ADVANCED CURATION ACTIVITIES AT NASA: PREPARATION FOR UPCOMING MISSIONS.

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Introduction: The responsibility for curating NASA's astromaterials collections falls to the NASA Curation Office at Johnson Space Center. Under the governing document, NASA Policy Directive (NPD) 7100.10F and derivative requirements documents, JSC is charged with curation of all extraterrestrial material under NASA control, including future NASA missions to include material returned in Mars Sample Return (MSR) efforts, OSIRIS-REx, NASA's subset of Hayabusa-2 samples, and any other sample return missions. The Directive defines Curation as activities including documentation, preservation, sample preparation, distribution, and tracking of samples for research, education, and public outreach. In this abstract we will describe Curation's research and development efforts to improve the care of existing collections and prepare for future NASA sample return missions. These efforts are collectively referred to as Advanced Curation, a term first coined in 2002 [1,2].

NASA Curation: The NASA Curation Office presently curates nine different astromaterials collections: (1) Apollo samples, (2) Luna samples, (3) Antarctic meteorites, (4) Cosmic dust particles, (5) Microparticle Impact Collection [formerly called Space Exposed Hardware], (6) Genesis solar wind atoms, (7) Stardust comet Wild-2 particles, (8) Stardust interstellar particles, and (9) Hayabusa-1 asteroid Itokawa particles. The next missions slated to return samples to JSC are Hayabusa-2/asteroid Ryugu and OSIRIS-Rex/asteroid Bennu, in 2021 and 2023, respectively. We currently curate contamination knowledge (CK) witness plates for OSIRIS-REx, and we will soon begin curating CK witness plates for the Mars 2020 mission, which is required to collect and cache martian samples for possible future return to Earth. NASA Curation will take physical possession of samples returned via MSR when that mission occurs, as well. NASA Curation places a high priority on minimizing and documenting terrestrial alteration of sample collections. To ensure that we are keeping the samples as pristine as possible, we routinely monitor the cleanliness of our cleanrooms and infrastructure systems. This monitoring includes measurements of inorganic and organic contamination in processing cabinets [3,4] and weekly airborne particle counts in most labs. Each delivery of LN_2 is monitored for contaminants, and the stable isotope composition of the gaseous N_2 is measured monthly. The quality of our UPW system is monitored daily.

Advanced Curation: The NASA Curation Office plans for the requirements of future collections as part of the Advanced Curation program. Advanced Curation is tasked with developing procedures, technology, and data sets necessary for curating new types of collections as envisioned by NASA exploration goals. Here we review the advanced curation efforts we plan to make that will be directly relevant to astrobiological studies of future sample collections that could be returned from habitable worlds within our Solar System. As each new sample collection is returned, dedicated new facilities are added to accommodate them. In addition to organic and inorganic cleanliness monitoring and cleaning, we are preparing to undertake a comprehensive study of the microbial ecology of our current cleanrooms and astromaterials collections. This activity will define the baseline of microbial contamination in our labs, and it will provide us with a benchmark with which to compare and test the biological cleaning protocols that we will develop. This undertaking is especially important considering that new collections NASA intends to receive in the near term include materials from carbonaceous chondrites, bodies known to contain significant quantities of organic carbon species and that can be susceptible to microbial colonization [5]. Advanced curation also includes active research on cold curation techniques for future missions, such as those that entail sample return from comets or other volatile-bearing Solar System bodies.

Concluding Remarks: The return of every extraterrestrial sample is a long-term scientific investment, and the curation facilities and personnel are the primary managers of that investment. Our primary goals are to maintain the integrity of the samples and ensure that the samples are distributed for scientific study in a fair, timely, and responsible manner. It is only through the long-term stability and support of curation facilities, coupled with the infusion of technological advances realized through new advanced curation initiatives that the maximum returns on that scientific investment are achieved. In the coming decades, sample return missions will increase in their complexity with respect to sample storage and sample handling requirements as we set our sights on astrobiologically significant targets for sample return. Our advanced curation efforts today ensure we will be poised to curate and handle these samples upon return.

References: [1] Bell, M., et al. *34th COSPAR Scientific Assembly*. Vol. 34. 2002. [2] Lindstrom, D., and C. Allen. *34th COSPAR Scientific Assembly*. Vol. 34. 2002. [3] Calaway, M.J., et al., (2014) NASA TP-2014-217393, July 1, pp. 108. [4] Allen, C.et al., (2011) *Chemie Der Erde-Geochemistry*, 71, 1-20. [5] Steele, A., et al. *NASA NTRS 20100036456* (2001).