TEM INVESTIGATIONS INTO THE STELLAR ORIGINS OF THE ^{13}C-RICH GRAPHITE SUBGROUP. T. K. Croat, S. Amari, E. Groopman and T. J. Bernatowicz. Laboratory for Space Sciences and Physics Dept., Washington University, St. Louis, MO 63130, USA. tkc@wustl.edu.

Introduction: The stellar origins of the ^{13}C-rich graphite group remain somewhat enigmatic. They show large C isotopic anomalies (typically $^{12}C/^{13}C<20$) but lack the expected anomalies in other elements that should be concomitant [1]. Recent multi-element NanoSIMS measurements of ^{13}C-rich high-density (HD) Orgueil graphites find anomalies consistent with a born-again AGB origin, but also uncover a further subset with ^{44}Ca excesses indicative of a SN origin [1]. To date, all three ^{13}C-rich low-density (LD) graphites observed in TEM were quite different from other LD graphites (they lacked TiCs and instead contained kamacites and in one instance SiCs and a refractory metal nugget [2, 3]). Here, we present TEM and NanoSIMS results from three more ^{13}C-rich LD graphites from the Murchison and Orgueil meteorites in an effort to discern their stellar source.

Experimental Methods: Graphites from the Murchison KE3 (1.65-1.72 g cm-3, >1 μm) [4] and the Orgueil OR1d (1.75-1.92 g cm-3, >1 μm) [5] density and size separates were selected based on NanoSIMS C, O and Si (and sometimes N) isotopic measurements. After isotopic studies, KE3i021, KE3i461, and OR1d6m-24[6] were embedded in resin, ultramicrotomed and studied in TEM with EDXS, imaging and diffraction.

Results and Discussion: The $^{12}C/^{13}C$ ratios of i461, i021, and 6m-24 were 3.40 ± 0.02, 15.8 ± 0.1, and 13.1 ±0.1, respectively. i461 contains minor element isotopic anomalies consistent with a SN origin ($^{16}O/^{18}O=346 \pm 4$; $\delta^{29}Si=-252 \pm 83$; $\delta^{30}Si=97 \pm 125$), whereas i021 and 6m-24 lack significant O or Si anomalies. Most LD ^{13}C-rich graphites (~80%) lack minor element anomalies. TiCs were again sparse or absent, with 0, 5, and 2 TiCs found in numerous graphite sections from i461, i021, and 6m-24, respectively (although limited material was available from i461). The resulting calculated TiC abundances (by areal fraction) are <160, 23 and 265 ppm, respectively, all lower than typical values from SN graphites (900 ppm median TiC abundance with 25-2400 ppm range [7]). Both TiCs in 6m-24 were relatively large (180-345 nm) whereas those in i021 were smaller (30-130nm); all were consistent with a ~4.4Å FCC structure. These lacked the s-process enrichments seen in AGB TiCs [8] and were chemically similar to SN TiCs [7], although with higher V content on average (5-20 at. %). TiCs from i021 show evidence of amorphous rims partially surrounding the grains, a phenomenon that may be related to reverse implantation of O into grain surfaces [9], whereas the 6m-24 TiCs show no clear evidence of rims. NanoSIMS isotopic measurements (of C, O, N, and Ca/Ti) of the TiCs and their host graphites will be made to further clarify their origins.

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