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CURATING NASA'S FUTURE EXTRATERRESTRIAL SAMPLE COLLECTIONS: HOW DO WE ACHIEVE MAXIMUM PROFICIENCY?

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Introduction: The Astromaterials Acquisition and Curation Office (henceforth referred to herein as NASA Curation Office) at NASA Johnson Space Center (JSC) is responsible for curating all of NASA's extraterrestrial samples. Under the governing document, NASA Policy Directive (NPD) 7100.10E "Curation of Extraterrestrial Materials", JSC is charged with "The curation of all extraterrestrial material under NASA control, including future NASA missions." The Directive goes on to define Curation as including "...documentation, preservation, preparation, and distribution of samples for research, education, and public outreach." Here we describe some of the ongoing efforts to ensure that the future activities of the NASA Curation Office are working to-wards a state of maximum proficiency.

Founding Principle: Curatorial activities began at JSC (Manned Spacecraft Center before 1973) as soon as design and construction planning for the Lunar Receiving Laboratory (LRL) began in 1964 [1], not with the return of the Apollo samples in 1969, nor with the completion of the LRL in 1967. This practice has since proven that curation begins as soon as a sample return mission is conceived, and this founding principle continues to return dividends today [e.g., 2].

The Next Decade: Part of the curation process is planning for the future, and we refer

to these planning efforts as "advanced curation" [3]. Advanced Curation is tasked with developing procedures, technology, and data sets necessary for curating new types of collections as envisioned by NASA exploration goals. We are (and have been) planning for future curation, including cold curation, extended curation of ices and volatiles, curation of samples with special chemical considerations such as perchlorate-rich samples, curation of organically- and biologically-sensitive samples, and the use of minimally invasive analytical techniques (e.g., micro-CT, [4]) to characterize samples. These efforts will be useful for Mars Sample Return, Lunar South Pole-Aitken Basin Sample Return, and Comet Surface Sample Return, all of which were named in the NRC Planetary Science Decadal Survey 2013-2022. We are fully committed to pushing the boundaries of curation protocol as humans continue to push the boundaries of space exploration and sample return. However, to improve our ability to curate astromaterials collections of the future and to provide maximum protection to any returned samples, it is imperative that curation involvement commences at the time of mission conception.

When curation involvement is at the ground floor of mission planning, it provides a mechanism by which the samples can be protected against project-level decisions that could undermine the scientific value of the re-turned samples. A notable example of one of the bene-fits of early curation involvement in mission planning is in the acquisition of contamination knowledge (CK). CK capture strategies are designed during the initial planning stages of a sample return mission, and they are to be implemented during all phases of the mission from assembly, test, and launch operations (ATLO), through cruise and mission operations, to the point of preliminary examination after Earth return. CK is captured by witness materials and coupons exposed to the contamination environment in the assembly labs and on the space craft during launch, cruise, and operations. These materials, along with any procedural blanks and returned flight-hardware, represent our CK capture for the returned samples and serves as a baseline from which analytical results can be vetted. Collection of CK is a critical part of being able to conduct and interpret data from organic geochemistry and biochemistry investigations of returned samples. The CK samples from a given mission are treated as part of the sample collection of that mission, hence they are part of the permanent archive that is maintained by the NASA curation Office.

We are in the midst of collecting witness plates and coupons for the OSIRIS-REx mission, and we are in the planning stages for similar activities for the Mars 2020 rover mission, which is going to be the first step in a multi-stage campaign to return martian samples to Earth.

Concluding Remarks: The return of every extraterrestrial sample is a scientific investment, and the CK samples and any procedural blanks represent an insurance policy against imperfections in the sample-collection and sample-return process. The curation facilities and personnel are the primary managers of that investment, and the scientific community, at large, is the beneficiary. The NASA Curation Office at JSC has the assigned task of maintaining the long-term integrity of all of NASA's astromaterials and ensuring that the samples are distributed for scientific study in a fair, timely, and responsible manner. It is only through this openness and global collaboration in the study of astromaterials that the return on our scientific investments can be maximized. For information on requesting samples and becoming part of the global study of astromaterials, please visit curator.jsc.nasa.gov

References: [1] Mangus, S. Larsen, W. (2004) NASA/CR-2004-208938, NASA, Washington, DC. [2] Allen, C. et al., (2011) Chemie Der Erde-Geochemistry, 71, 1-20. [3] McCubbin, F.M. et al., (2016) 47th LPSC 2668. [4] Zeigler, R.A. et al., (2014) 45th LPSC 2665.