INTRINSIC NITROGEN ISOTOPE RATIOS OF PRESOLAR SILICON CARBIDE GRAINS.

N. Liu[1], C. M. O'D. Alexander[2], L. R. Nittler [1]Department of Physics, Washington University in St. Louis, St. Louis, MO 63130, USA (nliu@physics.wustl.edu), [2]Earth and Planets Laboratory, Carnegie Institution, Washington, DC 20015, USA.

Introduction: Given the long timespan between the stellar birth and recovery of presolar grains in the laboratory, presolar grains could have been chemically altered so that their measured isotopic signatures would reflect mixing between stellar, asteroidal, and terrestrial compositions. Potential asteroidal and terrestrial contaminations, therefore, complicate the interpretation of presolar grain data and thus limit the scientific value of presolar grains in constraining astrophysical processes. In particular, terrestrial and/or asteroidal N contamination is suspected to have caused the close-to-terrestrial $^{14}N/^{15}N$ ratios observed in the majority of presolar graphite. The substantial effect of N contamination has been confirmed for presolar silicon carbide (SiC) in the study of [1], in which the authors observed significantly increased $^{14}N/^{15}N$ ratios for mainstream (MS) SiC grains after an extended period of ion sputtering of the grain surfaces. Here, we report $^{14}N/^{15}N$ ratios for additional SiC grains of diverse groups following the study of [1].

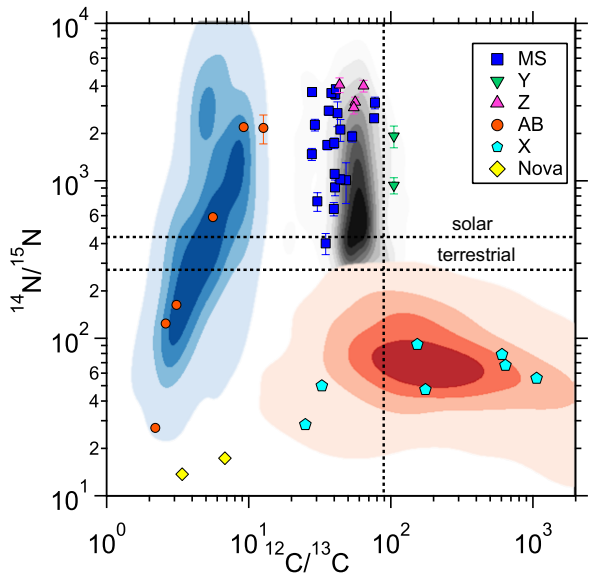

Fig. 1. *The N versus C isotope plot compares SiC from this study (symbols with 1σ errors) with the literature data for MS/Y/Z (in grayscale density map), AB (in blue-scale density map), and X (in red-scale density map) grains [2].*

Samples and Experiments: The SiC grains in this study were extracted from Murchison (CM2) using the CsF dissolution technique described in [3]. The C, N, and Si isotope ratios were measured with the WashU NanoSIMS 50 ion microprobe using standard analytical procedures. A Cs^+ beam of ~9 pA and ~1 pA was used for presputtering and analysis, respectively. All the isotope data were collected in imaging mode at a spatial resolution of ~100 nm. After C and Si isotope analyses, we further presputtered the grains for a few minutes until the CN^-/Si^- ratio becomes steady prior to N isotope analyses.

Results and Discussion: We have measured a total of 475 SiC grains (1.5 µm in size on average) for their C and Si isotopes, including 388 MS (81.7%), 26 AB (5.5%), 21 X (4.4%), 20 Z (4.2%), 17 Y (3.6%), and three putative nova (0.6%) grains. The overabundance of X grains in our sample results from a sample selection bias because we prioritized the analyses of Mg-rich SiC grains – X grain candidates (see [4] for details). We collected coordinated N isotope data for 42 of the grains, as shown in Fig. 1. **MS, Y, and Z Grains**: While it is a sample selection bias that our MS grains show lower $^{12}C/^{13}C$ ratios than the literature data, the higher $^{14}N/^{15}N$ ratios observed in our MS/Y/Z grains are consistent with the results of [1], pointing to a significant contribution of N contamination to the literature N isotope data. Although the literature data reveal a similar range of $^{14}N/^{15}N$ ratios for MS, Y, and Z grains [2], our four Z grains all exhibit high $^{14}N/^{15}N$ ratios, which differs significantly from the MS grains and implies different stellar origins. **AB Grains**: Recent statistical analyses [e.g., 5] of literature data pointed out a weak correlation between ^{13}C and ^{15}N for AB grains. This correlation is strengthened by our new AB grain data and points to the important role of hot CNO burning (at $T > \sim 1\times 10^8$ K) in governing the C and N isotope ratios of AB grains. **X Grains**: Our new data show a clear separation of the X from MS/Y/Z grains in Fig. 1, in contrast to an overlap between these groups in the literature data that could have been caused by N contamination. Our X grains with $^{12}C/^{13}C < 100$ seem to show lowered $^{14}N/^{15}N$ ratios, pointing to the 'nova' grain region. This provides further support to the proposed supernova origin of 'nova' grains [6].

Conclusions: Our analytical procedure allowed suppressing sampling nitrogen contamination. The 'cleaner' N isotope ratios of our SiC grains are more representative of intrinsic stellar signatures and revealed several new trends and features. More data are on the way to increase the statistics prior to the start of the meeting.

References: [1] Liu N. et al. (2021) *The Astrophysical Journal* 920: L26 (15pp). [2] Stephan T. et al. (2021) *LPS 52*, Abstract #2358. [3] Nittler L. R. and Alexander C. M. O'D. (2003) *Geochimica et Cosmochimica Acta* 67: 4961–4980. [4] Liu N. et al. (2017) *Meteoritics & Planetary Science* 52: 2550–2569. [5] Hystad G. et al. (2022) *Monthly Notices of the Royal Astronomical Society* 510: 334–350. [6] Liu et al. (2016) *The Astrophysical Journal* 820: 140 (14pp).