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NASA'S ASTROMATERIALS ACQUISITION AND CURATION OFFICE: ENABLING 50 YEARS OF LUNAR AND PLANETARY RESEARCH, NOW HEADING TO MARS

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The NASA Astromaterials Acquisition and Curation Office at the NASA Johnson Space Center curates all of NASA's extraterrestrial samples, including 10 unique collections: (1) Apollo lunar samples (1969); (2) Antarctic meteorites from asteroids, the Moon, and Mars (1976); (3) Cosmic dust particles collected in the stratosphere (1981); (4) Microparticle Impact Collection (1985); (5) Genesis solar wind atoms (2004); (6) Comet Wild 2 particles from the Stardust mission (2006); (7) Stardust interstellar particles (2006); (8) Hayabusa asteroid particles (2010); (9) OSIRIS-REx spacecraft coupons and witness plates (2015); and (10) Mars2020 spacecraft contamination knowledge. The broad range of samples in NASA collections have resulted in growing capabilities to curate large rock samples (Apollo, Meteorite), bulk regolith and cores-mixtures of particles ranging from submicron to 1 cm (Apollo), micron-scale particles (Cosmic Dust, Hayabusa), micron-scale particles embedded in aerogel (Stardust), solar wind atoms im-

planted in various materials (Genesis), carbon-rich samples (Meteorite), spacecraft pieces with embedded astromaterials (Microparticle Impact Collection), and materials that capture contamination knowledge for extraterrestrial samples (Genesis, Stardust, OSIRIS-Rex, Mars2020). The standards of Astromaterials Curation are described by NASA Policy Directive 7100.10F and derivative documents that specifically direct the NASA Curation Office at JSC to implement the "...curation of all extraterrestrial material under NASA control, including future NASA missions", and defines curation to include documentation, preservation, preparation, and distribution of samples for research, education, and public outreach. This policy ensures the proper curation of current and future astromaterials collections, including future samples from Mars, at the Johnson Space Center. Based on this policy, the NASA Astromaterials Curation Office has built an experience base spanning 50 years that encompasses curation facility planning, research and development of sample handling and contamination control protocols, partnering with mission teams, and continuous daily operations [1,2]. The resulting product is the world's most diverse, extensive, best-documented, and least-contaminated extraterrestrial sample collection that supports planetary research by hundreds of researchers around the globe. An average of 1500 samples are allocated to scientists every year. These allocations result in 100s of papers annually, fundamental discoveries about the evolution of the solar system (e.g. [3]), and serve as ground truth for robotic missions such as NASA's Dawn mission to Vesta and Ceres, OSIRIS REx mission to Bennu [1,3], and the rovers on Mars.

Advances in Astromaterials Curation: Today's advanced curation initiatives build on decades of NASA experience developing and executing astromaterials curation facilities and protocols. Lessons from the Apollo missions formed the foundation of NASA's curation effort, including the need for early involvement of curation scientists in mission planning [1], have been applied to all subsequent sample return campaigns. The 2013 National Academy of Sciences report [4] noted: "Curation is the critical interface between sample return missions and laboratory research. Proper curation has maintained the scientific integrity and utility of the Apollo, Antarctic meteorite, and cosmic dust collections for decades. Each of these collections continues to yield important new science." Today, a large part of NASA Curation's efforts includes planning for samples returned from future missions, including samples from locations designated "restricted Earth return" such as Mars. Key areas of research include: 1) detecting and monitoring all forms of contamination and achieving increasingly high levels of cleanliness (inorganic and organic [5]) in our facilities to enable analysis for all elements and relevant organic species; 2) development of new high precision cleaning and validation techniques for sampling materials and witness plates; 3) continued research on sample handling and containment technologies including cross contamination and robotic sample handling solutions, and concepts for restricted samples (see Calaway et al, this session); 4) development of requirements for cold curation that will enable preservation and handling of samples, including volatiles collected at extremely low temperatures. We are also enhancing sample databases and documentation of data derived from NASA's astromaterials samples, restoring legacy data sets, collecting and serving high resolution imagery, developing 3D imaging techniques and have established an X-ray CT laboratory [6], and upgrading labs with web-based communication enabling remote access for investigators from around the world. These advances support the continued curation of Apollo samples, our other astromaterials collections, and the future curation of samples from challenging exploration destinations such as the south polar region of the Moon, icy moons of outer planets, comets, and the surface of Mars.

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