NANOSIMS AND RIMS ISOTOPIC STUDIES OF HIGH-DENSITY GRAPHITE GRAINS FROM ORGUEIL. M. Jadhav[1], M. R. Savina[2], K. B. Knight[3], J. Levine[3], M. J. Pellin[2], S. Amari[1], K. K. Marhas[1], E. Zinner[1], T. Maruoka[1]*, and R. Gallino[4], [1]Laboratory for Space Sciences and the Physics Department, Washington University in St. Louis, One Brookings Dr., St. Louis, MO 63130, USA. (manavijadhav@wustl.edu), [2]Materials Science Division, Argonne National Laboratory, Argonne, IL, 60439. [3]Chicago Center for Cosmochemistry, University of Chicago, Chicago IL, 60637. [4]Dipartimento di Fisica Generale, Università di Torino, Via P. Giuria 1, I-10125 Torino, Italy. *present address: Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki 305-8572, Japan.

Introduction: We report on continuing correlated isotopic studies of light and heavy elements of high-density graphite grains from Orgueil. Previous NanoSIMS isotopic analyses of C, N, O, and Si [1, 2] of high-density graphite grains have suggested that these grains originate from low-metallicity, asymptotic giant branch (AGB) stars. Recently [3], we extended NanoSIMS isotopic analyses to Al-Mg, K, Ca, and Ti, and have also undertaken resonant ionization mass spectrometry (RIMS) analyses of Mo and Ba with CHARISMA at Argonne National Laboratory.

Experimental: Large (average size, ~5μm) high-density graphite grains from the ORG1f ($\rho \sim 2.02\text{-}2.04$ g cm^{-3}) fraction were picked with a micromanipulator and transferred to a gold-foil mount. C, N, O, and Si isotopic analyses in the NanoSIMS were carried out with negative secondary ions, those of Al-Mg, K, Ca, and Ti with positive secondary ions [3]. We made sure that enough grain material was preserved to allow measurements of heavy-element isotopes with RIMS. The RIMS method has been discussed in detail elsewhere [4]. This technique was modified for our analyses in that the two elements measured, Mo and Ba, were resonantly ionized simultaneously, thus increasing efficiency.

Results and Discussion: A subset of the 44 high-density graphite grains analyzed in the NanoSIMS shows extremely interesting isotopic compositions. The presence of ^{44}Ti in 4 grains indicates an origin in Type II supernovae (SNe). Fifteen grains exhibit extremely large Ca and Ti anomalies. The ^{42,43,44}Ca and ^{46,47,49,50}Ti excesses in several of the grains are much higher than predicted for AGB star envelopes and approach those predicted for O-rich supernova zones and pure He-shell material in AGB stars. These measurements lead us to consider Type II SNe as a source for some high-density graphite grains. Three of the grains that seem to contain pure He-shell material have ^{12}C/^{13}C < 20. Born-again AGB stars, such as Sakurai's object (V4334Sgr), exhibit enhanced s-process elemental abundances and very low ^{12}C/^{13}C ratios (~4). We consider such stellar objects another possible source for high-density graphite grains. Thus, contrary to our previous conclusions, high-density graphite grains seem to have multiple stellar sources. Two out of the 5 grains measured by the RIMS technique, show depletions in ^{92,94,95,97,98,100}Mo (normalized to s-only ^{96}Mo) by several hundred permil, indicating an s-process signature. The ^{134}Ba signal is contaminated by a large tail from the ^{133}Cs signal making the ^{134}Ba abundances unreliable. Cs was implanted in the grains during the NanoSIMS measurements. We expect to obtain Mo and Ba data on additional grains in the near future, and to report them at the meeting. These analyses will provide better constraints on the stellar sources of high-density graphite grains.

References: [1] Jadhav M. et al. 2006. *New Astronomy Reviews* 50:591–595. [2] Zinner E. et al. 2006. *Proceedings of Science* (Nuclei in the Cosmos-IX) 019. [3] Jadhav M. et al. 2007. Abstract # 2256. 38th Lunar & Planetary Science Conference. [4] Savina M. R. et al. 2003. *Geochimica et Cosmochimica Acta* 67: 3215-3225.