Towards a unified understanding of presolar SiC grains from AGB stars

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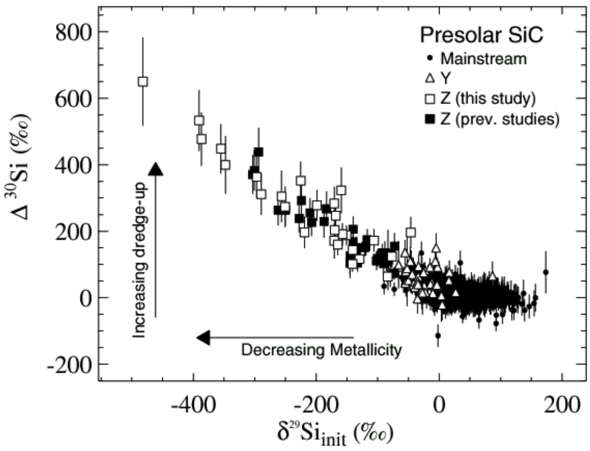
Presolar SiC grains of type mainstream (~90%), Y (2%), and Z (2%) are believed to originate in asymptotic giant branch (AGB) stars, with the metallicity of the parent stars decreasing in the order mainstream->Y->Z. Here, a new large database of presolar SiC grains from the Murchison meteorite [1] is used to investigate the relationships between mainstream, Y and Z grains and the evolution of AGB stars as a function of metallicity.

Silicon isotopic compositions of AGB SiC grains are believed to reflect mixing of initial compositions determined by galactic chemical evolution (GCE) and material dredged-up to the parent stars' surfaces during the AGB phase. Following [2,3], we have projected grain Si compositions onto an assumed GCE line to deconvolve the two components. Shown in the Figure are inferred Δ^{30}Si values (shifts in ^{30}Si/^{28}Si from the GCE line) plotted versus inferred initial δ^{29}Si ratios for ~1,300 new SiC grains, and for 27 Z grains from previous studies [2]. For grains with $\delta^{29}Si_{init}<0$, there is a striking linear correlation between Δ^{30}Si and $\delta^{29}Si_{init}$, which flattens out for higher $\delta^{29}Si_{init}$ values. Qualitatively this is consistent with theoretical predictions [*eg*, 3], but the calculations do not appear to predict such a tight trend. Moreover, Z grains have a similar C-isotopic distribution to mainstream grains, but models predict higher ^{12}C/^{13}C ratios for larger Δ^{30}Si values. The smooth trend from mainstream to Z grains suggests that typical low-metallicity AGB stars do not have high ^{12}C/^{13}C ratios, perhaps requiring cool bottom processing during the AGB phase. In this regard, it is intriguing that Y grains (^{12}C/^{13}C > 100) have a relatively limited range of $\delta^{29}Si_{init}$ values.



References: [1] Nittler L. R. & Alexander C. M. O'D. (2002) *MPS*, submitted abstract [2] Hoppe *et al.* (1997) *ApJ*, 487, L101-L104. [3] Amari S. *et al.* (2001) *ApJ*, 546, 248-266.

Production of selected cosmogenic radionuclides by muons

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Targets of C_9H_{12}, Al_2O_3, SiO_2, S, Ar, K_2SO_4, $CaCO_3$, Fe, Ni, Cu, Gd, Yb and Tl were irradiated with slow negative muons at the Paul Scherrer Institute in Villigen and with 100 and 190 GeV muons at CERN in Geneva. Short- and long-lived radionuclides were measured by γ-spectroscopy and AMS, respectively. Channel probabilities for the production of radionuclides after nuclear μ^- capture and cross sections of fast muon induced production reactions to radionuclides were determined. The investigated long lived radionuclides were ^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl and ^{53}Mn. Calculations of cosmic-ray muon fluxes and muon energies were carried out in the lithosphere as function of depth. With the help of the measured channel probabilities and cross sections calculations of the cosmic-ray muon induced production of radionuclides in the lithosphere were performed. Production of radionuclides by the nucleonic component of the cosmic rays and production by neutron capture reactions were also considered where the neutrons originate from the nucleonic component, negative muon capture, fast muon induced reactions and from decays of U and Th. The relevance of the measurements and calculations for geological applications as e.g. determinations of erosion and ablation rates and of surface exposure ages, for low-level counting experiments as e.g. solar neutrino measurements and dark matter searches, and for neutron fluence measurements in Hiroshima and Nagasaki is pointed out.