ON THE ORIGIN OF ^{22}Na IN Ne-E(L).

S. Amari. Laboratory for Space Sciences and the Physics Department, Washington University, St. Louis, MO 63130, USA. E-mail: sa@wuphys.wustl.edu.

Introduction: Ne-E(L) is carried by presolar graphite grains with a range of density (1.6–2.2 g/cm^3) [1]. The ^{22}Ne in Ne-E(L) was long thought to come from the decay of ^{22}Na ($T_{1/2}$ = 2.6 a). Although a dominant source of ^{22}Ne is ^{22}Na, a portion of the ^{22}Ne is ^{22}Ne produced in asymptotic giant branch (AGB) stars and proportions of ^{22}Ne from the two origins vary with density [2]. In the case of low-density graphite grains (1.65–1.72 g/cm^3) from Murchison, all the ^{22}Ne originated from ^{22}Na produced in supernovae, not in novae [3]. Here we further examine the origin of ^{22}Na in higher-density separates from Murchison.

Discussion: There are two stellar sources for ^{22}Na. In type II supernovae it is produced in the O/Ne zone during hydrostatic C burning by ^{21}Ne(p,γ)^{22}Na, where ^{21}Ne is produced by ^{20}Ne(n,γ)^{21}Ne and protons by ^{12}C(^{12}C,p)^{23}Na [4, 5]. In novae, ^{22}Na is produced via ^{20}Ne(p,γ)^{21}Na($\beta^+\nu$)^{21}Ne(p,γ)^{22}Na that requires $T \sim 4 \times 10^8$K. Therefore, ONe novae, more massive than CO novae, can reach higher peak temperatures, have higher ^{22}Na yields [$(3.1 - 65) \times 10^{-5}$ in ONe novae; $(8.5 - 34) \times 10^{-8}$ for CO novae, in mass fraction] [6].

A difficulty to explain ^{22}Na in presolar graphite by nova origin is that Ne is much more abundant than ^{22}Na in both types of novae: ^{20}Ne/^{22}Na ratios range from 406 to 11,300 [6]. In addition, although ^{20}Ne/^{22}Ne ratios expected for CO nova ejecta are low (0.07 to 0.72), those for ONe novae, which are a proficient producer of ^{22}Na, are rather high (37 to 2,890) [6]. Therefore, if graphite grains contain ^{22}Na from novae, ^{22}Na must have been incorporated into the grains in an environment where Ne could be totally eliminated during the grain formation and/or in the subsequent stage.

Supernovae pose a similar situation. In the O/Ne zone in a 25M_{sun} star with solar metallicity, the ^{22}Na yield is estimated to be 1.89×10^{-6} (in mass fraction) and the ^{20}Ne/^{22}Na ratio is 1.14×10^5 [4]. However, in the case of supernovae, implanted Ne into the grain surface is likely to be removed after grains encounter the reverse shock. Infrared observations of Cassiopeia A indicate that nucleosynthetic zones are associated with characteristic dust to the zones [e.g., 7], indicating that relative velocities between the dust and the gas are relatively small. A relative velocity between grains and the gas (Ne), estimated from the amorphous rims of TiC subgrains in low-density graphite [8], is ~300 km/s. Using this velocity, Ne would be implanted into 25 nm down the grain surface [3]. The layer of this thickness is very likely be sputtered when grains travel into the hot H-rich outer zones and into the ISM (interstellar medium) after the reverse shock reaches nucleosynthetic zones, causing decoupling of the grains and the gas [9]. Whether the same scenario works for nova ejecta remains to be seen: there are no observations or theoretical work that access the interaction between the nova ejecta and the ISM yet.

References:[1] Amari S. et al. 1990. *Nature* 345: 238-240. [2] Amari S. et al. 1995. *GCA* 59: 1411-1426. [3] Amari S. 2008. *ApJ,* submitted. [4] Rauscher T. et al. 2002. *ApJ.* 576: 323-348. [5] Limongi M. and Chieffi A. 2003. *ApJ* 592: 404-433.[6] José J. and Hernanz M. 1998. *ApJ* 494: 680-690. [7] Rho J. et al. 2008. *ApJ* 673: 271-282. [8] Croat T. K. et al. 2003. *GCA* 67: 4705-4725. [9] Nozawa T. et al. 2007. *ApJ* 666: 955-966.