ISOTOPIC STUDY OF PRESOLAR GRAPHITE IN THE KFC1 SEPARATE FROM THE MURCHISON METEORITE.
S. Amari1, E. Zinner1, and R. S. Lewis2. 1Laboratory for Space Sciences and the Physics Department, Washington University, St. Louis, MO 63130, USA (sa@wuphys.wustl.edu), 2Enrico Fermi Institute, University of Chicago, Chicago, IL 60637, USA.

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<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. 50Ti was not determined because of large 50Cr 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 We include the unpublished data on eleven KFC1 grains obtained with the CAMECA-IMS3f in the following discussion.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 -value plot, 35 grains that exhibit an anomaly in either their Si or Ti isotopic ratios (>2) 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 46Ti and 49Ti relative to 48Ti, which is also expected as a result of neutron capture in the He intershell during the third dredge-up. The 49Ti/48Ti 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) 12C/13C ratios of the graphite are higher (up to 4064) than those of Z grains (30-100) (2) The average 28Si/28Si of the KFC1 graphite (−30±13‰) is higher than that of Z grains (−76±57‰). (3) 46Ti/48Ti and 49Ti/48Ti 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 12C/13C 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 28Si/28Si value of the graphite indicates higher metallicity of the parent stars of the graphite than of the parent stars of Z grains.