IRON ISOTOPIC ABUNDANCES IN PRESOLAR GRAINS. R. Trappitsch[1,2], M. R. Savina[2,4], D. G. Willingham[2,4], N. Liu[1,2], M. J. Pellin[1,2,3,4], N. Dauphas[1,2,3], and A. M. Davis[1,2,3] [1]University of Chicago, Department of the Geophysical Sciences, [2]Chicago Center for Cosmochemistry, [3]Enrico Fermi Institute, University of Chicago, Chicago, IL, USA, [4]Material Science Division, Argonne National Laboratory, Argonne, IL, USA, trappitsch@uchicago.edu

Introduction: Presolar grains, found in minimally altered meteorites, are condensates from stellar outflows and carry the nucleosynthetic record of their parent stars. These grains were incorporated into meteorite parent bodies at solar system formation and therefore represent earlier stellar ejecta. Up to now they are the only samples available for laboratory studies of stellar nucleosynthesis and galactic chemical evolution (GCE). Transition metals in presolar grains are of interest since they are seed nuclei for *s*-process nucleosynthesis. Here we present Fe isotope measurements performed on 12 unclassified presolar SiC grains that are most likely mainstream grains from asymptotic giant branch (AGB) stars. Iron isotopes have been measured in several types of presolar SiC grains [1], however, due to isobaric interference from abundant ^{58}Ni, the minor isotope ^{58}Fe could not be measured. Our measurements were performed using resonance ionization mass spectrometry (RIMS) on the CHARISMA instrument at Argonne National Laboratory. This technique allows measurement of all Fe isotopes without isobaric intereferences.

Nucleosynthesis in AGB stars is not expected to change the relative Fe isotopic abundances significantly, except for ^{58}Fe. Hence, ^{54}Fe, ^{56}Fe, and ^{57}Fe in presolar grains should provide a record of GCE, while ^{58}Fe should show an AGB component. Recent measurements of Cr in presolar SiC grains [2] showed that the data were not in agreement with recent GCE models [3] nor were the expected *s*-process enhancements in δ^{54}Cr found. Our Fe isotope measurements also do not show enhancements predicted by nucleosynthesis in AGB stars [4,5], but the data agree with GCE models [3].

Materials & Methods: Presolar SiC grains were separated from the Murchison meteorite using high-purity reagents and techniques specifically developed to prevent laboratory contamination. The grains were pressed into a gold substrate. Isotope measurements were performed at Argonne National Laboratory using RIMS on the CHARISMA instrument. Grain material was desorbed using a pulsed, secondary ions were electrostatically ejected, and neutral Fe atoms were then resonantly ionized using three tunable Ti:sapphire lasers. To correct for instrumental bias, we prepared a standard mount with synthetic SiC grains (NIST 112b) containing 0.13 wt% Fe. Fe-bearing Cr_2C_3 grains were placed on the mount and used as secondary Fe standards. To check for contamination we analyzed grain-free areas, and found no detectable Fe. No interferences from Cr or Ni were visible in the spectra, even when measuring Cr_2C_3 grains, and off-resonance spectra (taken with the resonance laser detuned) showed no backgrounds under the Fe peaks. Presolar grain data for any given day was normalized to standards measured on the same day. Reported uncertainties are 95 % confidence intervals containing both statistical and non-statistical errors.

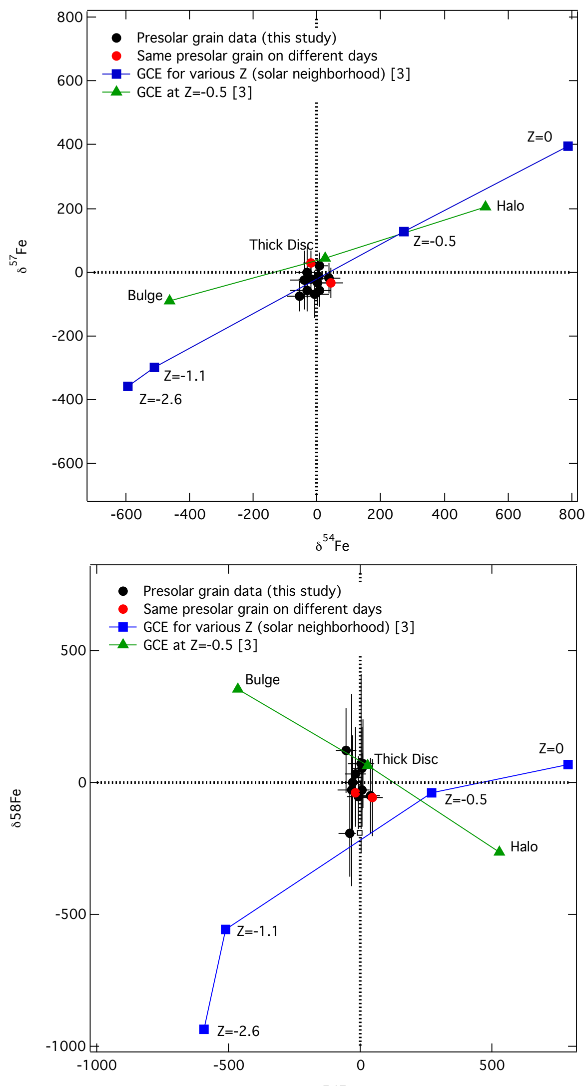

Fig. 1: *Most measured presolar grains show solar system Fe isotope ratios. The red points represent the same grain measured on two different days. The green and blue curves are from [3] for different metallicities and galactic regions.*

Results: Figure 1 shows the presolar grain data in δ-units normalized to ^{56}Fe and terrestrial ratios (δ^{i}Fe = δ^{i}Fe/^{56}Fe). One presolar grain was measured on two different days and therefore normalized with different standards (red datapoints). This shows that our data are consistent within the 95 % confidence interval. Most other grains plot around the solar value. Two grains show slight deficits in δ^{57}Fe of –58±50 and –75±49 ‰, one grain a slight deficit in δ^{54}Fe of –54±39 ‰, and one grain a slight deficit in δ^{58}Fe of –194±165 ‰.

Discussion: Figure 1 compares the measured data with recent GCE models [3]. The data agree well with a parent star metallicity of [Fe/H] = –0.5. This metallicity corresponds to an age of 5 to 7 Gyr relative to present.

Figure 2 shows model calculations for various AGB stars. Shown are the isotopic ratios in the last few thermal pulses, where C/O>1 and SiC can condense. Lines are drawn between the thermal pulses to guide the eye.

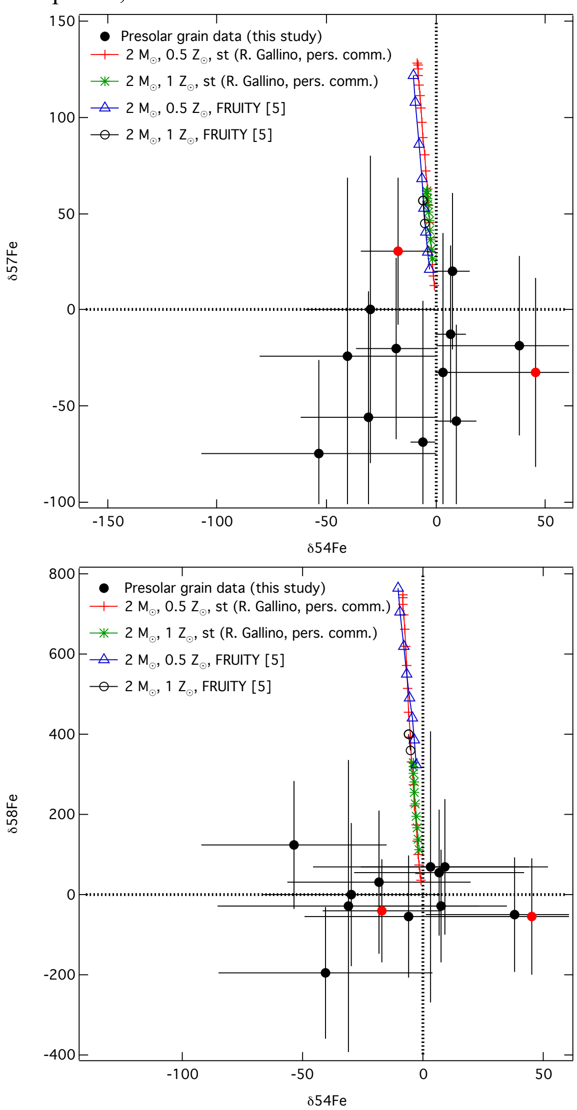

Figure 2: Comparison of different TP-AGB models. Points connected with lines are thermal pulses with C/O>1.

All models predict a slight deficit in δ^{54}Fe and excesses in δ^{57}Fe and δ^{58}Fe. Effects in δ^{58}Fe are much larger than in the other isotopes. For lower metallicity stars, the deviation from the solar system ratio is much larger. Our data (Figure 1) do not show the effects predicted by the models.

One explanation for the lack of isotopic anomalies would be contamination with solar system material. To explain the observed δ^{58}Fe within uncertainty, 80 % of the total Fe signal would have to be contamination, assuming a mean δ^{58}Fe from an AGB star of 500 ‰. Since count rates were stable as material was desorbed from the grain and no Fe signal was detected, surface contamination can be excluded. Contamination might result from aqueous alteration on the Murchison parent body as proposed for other elements, *e.g.*, [6]. However, Marhas et al. [1] reported normal isotope ratios for mainstream grains but measured isotope anomalies in X grains, which contain ~10 times less Fe than mainstream grains [7] and would be expected to show larger contamination effects.

Conclusion & Outlook: We measured the Fe isotopic composition of 12 presolar SiC grains and did not find the anomalies in δ^{58}Fe expected from AGB star nucleosynthesis models [4,5]. For δ^{54}Fe and δ^{57}Fe these findings are consistent with earlier measurements on mainstream grains [1]. In order to avoid contamination, we measured iron isotope composition before classifying the grains using a NanoSIMS. Since 93 % of all SiC grains are mainstream [8], it is likely that most if not all of our grains are of this type. While the data do not show isotope anomalies as predicted by AGB star models, contamination with solar system material or GCE might mask AGB contribution.

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