EVIDENCE FOR SHORT-LIVED ^{32}SI IN PRESOLAR SIC GRAINS OF TYPE C.

Ernst Zinner[1], Peter Hoppe[2], and Marco Pignatari[3,4]. [1]Laboratory for Space Sciences and the Physics Department, Washington University St. Louis, MO 63130, USA. E-mail: ekz@wustl.edu. [2]Max Planck Institute for Chemistry, D-55128 Mainz, Germany. [3]Department of Physics, University of Basel, CH-4056 Basel, Switzerland. [4]NuGrid collaboration (http://www.nugridstars.org).

Introduction: An extremely rare sub-category of presolar SiC grains are grains of type C [1-7]. These grains have large excesses in ^{29}Si and ^{30}Si and almost all of them have ^{12}C/^{13}C ratios larger than solar. A subset of these grains that have been analyzed for their S isotopic compositions show excesses in ^{32}S [3-6]. The combination of isotopically heavy Si with isotopically light S is puzzling, because in CCSN models the Si/S zone with large ^{32}S excesses also has large ^{28}Si excesses, and zones with heavy Si have also heavy S. Hoppe et al. [5] have invoked S/Si fractionation caused by S molecule chemistry to explain this puzzle. However, this explanation is unsatisfactory in view of the fact that in one C grain the observed ^{32}S excess is larger than the maximum predicted for the Si/S zone [6].

Radiogenic ^{32}S: An attractive alternative is the possibility that the ^{32}S excesses in C grains originated from the decay of short-lived ^{32}Si ($\tau_{1/2}$ = 153 yr). This radioactive nuclide is produced by neutron capture at high neutron densities such as in the short neutron burst proposed to explain the Mo isotopic patterns found in SiC X grains [8]. In the 15$M_{\odot}$ SN model by Rauscher et al. [9] such a neutron burst and high ^{32}Si abundances are found in the outer layers of the O/C zone. In the 12$M_{\odot}$ SN by Heger [10] it is located at the boundary between the He/C and C/O zone, which is C-rich (C>O). In both models, these regions have ^{29}Si and ^{30}Si excesses. Recently, Pignatari et al. [11] explored explosive He-burning in the He/C zone of a 15$M_{\odot}$ CCSN model and could produce large ^{28}Si excesses in the bottom layer, which can explain the isotopic signatures of X grains, including the presence of ^{44}Ti. What makes this scenario attractive is that the layers remain C-rich. Above this bottom layer, the conditions of the SN shock can produce neutron captures at high neutron densities (10^{18-19} cm^{-3}) on a short time scale that result in ^{29,30}Si excesses and the production of ^{32}Si at an abundance sufficient to explain the Si and S isotopic ratios observed in C grains [12]. Some local mixing with the underlying C-rich layer that has ^{44}Ti might also explain the ^{44}Ca excesses from ^{44}Ti decay seen in some C grains.

References: [1] Amari S. *et al.* (1999) *Astrophys. J.* 517, L59-L62. [2] Croat T. K. *et al.* (2010) *Astron. J.* 139, 2159-2169. [3] Gyngard F. *et al.* (2010) *Meteorit. Planet. Sci.* 45, A72. [4] Hoppe P. *et al.* (2010) *Astrophys. J.* 719, 1370-1384. [5] Hoppe P. *et al.* (2012) *Astrophys. J. Lett.* 745, L26 (5pp). [6] Xu X. C. *et al.* (2012) *Meteorit. Planet. Sci.* 47, Abstract #5104. [7] Zinner E. *et al.* (2010) *Lunar Planet Sci.* XLI, Abstract #1359. [8] Meyer B. S. *et al.* (2000) *Astrophys. J.* 540, L49-L52. [9] Rauscher T. *et al.* (2002) *Astrophys. J.* 576, 323-348. [10] Heger http://webusers.physics.umn.edu/~alex/sollo03/ [11] Pignatari M. *et al.* (2013) *Astrophys. J. Lett.* 767, L22. [12] Pignatari M. *et al.* (2013) *Astrophys. J. Lett.*, in press.