

Sample Return and Preliminary Examination Processes for the OSIRIS-REx Mission

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The OSIRIS-REx spacecraft collected a sample of asteroid (101955) Bennu on October 20, 2020 [1, 2] and departed the asteroid in May 2021. On September 24, 2023, the spacecraft will fly by Earth and release the Sample Return Capsule (SRC), which will land four hours later in the desert of the U.S. state of Utah. Once the SRC is located within the landing ellipse, the OSIRIS-REx recovery team will be flown via helicopter to retrieve the SRC and take it to a temporary cleanroom for initial processing. In the cleanroom, the SRC will be opened, a high-purity nitrogen purge will be established, and the sample canister assembly will be packed for transport to the OSIRIS-REx curation facility at NASA's Johnson Space Center (JSC).

The Preliminary Examination (PE) period for sample analysis begins once the sample canister is opened at JSC. The focus during this time will be on disassembly of the sample canister, initial documentation of the sample, production of a sample catalog (to be completed within six months of Earth return), splits of sample for international partners, and the initial allocation of sample to the Sample Analysis Team (SAT). Within approximately one week after sample return, a Quick Look Tiger Team of the SAT will conduct a very preliminary characterization using a small amount of sample collected from the outside of the sample acquisition mechanism. Armed with information from the Quick Look sample analysis, the SAT will then focus on identification of distinct lithologies within the bulk sample using the mission imaging system known as QRIS (Quantitative Reflectance Imaging System), visual inspection, density calculations, and initial analysis on bulk oxygen isotope abundances as well as H, N, and C to enable decisions on which particles will be allocated to each planned science investigation. While the bulk sample is being processed for analysis, contact pads from the sample acquisition mechanism will also be processed.

The OSIRIS-REx team is preparing for sample return, recovery, and analysis with a series of reviews, team training activities, and readiness tests scheduled over the next year. The SAT is currently conducting a Sample Analysis Readiness Test (SART) which will conclude by June 2023, during which the SAT is demonstrating certification in key areas necessary for sample analysis. The SART is providing valuable lessons for revision of the mission Sample Analysis Plan (SAP) and is helping the team prepare for our July 2023 sample analysis readiness review. The SAT also completed two Sample Analysis Science Operational Proficiency Integrated Exercises (SA-SOPIEs), with a third scheduled in early 2023. These exercises use analog sample material to test instrumentation, initial sample characterization, and the selection of particles the SAT will use to address early mission science and the hypotheses outlined in the SAP.

References

[1] Lauretta, D.S. et al. 2021. In *Sample Return Missions*, Longobardo, A., ed. (Elsevier), pp. 163–194. [2] Lauretta, D.S. et al. 2022. *Science* Vol 377 pp. 285-291.