The first year of Bennu samples on Earth for OSIRIS-REx curation

N. G. Lunning[1], S. A. Eckley[2], R.C. Funk[3], M. Montoya[2], J. Plummer[2],M. Rodriguez[3], E. H. Blumenfeld[4], J. E. Aebersold[5], C. J. Snead[1], E. W. O'Neal[2], C. Calva[6], C. Gonzales[2], J. Ferdous[2], K. Allums[7], E. V. Rivera[8], D. J. Rohmer[6], K. Righter[9], F. M. McCubbin[1], J. Davidson[1]

[1]NASA, Houston, TX (nicole.g.lunning@nasa.gov); [2]Amentum, JETS II, Houston, TX; [3]GeoControl Systems, Inc., JETS II, Houston, TX; [4]LZ Technology Inc., JETS II, Houston, TX; [5]Texas State University, JETS II, Houston, TX; [6]Barrios Technology, Inc., Houston, TX; [7]HX5, LLC, JETS II, Houston, TX; [8]Mclaurin Aerospace, JETS II, Houston, TX; [9]University of Rochester, Rochester, NY

The OSIRIS-REx sample return capsule (SRC) returned to Earth on September 24, 2023 when it gently landed at the Utah Test and Training Range [1]. The SRC carried inside the Touch-and-Go Sample Acquisition Mechanism (TAGSAM) head which collected samples from Asteroid Bennu on October 20, 2020. The disassembly of the returned spacecraft hardware began with the SRC in a temporary cleanroom at UTTR, which included attaching a nitrogen flow purge line to protect the returned asteroid sample. Spacecraft hardware disassembly continued with the sample canister and TAGSAM head inside of nitrogen atmosphere gloveboxes located in a specially designed OSIRIS-REx curation cleanroom at Johnson Space Center in Houston, Texas. Asteroid samples became accessible at three main points (1) In late September 2023 when removal of the canister lid revealed asteroid sample outside of the TAGSAM head (2) In October 2023 when asteroid sample was removed by scooping it out of the TAGSAM head with stainless steel tools and transferred to long term storage trays (3) In January 2024 after completion of TAGSAM disassembly which enabled the remaining asteroid sample to be poured out into long-term storage trays. These samples were documented with high-quality, high resolution archival photography by the Advanced Imaging and Visualization of Astromaterials (AIVA) Team [more details in 1-2]. As individual samples are processed, named, containerized, and weighed, the curation processing team also document and photograph those samples [2]. Each sample named by the curation team as of February 2024 was added to the public facing OSIRIS-REx sample catalog that was initially released in March 2024 with the Astromaterials Newsletter [3] and updated in October 2024 [4].

In addition, one-at-a-time, samples may be XCT scanned and remain curation pristine by XCT scanning the sample through an aluminum container sealed with a stainless steel tri-clamp top with a FKM gasket. The first OSIRIS-REx sample XCT scanned were to support public displays (e.g. Figure 1 of public display sample on exhibit at the Alfie Norville Gem and Mineral Museum at University of Arizona). XCT scanning has emerged as a powerful tool for characterizing Bennu samples in 3D and has revealed textural features of these samples while keeping the samples curation pristine, which facilitates decisions about whether certain particles are consistent with recognized morphologies and/or if those particles should be rendered non-curation pristine. In addition, three-dimensional volumes may be extracted from these XCT scans. As of the Fall 2024 update to the NASA OSIRIS-REx catalog, twenty-four Bennu samples have been XCT scanned by OSIRIS-REx curation. One notable scan from the Fall 2024 catalog update is of OREX-800096-0, which revealed distinctive vein-like features within this particle (Figure 2). As more samples from the NASA collection are XCT scanned in the coming months and years, additional features maybe identified that are otherwise not recognizable in curation pristine samples.

References

[1] Lauretta, D.S. Connolly, H.C., Aebersold, J.E., Alexander, C.M. O'D., Ballouz, R.L., Barnes, J.J., Bates, H.C., Bennett, C.A., Blanche, L., Blumenfeld, E.H., Clemett, S. J., Cody, G. D., DellaGiustina, D. N., Dworkin, J. P., Eckley, S.A., Foustoukos, D.I., Franchi, I.A., Glavin, D. P., Greenwood, R.C., Haenecour, P., Hamilton, V.E., Hill, D.H., Hiroi, T., Ishimaru, K., Jourdan, F., Kaplan, H.H., Keller, L.P., King, A.J., Koefoed, P., Kontogiannis M.K., Le, L., Macke, R.J., McCoy, T.J., Milliken, R.E., Najorka, J., Nguyen, A.N., Pajola, M., Polit, A.T., Righter, K., Roper, H.L., Russell, S.S., Ryan, A.J., Sandford, S.A., Schofield, P.F., Schultz, C.D., Seifert, L.B., Tachibana, S., Thomas-Keprta, K.L, Thompson, M.S., Tu, V., Tusberti, F., Wang, K., Zega, T.J., Wolner, C. W. V., the OSIRIS-REx Sample Analysis Team. 2024. Asteroid (101955) Bennu in the laboratory: Properties of the sample collected by OSIRIS-REx Meteoritics & Planetary Science 59 (9):2453-2486 [2] Lunning, N.G., Blumenfeld, E.H., Aebersold, J.E., Snead, C.J., Rodriguez, M., Funk, R.C., Montoya, M., Plummer, J., Mueller, L., Smith, T., Stevens, M., Calva, C., Gonzales, C., Ferdous, J., Allums, K., Righter, K., and McCubbin, F. M.2024 The OSIRIS-REx Sample Catalog. MetSoc Abstract #6073 [3] OSIRIS-REx Sample Catalog, Astromaterials Newsletter 6,1 [4] OSIRIS-REx Sample Catalog, Astromaterials Newsletter 6,2

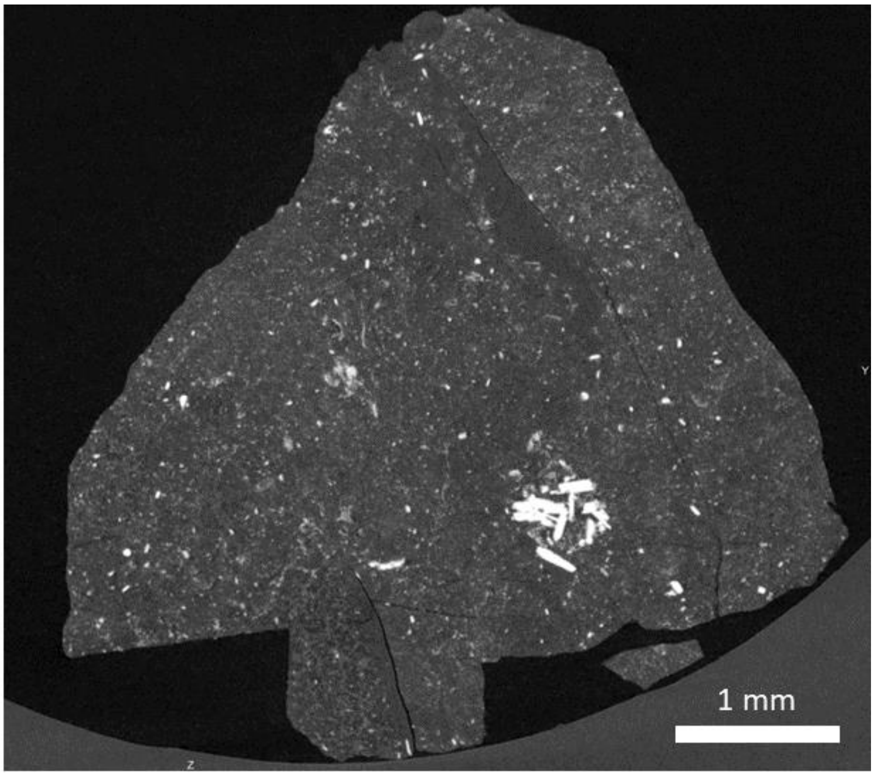

Figure 1. Image from XCT scan of OREX-800054-0 (a particle, 0.076 grams). 6.00 µm/voxel edge. Grayscale differences reflect differences in x-ray attenuation with the most x-ray attenuating phase in white. Curvature and light gray material at bottom of image is the aluminum container.

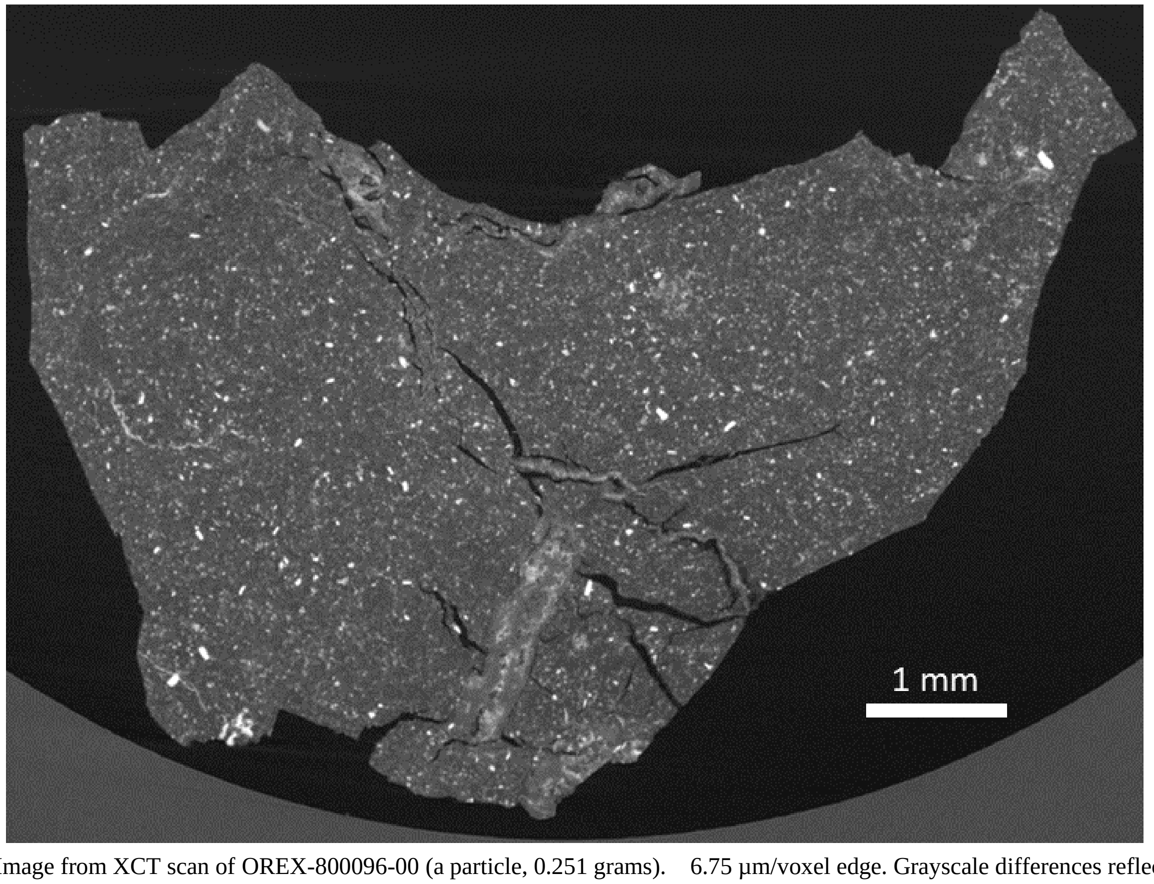

Figure 2. Image from XCT scan of OREX-800096-00 (a particle, 0.251 grams). 6.75 µm/voxel edge. Grayscale differences reflect differences in x-ray attenuation with the most x-ray attenuating phase in white. Curvature and light gray material at bottom of image is the aluminum container.