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Presolar graphite in meteorites - *H.C. Urey Medal Lecture*

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Presolar grains are stardust formed in the stellar outflow or ejecta, and remained mostly intact in primitive meteorites and other extra-terrestrial materials throughout the journey to Earth. The study of presolar grains helps us better understand nucleosynthesis in stars and mixing in stellar ejecta and outflow, and has opened a new field of astronomy.

Mineral types of presolar grains include diamond, SiC, graphite, oxides, silicates and refractory carbides. Presolar graphite carries a ^{22}Ne-rich component, Ne-E(L), and shows a range of density (1.6 – 2.2 g/cm^3). One of the most intriguing features of presolar graphite is that isotopic and morphological features depend on density [1-3].

Many low-density graphite grains (1.6 ~ 2.10 g/cm^3) show ^{15}N and ^{18}O excesses, high ^{26}Al/^{27}Al ratios (up to 0.69), Si isotopic anomalies (^{28}Si excess in many cases, ^{29,30}Si excesses in some cases), and the initial presence of ^{44}Ti ($T_{1/2}$ = 60 a) in the form of ^{44}Ca excesses. These isotopic signatures of low-density graphite grains are similar to those of SiC X grains and both of them are considered to have originated from supernovae.

A significant portion of high-density graphite grains in both Murchison (CM2) and Orgueil (CI) were produced in asymptotic giant branch (AGB) stars with low-metallicity. However, high-density grains of supernova origin are much more abundant in Orgueil than in Murchison. Also, a few high-density Orgueil grains with low ^{12}C/^{13}C ratios (9 ~ 18, $^{12}C/^{13}C_{solar}$ = 89) and extremely high Ca and Ti excesses most likely formed in post-asymptotic giant branch stars that had suffered a very late thermal pulse.

References: [1] Hoppe P. et al. (1995) *Geochim. Cosmochim. Acta*, 59, 4029-4056. [2] Jadhav M. et al. (2013) *Geochem. Cosmochim. Acta*, 113, 193-224. [3] Amari S. et al. (2014) *Geochem. Cosmochim. Acta*, 133, 479-522.