PRESOLAR GRAIN ABUNDANCES IN 81P/WILD 2.

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Introduction: The first cometary samples were returned in 2006 by NASA's Stardust mission to Wild 2 [1]. One expectation for these samples was that their cold Kuiper belt origin would enhance preservation of primitive solar system components, including abundant presolar grains. However, early O isotopic studies of Stardust crater residues indicated abundances that were significantly lower than those found in primitive meteorites and IDPs [2, 3]. Preliminary data from hypervelocity impact shots of material from the Acfer 094 chondrite into Al foil [4] also showed low presolar grain abundances, suggesting that the distinctive localized isotopic signatures of these grains are lost by homogenization in impact melt on the foils; indeed, residue melt with an ^{18}O-rich signature has been identified in one Wild 2 impact crater [5]. Here we report additional data from Acfer 094 test shots and discuss their implications.

Experimental: Aggregate projectiles were made from Acfer 094, ground to homogenize fine-grained matrix and coarser components and then impregnated with acrylic adhesive [4]. The samples were shot onto Al 1100 foil at impact speeds of 6.2–6.3 km/s [e.g., 6] with the two stage light gas gun at the University of Kent. NanoSIMS C and O imaging was carried out to look for presolar grains in the resulting impact craters.

Results: We identified a total of four presolar grains in three separate foils. The total area measured is ~24,800 μm^2. Two grains are ^{13}C-rich and are likely SiC. The other two grains are ^{17}O-rich (group 1) silicate or oxide grains. The calculated abundances are ~5–6 ppm for both SiC and O-anomalous grains.

Discussion: Acfer 094 is a primitive carbonaceous chondrite with matrix-normalized presolar silicate abundances of ~150–200 ppm [7, 8], equivalent to ~75–100 ppm bulk abundance (based on 50% matrix; [9]). In our earlier work [4], we found one presolar SiC and no O-anomalous grains, suggesting loss of much presolar material upon impact. Our additional data, covering almost 10 times more area, confirm the low abundance and provide strong evidence that the isotopic signatures of presolar silicates (which dominate the presolar grain inventories of extraterrestrial materials) are preferentially lost during the impact process.

Estimates of presolar silicate/oxide abundances for comet Wild 2 have been < ~20 ppm [2, 3], based on the identification of three group 1 grains; a separate estimate of > 1000 ppm, based on one additional grain [5], is less certain because the total area measured is small and the anomaly is spread out over a region of molten residue, making the size of the original grain difficult to ascertain. Assuming measured abundances of 10–20 ppm in Wild 2 and a loss rate similar to that observed in our test shots, we estimate the true presolar grain abundance for comet Wild 2 to be between 125–330 ppm, similar to primitive meteorites and approaching the values in IDPs.

[1] Brownlee et al. (2006) *Science* 314, 1711. [2] Stadermann and Floss (2008) *LPS 39*, #1889. [3] Leitner et al. (2009) *LPS 40*, #1512. [4] Stadermann et al. (2009) *LPS 40*, #1188. [5] Leitner et al. (2010) *LPS 41*, #1607. [6] Kearsley et al. (2006) *MAPS* 41, 167. [7] Nguyen et al. (2007) *ApJ* 656, 1223. [8] Vollmer et al. (2009) *GCA* 73, 7127. [9] Konrad et al. (2010) *LPS 41*, #1447.