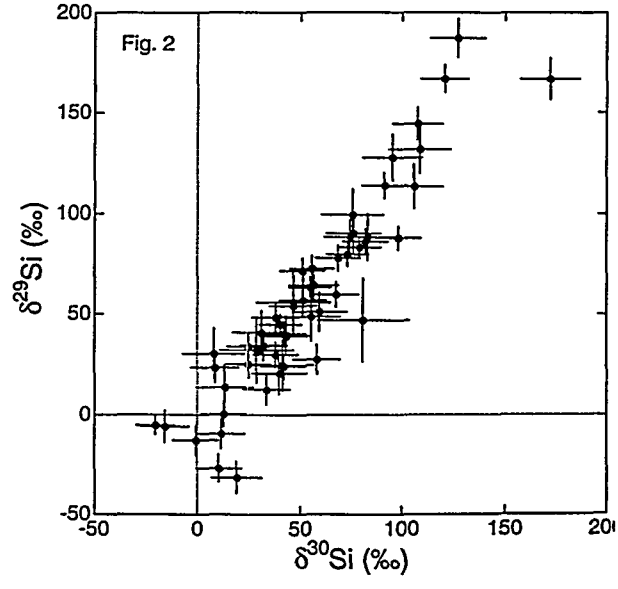
Introduction: Although a variety of types of presolar SiC grains have been classified by their C, N, and Si isotopic composition, the majority of such grains are so-called mainstream grains and are believed to have come from asymptotic giant branch stars [1]. We have previously reported the Mo isotopic compositions of presolar SiC grains whose C, N, and Si isotopic compositions were not known [2]. Since most presolar SiC grains fall in the mainstream group, we assumed that these grains were mainstream. The excellent match of the Mo isotopic data with expectations for nucleosynthesis in AGB stars was consistent with this identification. In order to better understand the distribution of isotopic compositions in presolar grains, we have begun to measure heavy element isotopic compositions of presolar SiC grains of known C, N and Si isotopic composition.

Experimental methods: Approximately 2000 grains of Murchison SiC grain size separate KJG [3] (2.1–4.5 μm diameter) were dispersed onto a soft gold mount. The grains were classified by ion imaging [4] with the Washington University ion microprobe, with the primary goal of identifying unusual grains. As part of this work, isotopic compositions of Si, C and N were measured by ion microprobe in 56 mainstream grains. The isotopic compositions of Mo in four mainstream grains (so far) were measured by laser ablation laser resonant ionization mass spectrometry using the CHARISMA instrument at Argonne National Laboratory. The analytical methods were similar to those used previously [2].

Results and Discussion: We report here the isotopic compositions of 4 mainstream grains and examine correlations among isotope ratios. The isotopic compositions of C, N, and Si in all mainstream grains in our mount are shown in Figs. 1 and 2. Mo isotopic compositions of the new mainstream grains are compared with our previous data [2] in Fig. 3. The Mo isotopic data lie at the *s*-process-enriched end of the correlations seen in our previous work and extend the correlation slightly. On a mixing line between terrestrial composition and pure *s*-process Mo, grain C-100-4 contains 96% *s*-process material. The data collected so far cover a relatively narrow range in Mo and Si isotopic composition. As an AGB star evolves, it can produce a relatively wide range of Mo isotopic compositions as *s*-process material from the He shell is mixed



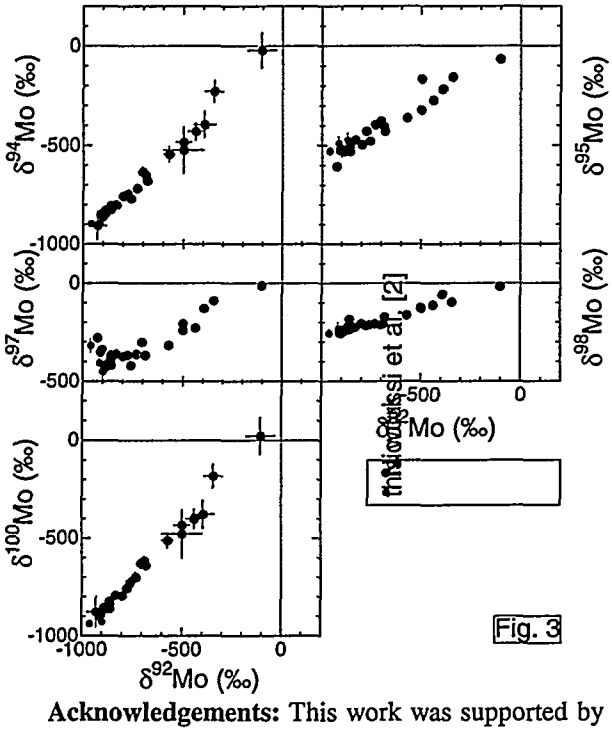
into the envelope in repeated third dredge-up episodes. This can also lead to substantial variations in C isotopic composition, as ^{12}C is produced in copious amounts in the He shell and is responsible for turning the AGB into a carbon star after several third dredge-up episodes. On the other hand, Si isotopic variations of only a few tens of ‰ are expected [5] and no significant variation in N isotopes is expected. The variations in N isotopic composition among mainstream grains are not well understood (see [6] for a recent re-



view).

All grains have similar sorts of Mo isotopic patterns, so δ^{92}Mo is representative of the distance along the mixing line from solar to pure *s*-process. In AGB stars, the isotopic composition of the envelope is predicted to proceed to larger and larger negative δ^{92}Mo values as third dredge-up episodes proceed.

In Fig. 4, we have plotted C, N and Si isotopic compositions as a function of δ^{92}Mo. There is a suggestion of a correlation between δ^{29}Si and δ^{92}Mo, but only a small part of the total range of δ^{29}Si observed in mainstream grains [6]. Further measurements will be necessary to establish the validity of the correlations.



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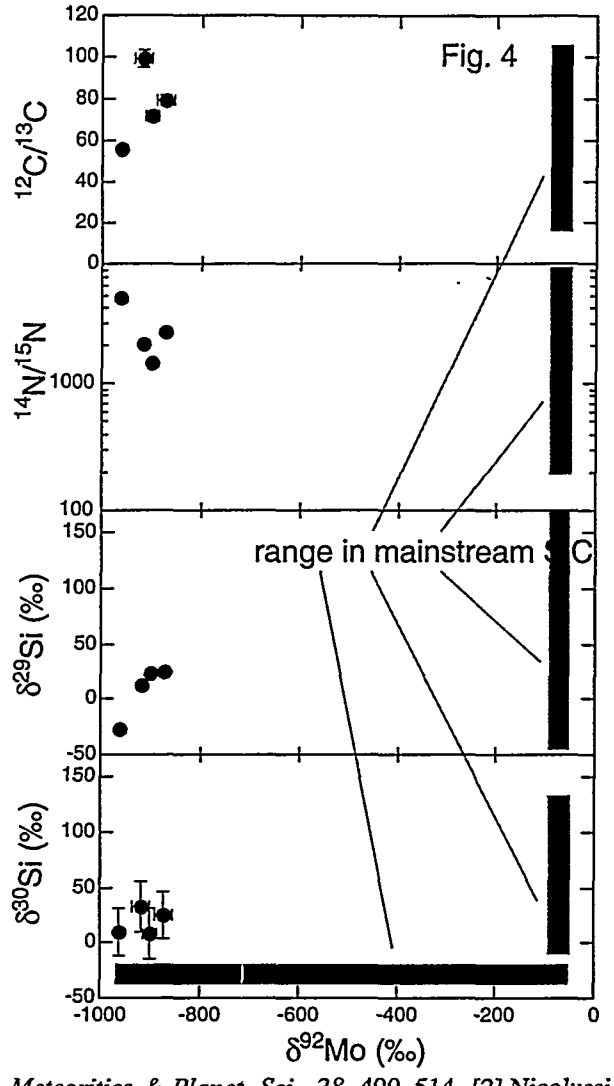

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