PRESOLAR GRAINS IN HUMMOCKY AND ANGULAR PARTICLES FROM ASTEROID BENNU. A. N. Nguyen[1,*], L. B. Seifert[1], K. Shimizu[2], K. Thomas-Keprta[3], L. Le[2], L. P. Keller[1], S. J. Clemett[5], Zia Rahman[2], J. J. Barnes[6], H. C. Connolly Jr.[6,7,8], and D. S. Lauretta[6]. [1]ARES, NASA JSC, Mail Code XI3, Houston, TX, USA; [2]Amentum JETS, NASA JSC, Houston, TX, USA; [3]Barrios JETS, NASA JSC, Houston, TX, USA; [4]Lunar and Planetary Institute, USRA, Houston, TX, USA, [5]Asterion JETS, NASA JSC, Houston, TX, USA; [6]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA; [7]Department of Geology, Rowan University, Glassboro, NJ, USA; [8]Department of Earth and Planetary Sciences, American Museum of Natural History, New York, NY, USA. *Email: lan-anh.n.nguyen@nasa.gov

Presolar grains that formed in the outflows and explosions of evolved stars seeded the molecular cloud that formed our solar system. These grains are preserved in primitive asteroid and comet samples. The detailed isotopic, mineralogical, and chemical study of presolar grains provides information on the initial materials that contributed to the formation of the solar system and the planetary bodies within it. Here we characterized presolar grains present in samples of asteroid Bennu returned by NASA's OSIRIS-REx mission to understand the nature and distribution of presolar materials that were accreted by the parent asteroid and to assess the degree of parent body hydrothermal alteration.

We analyzed intermediate-sized (~0.5–1 mm) Bennu particles of the angular (OREX-803165-0, OREX-803170-0) and hummocky (OREX-803172-0) lithologies that were embedded in epoxy and dry polished. Coordinated analysis of the particles entailed acquisition of images and elementals maps by scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX). Isotope mapping was conducted using nanoscale secondary ion mass spectrometry (NanoSIMS) to identify isotopically anomalous grains. Electron transparent cross-sections of select presolar grains were produced by focused ion beam (FIB) methods and the mineralogy and chemical compositions were assessed by scanning transmission electron microscopy (STEM).

We identified a total of 63 carbon-rich and 25 oxygen-rich presolar grains. Presolar SiC grains are affected by heating in the nebula and on the parent boy. The abundance of these grains in Bennu (~45 ppm) are consistent with abundances in unheated chondritic meteorites, indicating that the parent asteroid did not experience high temperatures. However, the proportion of SiC grains from supernova is six times greater in the Bennu samples than in other asteroid materials. Bennu's parent asteroid therefore accreted material from a region of the protoplanetary disk that was enriched in supernova SiC grains.

Presolar silicates are particularly susceptible to destruction by aqueous alteration. We find that the presolar silicate abundances in the Bennu particles generally support substantial aqueous alteration on the parent asteroid. However, three chemically distinct clasts in the hummocky Bennu particle contained higher abundances of presolar silicate grains (~90 vs. 4 ppm), denoting their less-altered nature. TEM analysis shows the presolar grains from these clasts retain their crystallinity and lack evidence for parent body alteration. Aqueous alteration was therefore heterogeneous on Bennu's parent asteroid.