

**CONTINUED SIMS TRACE ELEMENT STUDY OF PRESOLAR GRAPHITE GRAINS.** M. Jadhav<sup>1</sup>, K. Nagashima<sup>2</sup>, and G. R. Huss<sup>2</sup>, <sup>1</sup>Department of the Geophysical Sciences, The University of Chicago, Chicago, IL 60637, <sup>2</sup>Hawai'i Institute of Geophysics and Planetology, University of Hawai'i at Mānoa, Honolulu, HI 96822. E-mail: [manavi@uchicago.edu](mailto:manavi@uchicago.edu)

**Introduction:** A few quantitative trace-element measurements on bulk SiC fractions [e.g., 1] and individual presolar SiC grains [e.g., 2 – 6] have been carried out to date. Amari et al. [2] compared the observed trace-element abundance patterns in presolar SiC grains to results of condensation calculations for circumstellar environments to associate grains with different C-rich stellar environments [7]. However, very few published studies have attempted to quantify the abundance and distribution of trace elements in presolar graphite grains. Isotopic and TEM studies of graphites have indicated that presolar graphite grains have lower trace-element abundances compared to presolar SiC grains [e.g., 8 – 12]. Low-density (LD) graphite grains are good candidates for trace-element measurements compared to high-density grains because of their turbostratic structure that can accommodate trace elements better. Elements like Mg, Al, Si, and Ca appear to have been incorporated into the parent grains during primary graphite crystallization [10, 13]. Other trace elements like Ti, Zr, Ru, Mo, Fe, and Ni are found concentrated within early crystallizing subgrains [11, 12].

This study is part of the ongoing attempt to measure trace element abundances in presolar graphite grains by SIMS. Last year, we presented Mg, Si, Ca, Ti, V, and Fe data on graphites from Orgueil [14]. Here, we present data for additional trace elements (Sc, Fe, Ni, Rb, Sr, Y, Zr, and Nb) from the same grains.

**Experimental details:** Thirteen individual LD graphite grains from the OR1d ( $\rho \sim 1.75\text{--}1.92\text{ g cm}^{-3}$ ) density fraction were measured with the University of Hawai'i's Cameca ims 1280 ion microprobe. A 30–60 pA O<sup>-</sup> primary beam focused to  $\sim 1\ \mu\text{m}$  was rastered ( $12 \times 12\ \mu\text{m}^2$ ) over the graphite grains, and scanning ion images of  $^{12}\text{C}^+$ ,  $^{24}\text{Mg}^+$ ,  $^{28}\text{Si}^+$ ,  $^{44}\text{Ca}^+$ ,  $^{47}\text{Ti}^+$ ,  $^{51}\text{V}^+$ ,  $^{56}\text{Fe}^+$  (Stage 1) and  $^{12}\text{C}^+$ ,  $^{45}\text{Sc}^+$ ,  $^{56}\text{Fe}^+$ ,  $^{60}\text{Ni}^+$ ,  $^{62}\text{Ni}^+$ ,  $^{85}\text{Rb}^+$ ,  $^{86}\text{Sr}^+$ ,  $^{89}\text{Y}^+$ ,  $^{90}\text{Zr}^+$ ,  $^{93}\text{Nb}^+$  (Stage 2) were collected in magnetic-peak-jumping mode. The sample chamber was flooded with O<sub>2</sub> to enhance the ion yields. In Stage 3, a Cs<sup>+</sup> primary beam was used to measure C, N, and Si isotopic ratios in the same grains. Scanning ion images of the isotopic data were obtained in a combination of both multi-collection and peak-jumping modes. L'image software was used to extract isotopic ratios from the regions of interest.

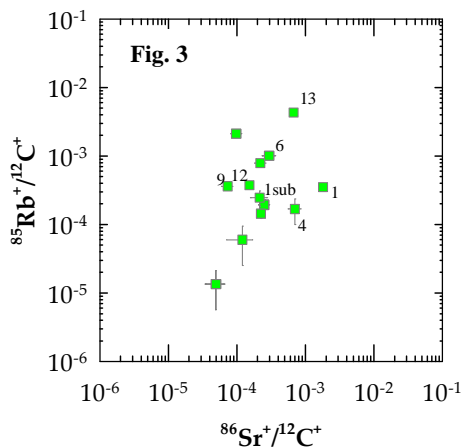
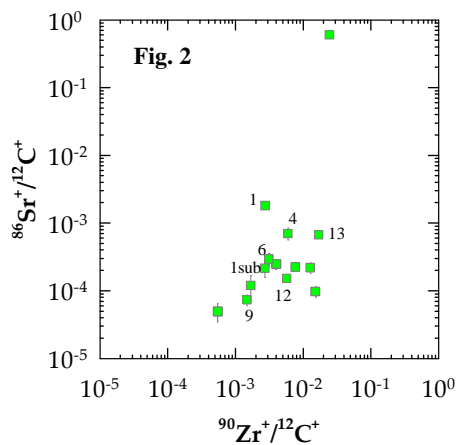
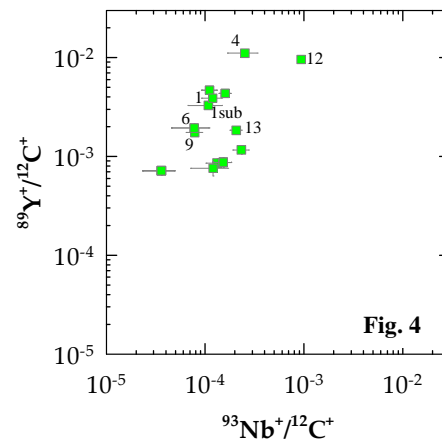
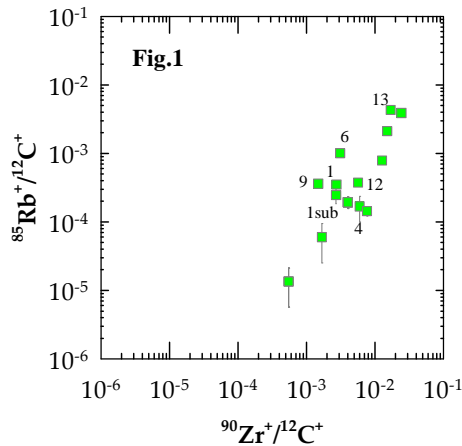
Synthetic SiC grains were used as standards for the C, N, and Si isotopic measurements. We used USGS24

graphite and NBS610 glass as standards for all other elements presented here. The required trace-element concentrations in USGS24 graphite will soon be measured by ICP-MS. Due to the lack of a proper graphite standard to obtain absolute concentrations, we present ion counts of the measured ions normalized to  $^{12}\text{C}$  counts and compare relative abundances in this abstract.  $^{60}\text{Ni}/^{62}\text{Ni}$  is not corrected for instrumental mass fractionation. The C, N, and Si isotopes and Mg-Fe elemental data were discussed in [14].

**Results:** The  $^{45}\text{Sc}^+/^{12}\text{C}^+$  ratios in the LD graphite grains from this study range from 0.001–0.2,  $^{60}\text{Ni}^+/^{12}\text{C}^+$  from  $4 \times 10^{-4}$ –3,  $^{85}\text{Rb}^+/^{12}\text{C}^+$  from  $10^{-5}$ –0.004,  $^{86}\text{Sr}^+/^{12}\text{C}^+$  from  $5 \times 10^{-5}$ –0.6,  $^{89}\text{Y}^+/^{12}\text{C}^+$  from  $7 \times 10^{-4}$ –0.01,  $^{90}\text{Zr}^+/^{12}\text{C}^+$  from  $5 \times 10^{-4}$ –0.02, and  $^{93}\text{Nb}^+/^{12}\text{C}^+$  from  $4 \times 10^{-5}$ – $10^{-3}$ . Most of these elements are expected to be concentrated in refractory subgrains within the graphites [11, 12]. Except for large Fe-Ni subgrains, there was no sign of other subgrains in the depth profiles of these grains. If the trace element signals are from subgrains much smaller than  $1\ \mu\text{m}$  (spatial resolution of the primary beam) then it was possible that they were missed during data analysis. Thus, the spatial distribution of trace elements within the grains in this study is unresolved.

No correlations exist between the trace element content and the C, N, and Si isotopic ratios of the grains. We show correlations between different trace element contents in Figs. 1-4. The type II supernova grains (grains 1, a subgrain within grain 1 (1sub), 4, 6, 9, 12, and 13), identified on the basis of their N and/or Si isotopic compositions [14], are marked on each plot to spot possible correlations. We plot raw ion counts for all the elements. All errors are  $1\sigma$ . Dashed lines in Fig. 5 represent solar isotopic values.

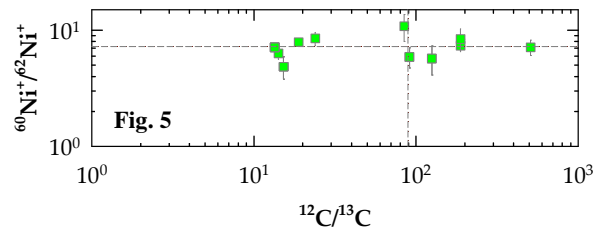
A good correlation exists between  $^{85}\text{Rb}$  and  $^{90}\text{Zr}$  contents in the grains with Zr being more abundant (Fig. 1). In Fig. 2, if the grain with the highest  $^{86}\text{Sr}/^{12}\text{C}$  ratio ( $\sim 0.6$ ) is ignored (possibly highly contaminated based on the  $^{56}\text{Fe}$  content) then  $^{86}\text{Sr}$  and  $^{90}\text{Zr}$  contents of the grains are fairly well correlated. No such correlation was seen in presolar SiC grains [2]. Zr is more abundant than Sr in the grains. The average Sr and Rb abundances in the grains are roughly equal (Fig. 3) and also fairly well correlated. The relative abundance of Y in the grains is higher than that of Nb. These elements are weakly correlated with each other (Fig. 4).



A detailed discussion of these and other trace element correlations and their implications for the chemical environments in which these grains condensed will be presented at the meeting.

*Note on Fe-Ni contamination:* As observed in [14], the grains were highly contaminated by terrestrial Fe. We compared the level of contamination between the two measurement stages in the hope that as grains are

sputtered away by the primary beam, contamination would decrease. Contamination was lower during this stage of measurements in the grains with already low  $^{56}\text{Fe}/^{12}\text{C}$  ratios but the ratio remained the same in heavily contaminated grains. We also measured  $^{60}\text{Ni}$  and  $^{62}\text{Ni}$  in the grains in an attempt to identify good candidates for future  $^{60}\text{Fe}$  measurements. The  $^{60}\text{Ni}/^{62}\text{Ni}$  ratios in the grains (including the 6 SN grains) were solar within errors (Fig. 5) indicating the grains also have a large amount of solar or terrestrial Ni contamination.



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