# Curating NASA's Past, Present, and Future Extraterrestrial Sample Collections

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**Overview:** As codified in NASA Policy Directive (NPD) 7100.10F, the Astromaterials Acquisition and Curation Office at NASA Johnson Space Center (hereafter JSC Curation) is charged with curation of all extraterrestrial material under NASA control, including future NASA missions. The NPD defines Curation as including documentation, preservation, preparation, and distribution of samples for research, education, and public outreach. Here we briefly describe NASA's astromaterials collections, the physical infrastructure involved in the curation process, as well as our plans for future facilities to house our emerging astromaterials collections.

**Current Facilities:** JSC Curation curates all or part of nine astromaterial collections in seven clean room suites, comprising 22 different rooms: (1) Apollo Samples (1969; ISO 6-7), (2) Luna Samples (from USSR; 1972; ISO 7), (3) Antarctic Meteorites (1976; ISO 7), (4) Cosmic Dust (1981; ISO 5), (5) Microparticle Impact Collection (formerly called Space Exposed Hardware; 1985; ISO 5), (6) Genesis Solar Wind Atoms (2004; ISO 4); (7) Stardust Comet Particles (2006; ISO 5), (8) Stardust Interstellar Particles (2006; ISO 5), (9) Hayabusa Asteroid Particles (from JAXA; 2010; ISO 5). We also curate spacecraft coupons and witness plates for multiple past and current missions (e.g. Stardust, OSIRIS-REx, as well as upcoming missions (e.g., Mars2020). Thus, we currently curate large rock samples (Apollo, Meteorites), bulk regolith and core samples that are intimate mixtures of particles ranging from submicron to 1 cm (Apollo), micron-scale individual particles (Cosmic Dust, Hayabusa), micron-scale particles embedded in aerogel (Stardust), atoms of the solar wind implanted in various materials, physical pieces of spacecraft that have astromaterials embedded in them (Microparticle Impact Collection), and materials that capture contamination knowledge for returned extraterrestrial samples (Genesis, Stardust, OSIRIS-REx). In addition to the labs that house the samples, we have installed and maintained a wide variety of facilities and infrastructure required to support the clean-rooms: >10 different HEPA-filtered air-handling systems, ultrapure dry gaseous nitrogen systems, an ultrapure water (UPW) system, and cleaning facilities to provide clean tools and equipment for the labs. We also have sample preparation facilities for making thin sections, microtome sections, and even focused ion-beam (FIB) sections to meet the research requirements of scientists. To ensure that we are keeping the samples as pristine as possible, we routinely monitor the cleanliness of our clean rooms and infrastructure systems. This monitoring includes: daily monitoring of the quality of our UPW, weekly airborne particle counts in the labs, monthly monitoring of the stable isotope composition of the gaseous $N_2$ system, and annual measurements of inorganic or organic contamination in processing cabinets. Additionally, each delivery of liquid $N_2$ is monitored for contaminants (typically <6 ppm Ar, and <1 ppm all others combined). We also track within our databases the current and ever-changing characteristics (weight, location, destructive analysis spots) of >250,000 individual samples across our various collections (including the 19,141 samples on loan to 433 Principal Investigators in 24 countries). Similarly, there are 100s of thousands of images associated with the samples that are stored on our servers. We also have the sample processing and sample handling records (often hand written) for our older collections.

**Future Facilities:** The next sample return missions are Hayabusa2 and OSIRIS-REx, in 2020 and 2023 respectively. Details of the curation plans for each mission can be found in [1,2]. The designs for a new state-of-the-art suite of clean rooms to house these samples at JSC have been finalized. This includes separate ISO class 5 clean rooms to house each collection, a common ISO class 7 area for general use, an ISO class 7 microtome laboratory, and a separate thin section lab. Additionally, a new cleaning facility is being designed and procedures developed that will allow for enhanced cleaning of cabinets and tools in an inorganically, organically, and biologically clean manner. We are also designing a large multi-purpose Advanced Curation laboratory [3] that will allow us to develop the techniques necessary to fully support the Hayabusa2 and OSIRIS-REx missions, as well as future possible sample return missions (e.g., Lunar Polar Volatiles, Mars, Comet Surface). A micro-CT laboratory dedicated to the study of astromaterials has come online this summer within JSC Curation, and we plan to add additional facilities that will enable non-destructive (or minimally-destructive) analyses of astromaterials in the near future (e.g., micro-XRF, confocal imaging Raman Spectroscopy). These facilities will be available to: (1) develop sample handling and storage techniques for future sample return missions, (2) be utilized by PET for future sample return missions, (3) for retroactive PET-style analyses of our existing collections, and (4) for periodic assessments of the existing sample collections.

**References** [1] Righter K. et. al. (2017) This Symposium. [2] Nakamura-Messenger K. et. al. (2017) This Symposium. [2] McCubbin F. M. et. al. (2017) This Symposium.