A PRESOLAR SiC GRAIN FROM A SUPERNOVA WITH UNUSUAL Si-ISOTOPIC COMPOSITION.

P. Hoppe[1], J. Leitner[1], and S. Amari[2]. [1]Max-Planck-Institute for Chemistry, Particle Chemistry Dep., 55128 Mainz, Germany (hoppe@mpch-mainz.mpg.de). [2]Laboratory for Space Sciences and the Physics Department, Washington University, St. Louis, MO 63130, USA.

Introduction: Silicon carbide (SiC) is the best studied presolar mineral phase and a wealth of isotopic information exists on a large number of elements [1]. Of particular importance are the SiC X grains that formed in the ejecta of Type II supernova (SNII) explosions. Recently, we reported the discovery of a presolar SiC grain with unusual Si-isotopic signature (strong enrichment in ^{29}Si, depletion in ^{30}Si) and speculated that this grain might be related to the X grain family and formed in a SNII as well [2]. Here, we will explore this possibility in more detail.

Isotope signatures of grain KJB2-11-17-1: Grain KJB2-11-17-1 was found during a fully automated ion imaging survey of SiC grains from Murchison separate KJB (typical grain size: 0.25-0.45 μm [3]) with the NanoSIMS at MPI for Chemistry. A total of 1280 SiC grains was identified and measured for C- and Si-isotopic compositions. Grain KJB2-11-17 has ^{12}C/^{13}C = 265 ± 14, δ^{29}Si = +634 ± 20 ‰, and δ^{30}Si = -177 ± 18 ‰. The ^{29}Si/^{30}Si of ~2x solar is the highest ratio found so far among presolar grains. A subsequent Ca-Ti measurement gave δ^{42}Ca = -14 ± 16 ‰ and δ^{44}Ca = 40 ± 19 ‰. In the context of a SNII origin the small but noticable ^{44}Ca excess is likely due to the decay of radioactive ^{44}Ti; the inferred initial ^{44}Ti/^{48}Ti is 0.018 ± 0.009.

Discussion: In order to quantitatively explore the proposed SN origin of KJB-11-17-1 we performed mixing calculation using the 15 $M_\odot$, 19 $M_\odot$, and 25 $M_\odot$ SNII models of [4]. The best match was obtained with the 15 $M_\odot$ model when matter from the SiS, ONe, HeC, HeN, and H zones was mixed in a ratio 0.19% : 2.3% : 37.3 % : 22.0% : 38.2%. This gives C/O ~ 1, ^{12}C/^{13}C = 267, δ^{29}Si = 49 ‰, δ^{30}Si = -162 ‰, and ^{44}Ti/^{48}Ti = 0.018. This is a very good match with the KJB2-11-17-1 data except that the predicted ^{29}Si enrichment falls far short the observed value. It was suggested already previously by [5] that SN models may underestimate the ^{29}Si yield in the C- and Ne-burning (ONe, OSi) zones by about a factor of two and that the ^{26}Mg(α,n)^{29}Si reaction rate has to be roughly doubled compared to that given by [6]. Because of its very high ^{29}Si/^{30}Si ratio, which indicates relative large contributions from the ONe and/or OSi zones, grain KJB2-11-17-2 provides the opportunity to make a stringent test of this hypothesis. Taking the mixing ratio of different SN zones as given above and doubling the ^{29}Si yield in the ONe and OSi zones gives δ^{29}Si = +630 ‰ which is a perfect match to our data. This clearly supports the idea that current SN models underestimate the production of ^{29}Si. As pointed out by [5], this would also explain why GCE models give too low ^{29}Si/^{28}Si [7].

References: [1] Zinner E. 2003. In *Treatise on Geochemistry* (eds. A. Davis, H. D. Holland, K. K. Turekian), pp. 17-39. [2] Hoppe P. et al. 2008. Abstract #1025. 39th Lunar & Planetary Science Conference. [3] Amari S. et al. 1994. *Geochim. Cosmochim. Acta* 58: 459-470. [4] Rauscher T. et al. 2002. *Astrophys. J.* 576: 323-348. [5] Travaglio C. et al. 1998. In *Nuclei in the Cosmos V* (ed. N. Prantzos), pp. 567-569. [6] Fowler W. A. et al. 1975. *Ann. Rev. Astron. Astrophys.* 13: 69-112. [7] Timmes F. X. and Clayton D. D. 1996. *Astrophys. J.* 472: 723-741.