Continuing preparations for NASA curation of the OSIRIS-REx asteroid sample

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The OSIRIS-REx spacecraft collected an estimated 250-gram asteroid sample, completed its Bennu asteroid operations phase, and is on its way to return the asteroid sample to Earth on September 24, 2023 [1]. Construction of the OSIRIS-REx curation cleanroom (ISO 5) at NASA Johnson Space Center was completed in late 2021 and has been subject to ongoing monitoring for contamination knowledge [2,3]. The OSIRIS-REx curation cleanroom is inside of a lab suite with pass-throughs to an adjacent staging area and to an adjacent microtomy lab (ISO 7), which also separate it from the NASA Hayabusa2 cleanroom (ISO 5). In addition, a non-cleanroom space (OSIRIS-REx section lab) was built outside of the cleanroom suite for anticipated sample preparation activities that cannot be conducted in the curation cleanroom. Preparations for sample recovery and curation build on work that spans most of the last decade [e.g., 4] This presentation will cover curation preparation for the OSIRIS-REx sample over the last few years and plans for curation immediately following Earth return.

<u>Recovery</u>

The OSIRIS-REx curation team is involved in detailed planning for recovery of the sample return capsule (SRC) at the Utah Testing and Training Range (UTTR). This planning and preparation builds on lessons learned from the Genesis and Stardust recovery operations that also took place at UTTR. Our preparations involve plans for both nominal and off-nominal landing scenarios. For off-nominal landing scenarios, as a lesson learned from the environmental sensitivity of the returned Ryugu samples, a substantial factor is the potential sensitivity of the returned Bennu asteroid sample to environmental contamination and degradation, which may be much greater than that of the Genesis and Stardust samples. This includes the importance of, as rapidly as safe and feasible, getting the returned sample onto a nitrogen gas (GN2) purge to protect it from oxygen and humidity. In nominal landing scenarios, the sample canister that includes the Touch-And-Go Sample Acquisition Mechanism (TAGSAM) head will be flown from Utah to Houston for further disassembly at NASA JSC.

<u>Spacecraft disassembly at NASA JSC</u>

In Houston, the sample canister will remain under GN2 purge until it is transferred to a GN2 glovebox in the OSIRIS-REx curation cleanroom. The sample canister will be opened inside of a glovebox that was specifically designed to accommodate removing its lid. The curation team has been rehearsing this process and other hardware disassembly and sample handling processes in glovebox mockups to refine disassembly techniques. In addition, rehearsals are helping to prepare the team for the intense hardware and sample handling that will occur during preliminary examination (PE). After the sample canister lid is removed, the TAGSAM head will be revealed and its condition documented. It is unknown to what extent Bennu dust will have migrated from inside the TAGSAM head outward to cover the interior of the canister lid. Shortly after documentation of the interior of the canister lid and the exterior of the TAGSAM head, the TAGSAM head will be removed and weighed on a stand. The nominal weight of the empty TAGSAM (and the stand) will be subtracted from the weight of the returned TAGSAM head holding sample to get the first estimate of the mass of the returned bulk sample. Next, the TAGSAM head will be sealed inside of a transfer container and moved to a second specially designed glovebox for further documentation and disassembly.

The first operations in the glovebox designed for TAGSAM head disassembly will focus on the contact pads, which have been previously described [5]. The contact pads and associated particles will be visually examined, carefully documented in place, relevant hardware will be further disassembled, then the contact pads will be removed and containerized. Following containerization of the contact pads, disassembly of the TAGSAM head will continue until only several components remain holding the returned asteroid sample. At this point the sample will be gently poured off the remaining hardware, which will be followed by documentation of the bulk sample poured from inside the TAGSAM head into a set of trays for more detailed imagery and storage. The containers that returned samples, contact pads, and flight witness plates are stored inside of will be tested to quantify the time internal they are able to maintain an anoxic environment outside of a curation glovebox [6].

Laboratory monitoring described by [3] will continue throughout PE (the six months of after Earth return) and beyond. In addition, witness plates will be deployed to monitor the interiors of gloveboxes in which the spacecraft hardware will be disassembled and asteroid samples will be processed.

Catalog Release

PE will culminate in the initial public release of the OSIRIS-REx returned sample catalog around the end of March 2024. We anticipate the OSIRIS-REx return sample catalog will grow over time as more individual particles undergo basic characterization. After the release of the catalog in March 2024, the collection will be open for sample requests from the entire community. As is the case for all NASA's astromaterials collections, a collection-specific allocation board will be convened to review OSIRIS-REx sample requests.

References

[1] Lauretta, D. S., Adam, C. D., Allen, A. J., Ballouz, R. L., Barnouin, O. S., Becker, K. J., Becker, T., Bennett, C. A., Bierhaus, E. B., Bos, B. J. and Burns, R. D., 2022. Spacecraft sample collection and subsurface excavation of asteroid (101955) Bennu. *Science*, *377*(6603), pp.285-291 [2] Dworkin J. P., Adelman L. A., Ajluni T., Andronikov A. V., Aponte J. C., Bartels A. E., Beshore E., Bierhaus E. B., Brucato J. R., Bryan B. H., Burton A. S., Callahan M. P., Castro-Wallace S. L., Clark B. C., Clemett S. J., Connolly H. C., Cutlip W. E., Daly S. M., Elliott V. E., Elsila J. E., Enos H. L., Everett D. F., Franchi I. A., Glavin D. P., Graham H. V., Hendershot J. E., Harris J. W., Hill S. L., Hildebrand A. R., Jayne G. O., Jenkens R. W., Johnson K. S., Kirsch J. S., Lauretta D. S., Lewis A. S., Loiacono J. J., Lorentson C. C., Marshall J. R., Martin M. G., Matthias L. L., McLain H. L., Messenger S. R., Mink R. G., Moore J. L., Nakamura-Messenger K., Nuth J. A., Owens C. V., Parish C. L., Perkins B. D., Pryzby M. S., Reigle C. A., Righter K., Rizk B., Russell J. F., Sandford S. A., Schepis J. P., Songer J., Sovinski M. F., Stahl S. E., Thomas-Keprta K., Vellinga J. M., and Walker M. S..2018. OSIRIS-REx Contamination Control Strategy and Implementation. Space Science Review 214, 1-19. [3] Righter, K., Lunning, N.G., Snead, C.S., 2022. Contamination monitoring of the OSIRIS-REx ISO5 asteroid sample cleanroom. this symposium. [4] Righter, K. and Nakamura-Messenger, K., 2017. Sample curation in support of the OSIRIS-REx asteroid sample return mission. Hayabusa Symposium. [5] Bierhaus E. B., Clark B. C. Harris J. W., Payne K. D., Dubisher R. D., Wurts D. W., Hund R. A., Kuhns, Linn T. M., Wood J. L., May A. J., Dworkin J. P., Beshore E., Lauretta D. S., and the OSIRIS-REx Team. 2018. The OSIRIS-REx spacecraft and the Touch-and-Go sample acquisition mechanism (TAGSAM). Space Science Reviews 214, 1-46. [6] Snead, S. C., Righter, K., Lunning, N. G., 2022., this symposium.