SILICON AND TITANIUM ISOTOPIC ANALYSIS OF SILICON CARBIDE GRAINS OF TYPE X AND Z.

S. Amari 1, E. Zinner 1, R. Gallino 2, and C. S. Lewis 3, 1Laboratory for Space Sciences and the Physics Department, Washington University, St. Louis, MO 63130, USA (sa@wuphys.wustl.edu), 2Dipartimento di Fisica Generale dell’Università di Torino, 10125 Torino, Italy, 3Enrico Fermi Institute, University of Chicago, Chicago, IL 60637, USA.

We measured Ti isotopic ratios of four X and two Z grains from the Murchison KJG SiC separate (average size: 3µm) [1]. These are the first Ti isotopic analyses of Z grains and are of particular interest. Z grains are believed to have formed in low-mass low-metallicity asymptotic giant branch (AGB) stars [2]. Measurements of Si and Ti isotopic ratios of Z grains provide us with the opportunity to examine both the Galactic chemical evolution of these elements and neutron-capture processes in the He-shell of AGB stars because both effects are of comparable magnitude.

Candidates of X and Z grains were located by ion imaging with the Cameca-3f. This was followed by C, Si, and Ti isotopic ratio measurements with the NanoSIMS. All four X grains have excesses in 49Ti and 50Ti relative to 48Ti (Fig. 1a). Grain KJGN2-345-1 shows unusual Si and Ti isotopic features. In contrast to most X grains, it has a larger δ²⁹Si/²⁸Si = –589±5‰ than δ³⁰Si/²⁸Si = –412±6‰ depletion (see also Lin et al. [3]) and almost equal excesses in ⁴⁶Ti and ⁴⁷Ti. The Ti isotopic patterns of the X grains are similar to those of previously analyzed SiC X [4-6] and low-density graphite grains [7]. Three grains show the initial presence of ⁴⁴Ti in the form of ⁴⁴Ca excesses with inferred ⁴⁴Ti/⁴⁸Ti ratios ranging from 5.2×10⁻⁴ to 6.7×10⁻².

The two Z grains have relatively high ¹²C/¹³C ratios (93.5±0.6 for KJGN2-249-1 and 81.1±0.5 for KJGN2-415-3) but exhibit the typical Si isotopic signature of Z grains with ²⁹Si depletions and ³⁰Si enhancements (δ²⁹Si/²⁸Si = –130±5‰ and –108±5‰; δ³⁰Si/²⁸Si = 201±8‰ and 392±6‰ for 249-1 and 415-3, respectively) [2]. Their Ti isotopic patterns are striking (Fig. 1b). Titanium-46, ⁴⁷Ti, and ⁴⁹Ti are depleted relative to ⁴⁸Ti to almost the same degree for the two grains, while their ⁵⁰Ti/⁴⁸Ti ratios are quite different. Grain KJGN2-415-3 has a ⁵⁰Ti excess (δ⁵⁰Ti/⁴⁸Ti = 276±26‰), while grain KJGN2-249-1 has a deficit (δ⁵⁰Ti/⁴⁸Ti = –66±25‰). These ⁵⁰Ti/⁴⁸Ti ratios are positively correlated with the ³⁰Si/²⁸Si ratios of these two grains. Apparently, all original Si and Ti isotopic ratios in the parent stars of the two Z grains were lower than solar, indicating stars of low metallicity. During the 3rd dredge-up, the ²⁹Si/²⁸Si and ⁵⁰Ti/⁴⁸Ti ratios in the envelope are expected to increase more than the other Si and Ti isotopic ratios, leading to relative ²⁹Si and ⁵⁰Ti excesses. The correlation thus reflects the result of nuclear processes in the He-shell.

**Figure 1**