SILICON CARBIDE SUBGRAINS IN PRESOLAR GRAPHITE FROM MURCHISON.

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Introduction: Equilibrium condensation models for AGB stars predict that refractory carbides, like TiC, should condense at higher temperatures than graphite, while SiC condenses at lower temperatures than graphite[1]. Transmission electron microscopy (TEM) observations generally support these predictions, with refractory carbides often observed as internal subgrains within graphite, whereas SiC is only rarely observed inside of graphite [2, 3]. Here we present results from TEM studies of the only graphite grains known to have internal SiC subgrains, including one graphite that also contains an internal TiC subgrain.

Experimental: Graphite grains from the KFC1 density and size separate (2.15-2.20 g cm^{-3}, >1 μm) of the Murchison meteorite[4] were deposited from suspension onto a glass slide. The grains were then embedded in resin and sliced into ~70 nm sections with a diamond ultramicrotome and subsequently studied in a JEOL 2000FX TEM equipped with a NORAN Energy Dispersive X-ray Spectrometer (EDXS).

Results: Out of ~1500 graphite slices examined in the TEM for internal subgrains, only 4 have been found that contain internal SiC grains. Preliminary results for one of these graphites was presented in [5]. Three graphites contain multiple SiC subgrains, with as many as 23 SiCs in a single graphite. The SiC subgrains ranged in size from ~13-83 nm. All of the internal SiC grains were identified by diffraction patterns as FCC 3C-SiC, 2H-SiC, or an intergrowth between the two polytypes. This is consistent with the polytypes observed in both mainstream SiC [6] and SiC X-grains[7]. Although most KFC1 graphites have an AGB origin, the stellar origin of SiC-containing graphites is uncertain. These graphites lack clear indicators of an AGB origin, such as additional subgrains with s-process enrichments commonly observed in other KFC1 graphites[3]. The multiply twinned TiC observed in one of the SiC-containing graphites, as well as the Fe subgrain found in [5], have compositions similar to the subgrains found in KE3 SN graphites[8]. However, EDXS analysis of the graphites with SiC subgrains reveals no radiogenic isotopes, such as ^{26}Mg, which would be a clear indicator of a SN origin. NanoSIMS analysis of two of the SiC-containing graphites gives $^{12}C/^{13}C$ ratios of 110 ± 2 and 782 ± 18 (solar ratio = 89), which confirms their presolar origin. However, because the $^{16}O/^{18}O$ ratios are normal within errors, the stellar sources of these grains remain uncertain. Additional NanoSIMS measurements of the Si isotopic composition of these grains are planned to clearly distinguish between an AGB and a SN origin.

References: [1] Lodders K. and Fegley B., Jr. 1995. *Meteoritics and Planetary Science* 30:661-678. [2] Bernatowicz T. J. et al. 1996. *Astrophysical Journal* 472:760-782. [3] Croat T. K. et al. 2005. *Astrophysical Journal* 631:976-987. [4] Amari S. et al. 1994. *Geochimica et Cosmochimica Acta* 58:459-470. [5] Croat T. K. and Stadermann F. J. 2006. Abstract #2048. 37th Lunar and Planetary Science Conference. [6] Daulton T. L. et al. 2003. *Geochimica et Cosmochimica Acta* 67:4743-4767. [7] Hynes K. M. et al. 2006. Abstract #2202. 37th Lunar and Planetary Science Conference. [8] Croat T. K. et al. 2003. *Geochimica et Cosmochimica Acta* 67:4705-4725.