ISOTOPIC STUDY OF PRESOLAR GRAPHITE IN THE KFC1 SEPARATE FROM THE MURCHISON METEORITE.

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Introduction and Experimental: Graphite grains from the KFC1 separate (2.15-2.20g/cm^3) extracted from the Murchison meteorite [1] are isotopically distinct from those of the other separates. Most notably, the *s*-process Kr isotopic ratios inferred from measurements on bulk samples indicate that KFC1 grains formed in low-metallicity asymptotic giant branch (AGB) stars ($Z \leq 0.006$) [2]. We report isotopic analyses of graphite grains from the KFC1 separate. This is part of a continuing study of presolar graphite with a range of densities (1.65-2.20g/cm^3). First, carbon grains on the KFC1d mount were documented with the SEM. Then, by the NanoSIMS [3], C and Si isotopic ratios of 86 grains were analyzed in multi-detection mode followed by Ti isotopic analysis in combined analysis mode, which utilizes multi-detection and magnetic peak jumping. ^{50}Ti was not determined because of large ^{50}Cr interference. Due to very low Ti concentrations, we analyzed only 28 grains. We include the unpublished data on eleven KFC1 grains obtained with the CAMECA-IMS3f in the following discussion.

Discussion: In a Si-three-isotope δ-value plot, 35 grains that exhibit an anomaly in either their Si or Ti isotopic ratios (>2σ) lie on a straight line with a slope of 0.56±0.05 and an intercept of –31.1±5.5‰. This linear correlation can be explained by progressive alteration of the Si isotopic ratios in the envelope of AGB stars during the third dredge-up [4]. Titanium isotopic anomalies in 9 grains are characterized by excesses in ^{46}Ti and ^{49}Ti relative to ^{48}Ti, which is also expected as a result of neutron capture in the He intershell during the third dredge-up. The ^{49}Ti/^{48}Ti ratios are as high as 5 times solar.

Another presolar grain type that is believed to have formed in low-metallicity AGB stars is SiC of type Z [5]. The differences between KFC1 graphite and Z grains are (1) ^{12}C/^{13}C ratios of the graphite are higher (up to 4064) than those of Z grains (30-100) (2) The average δ^{29}Si/^{28}Si of the KFC1 graphite (–30±132‰) is higher than that of Z grains (–76±57‰). (3) ^{46}Ti/^{48}Ti and ^{49}Ti/^{48}Ti ratios of the graphite are much higher than the solar ratios, whereas those of the two Z grains measured for Ti isotopes are lower than the solar ratios [6]. The first observation indicates that the parent stars of Z grains had experienced cool bottom processing, which decreases ^{12}C/^{13}C ratios in the envelope [7, 8], while the parent stars of the KFC1 graphite had not, suggesting that the latter have higher mass (>3M_{sun}). The pronounced Ti excesses in the graphite agree with this hypothesis because final Ti isotopic ratios at the end of the third dredge-up are expected to increase with the mass of AGB stars [9]. The higher average δ^{29}Si/^{28}Si value of the graphite indicates higher metallicity of the parent stars of the graphite than of the parent stars of Z grains.

References: [1] Amari S. et al. 1994. *GCA* 58:459-470. [2] Amari S. et al. 1995. *GCA* 59:1411-1426. [3] Stadermann F. J. et al. 1999. LPS XXX, Abstract #1407. [4] Lugaro M. et al. 1999. *ApJ* 527:369-394. [5] Hoppe P. et al. 1997. *ApJ* 487:L101-L104. [6] Amari S. et al. 2003. *Meteorit. Planet. Sci*. 38:A66. [7] Charbonnel C. 1995. *ApJ* 453:L41-L44. [8] Wasserburg G. J. et al. 1995. *ApJ* 447:L37-L40. [9] Amari S. et al. 2001. *ApJ* 546:248-266.