PRELIMINARY EXAMINATION OF RETURNED SAMPLES FROM BENNU USING QUANTITATIVE PARTICLE ANALYSIS IN THE SCANNING ELECTRON MICROSCOPE

K. Thomas-Keprta[1], L. Le[2], L. P. Keller[3], P. Haenecour[4], T. J. McCoy[5], M. S. Thompson[6], T.J. Zega[4], H. C. Connolly Jr.[4,7,8] and D. S. Lauretta[4].

[1]Barrios Technology/Jacobs, NASA-JSC 2101 Nasa Parkway, Houston, TX 77058; kathie.thomas-keprta-1@nasa.gov; [2]Jacobs, NASA-JSC 2101 NASA Parkway, Houston, TX 77058; [3]XI3, NASA-JSC 2101 NASA Parkway, Houston, TX 77058; [4]Lunar and Planetary Laboratory, Univ. Arizona; Tucson, AZ 85721; [5]National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560; [6]Dept. Earth, Atmospheric & Planetary Science, Purdue Univ., West Lafayette, IN 47907; [7]Dept. Geology, Rowan Univ., Glassboro, NJ, USA; [8]Dept. Earth & Planetary Science, American Museum of Natural History, New York, NY, USA.

Introduction: The sample of regolith collected from asteroid Bennu by NASA's OSIRIS-REx spacecraft will land in Utah on September 24, 2023. A 100-mg aliquot of fine Bennu dust adhering to the internal surfaces of the sample return capsule and associated hardware will be collected by curation staff during disassembly and analyzed immediately by members of the sample analysis team in a "Quick-Look" (Q-L) procedure. The Q-L objectives are (1) to provide images for release to the public to inform on the nature of the returned sample, and (2) to perform a reconnaissance investigation of the mineralogic characteristics of the returned material for science purposes. We will determine the minerals that occur in the dust, assess their diversity, and determine relative abundances at the >5% level using a combination of optical microscopy, Fourier-transform infrared spectroscopy, X-ray powder diffraction, and field-emission scanning electron microscopy (SEM). Here we describe the procedures and techniques developed for the Q-L analyses using analog samples analyzed by SEM equipped with energy dispersive X-ray spectroscopy (EDX). To test these techniques, we have applied them to several samples, including powders of the Murchison (Fig. 1) and Orgueil meteorites, as well as simulant samples prepared by the mission.

Methods: A portion of the Q-L dust is mounted on Be planchettes and sputter-coated with ~5 nm of C to prevent surface charging and improve imaging and chemical characterization. JEOL 7600F and 7900F SEMs are used for imaging, and both are equipped with Oxford Instruments Ultim Max large area (170 mm^2) silicon drift EDX detectors (SDDs) for element spectra and mapping. We use the AZtec Point & ID and Feature software for data reduction. Nominal SEM operating conditions include an acceleration voltage of 15 kV at a beam current of ~ 1 nA, with spot/area EDX acquisition times ranging from 30 to 200 s. AZtec Feature chemical maps, including mineral identificationsare collected in overnight runs with datasets of ~1000 particles.

AZtec Feature is a guided, semi-automated software package for the characterization of large particle datasets. It allows the fusion of morphological and chemical data in combination with hierarchical user-defined classification criteria to interpret the mineral components present in samples. The hierarchical nature of the classification scheme allows for considerable flexibility and robustness with nested sub-classes. In situations where a particle meets the criteria for more than one sub-class, the particle is assigned to the sub-class that makes the strongest assertions for the particle based on the number of criteria and the semi-quantitative analysis result (e.g., poly-mineralic particles).

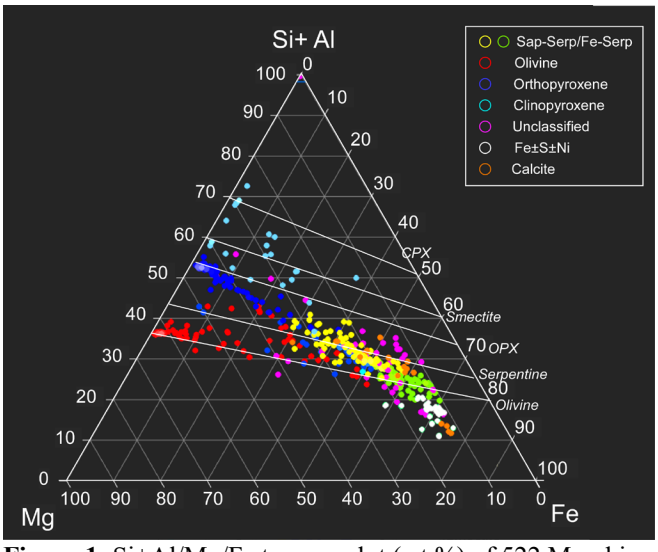

Figure 1: Si+Al/Mg/Fe ternary plot (wt %) of 522 Murchison meteorite particles. Individual phases, from greatest to least in abundance, are shown in the legend at right.

Summary: Coordinated analyses of the Bennu Q-L sample, including the use of AZtec Feature software, will provide rapid identification of the composition and mineralogy of several hundred particles, allowing a detailed first look at the nature of Bennu samples. These data will aid in indentification and selection of particles from the bulk sample for preliminary examination. **Acknowledgement**: This material is based upon work supported by NASA under Contract NNM10AA11C and Award NNH09ZDA007O issued through the New Frontiers Program.