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Presolar Grains and Organics in Mottled Samples from Asteroid Bennu

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Carbonaceous asteroids provide valuable insights into the primordial materials that formed planets within the protoplanetary disk. They contain organic matter and tiny dust particles known as presolar grains, which originate from the envelopes of aging stars and remnants of stellar explosions, including novae and supernovae, that occurred before the formation of our Solar System. These stardust grains are essential for understanding the building blocks of our Solar System. The recent sample return from asteroid 101955 Bennu by NASA's OSIRIS-REx mission offers a new opportunity to examine the distribution and abundance of presolar grains in carbonaceous asteroids [1].

The samples used in this study include particles collected from both inside and outside the sample collector. First, we obtained reflected-light optical images and 3D topographical images of each sample to categorize the particles based on their morphologies and apparent brightness (e.g., angular, hummocky, and mottled [1]). The samples were then embedded in epoxy and polished. Using the Hitachi TM4000Plus II tabletop SEM, we gathered back-scattered electron (BSE) images and energy-dispersive X-ray (EDX) spectroscopy elemental maps. We searched for isotopically anomalous hotspots associated with presolar grains and organic matter using the new CAMECA NanoSIMS-HR at the University of Arizona. In multicollection mode, we conducted raster ion imaging of $^{12,13}C$, $^{16,17,18}O$, and $^{12}C^{14,15}N$. Terrestrial kerogen was employed for tuning and acted as a reference material for C and N isotopes. Data were processed using the L'Image software.

We identified three ^{17}O-rich grains and 37 presolar grains with C isotopic anomalies, which are sometimes associated with anomalous $^{14}N/^{15}N$ ratios, in angular and hummocky particles [2]. Most of these are likely SiC grains. Additionally, we noted C and N isotopic anomalies linked to insoluble organic matter, appearing either as diffuse areas or small C nanoglobules. Currently, we are searching for presolar grains within mottled particles. At the meeting, we will discuss the distribution and abundance of presolar grains and organics in the mottled particles compared to the angular and hummocky samples.

References: [1] Lauretta & Connolly et al. (2024) *MAPS*, 59, 2453. [2] Haenecour et al. (2024) *MetSoc2024*, #6169.