A PRESOLAR SPINEL GRAIN OF PROBABLE NOVA ORIGIN.

F. Gyngard and E. Zinner. Laboratory for Space Sciences and Department of Physics, Washington University, St. Louis, MO 63130. Email: fmgyngar@wustl.edu.

Introduction: Presolar grains from novae are exceedingly rare. A few SiC and graphite grains have been identified by large ^{13}C, ^{15}N, and ^{30}Si excesses [1, 2]. While some purported nova grains may have actually condensed in a supernova [3], some are undoubtedly nova condensates [4, 5]. Except in rare cases, the material ejected in nova explosions is O-rich, and it remains a puzzle why to date only carbonaceous phases, with one possible exception [6], have been identified. Here we report the discovery of a presolar spinel grain with a likely nova origin.

Experimental: The "CG" residue of Murray, prepared by physical and chemical separation [7] and consisting of high concentrations of spinel grains (diameter ~0.5µm), was scanned for O-anomalous grains with an automated measurement technique recently developed for the NanoSIMS [8]. Grain C4-8 was not identified by the particle definition software, but was recognized as an ^{17}O hotspot in an ion image taken during the automated surveys. High-resolution SEM images confirmed that it was surrounded by multiple grains. Subsequent removal of surrounding isotopically normal material [9] and manual measurement of ^{16,17,18}O revealed the grain to be extremely enriched in ^{17}O. Following O isotopic analysis, $^{24,25,26}Mg^+$ and $^{27}Al^+$ were measured in multicollection mode with an O^- primary beam in a separate measurement session.

Results: The O isotopic composition of C4-8 is characterized by a huge enrichment in ^{17}O and a modest depletion in ^{18}O, with $^{17}O/^{16}O = (4.40 \pm 0.01) \times 10^{-2}$ and $^{18}O/^{16}O = (1.10 \pm 0.02) \times 10^{-3}$. This isotopic signature is similar to that of Group 1 grains [10]. However, RGB and AGB stars undergoing 1st and 2nd dredge-up, the most likely sources of these grains [11], cannot produce $^{17}O/^{16}O > 4 \times 10^{-3}$ [12]. C4-8 is significantly enriched in ^{25,26}Mg ($\delta^{25}Mg = 949 \pm 9‰$ and $\delta^{26}Mg = 929 \pm 7‰$) and, similar to the situation for O, nucleosynthesis in the O-rich envelope of AGB stars ($\lesssim 3M_{\odot}$) cannot produce $\delta^{25}Mg \gtrsim 40‰$ [13]. The most likely condensation environment for a grain with extreme enrichments in both ^{17}O and ^{25}Mg is found in nova ejecta. The best match for the O isotopes in C4-8 is achieved by models for CO novae with a 0.8 or 1.15$M_{\odot}$ white dwarf; however, the Mg isotopic composition is much better explained by a 0.6 $M_{\odot}$ CO model [2]. The only other putative nova oxide identified so far, T54 [14], is also ^{17}O rich, but has not been analyzed for Mg/Al and cannot help refine the model predictions. Recent model calculations have indicated nova nucleosynthesis beyond Ca [5], and future isotopic measurements (e.g. Ca, Ti) of C4-8 are planned to better constrain the origin of this unique grain.

References: [1] Amari S. et al. (2001) *ApJ.* 551, 1065. [2] José J. et al. (2004) *ApJ.* 612, 414. [3] Nittler L.R. and Hoppe P. (2005) *ApJ.* 631, L89. [4] Nittler L.R. et al. (2006) *MAPS* 41, A134. [5] José J. and Hernanz M. (2007) *MAPS.* 42, 1135. [6] Nittler L.R. (2005) *ApJ* 618, 281. [7] Tang M. et al. (1988) *GCA* 52, 1221. [8] Gyngard F. et al. (2009) *LPSC* 40, 1386. [9] Zinner E. and Gyngard F. (2009) *LPSC* 40, 1046. [10] Zinner E. (2007) *TOG* vol. 1.02, pp. 1-33. [11] Nittler L.R. (1997) in *Astrophys. Impl. Lab. Study of Presolar Mat.* pp. 59-82. [12] Boothroyd A.I. and Sackmann I.-J. (1999) *ApJ.* 510, 232. [13] Zinner E. et al. (2005) *GCA* 69, 4149. [14] Nittler L.R. et al. (1997) *ApJ* 483, 475.