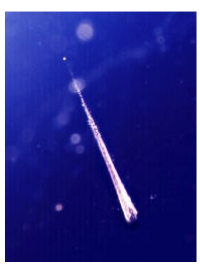
JSC CURATION AND FUTURE SAMPLE RETURN MISSIONS. K. E. Cyr, Mailcode SN2, Johnson Space Center, 2101 NASA Rd. 1, Houston, TX, 77058, kimberly.e.cyr1@jsc.nasa.gov.

Introduction: Johnson Space Center (JSC) is the NASA center charged with curation of extraterrestrial samples. JSC Curation involves several components, including: protecting samples from contamination; preserving a portion of each sample collection for future study, in expectation of advances in analytical techniques; performing and documenting the sample's preliminary examination (weight, location, physical description, imaging) as well as documenting its handling history; disseminating sample information to the public; and distributing samples to scientists around the world for study.

Current collections include 382 kg of *Apollo* lunar soils and rocks, 8500+ Antarctic meteorites, cosmic dust collected in Earth's stratosphere, and space exposed hardware, e.g. the Long Duration Exposure Facility (LDEF). Other current and future sample return missions take advantage of JSC's wealth of curatorial experience, laboratories and sample distribution network. These include *Stardust*, *Genesis*, *MUSES-C* and Mars missions.

Stardust: Launched February 1999, samples return February 2006. The NASA *Stardust* mission will be the first mission to return samples from a comet. The spacecraft will encounter comet Wild-2 in January 20004; as the spacecraft passes through the coma, a tray of silica aerogel will be exposed. Grains from the comet coma, as well as other interstellar dust particles, will impact the aerogel and embed within it, returning to earth in 2006.

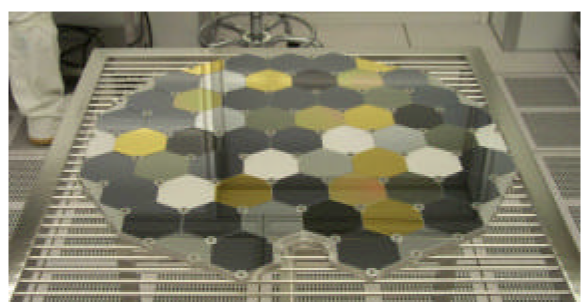


Left: Close-up photo of the aerogel tray. Right: Close-up of particle embedded in aerogel; the track made by the particle runs bottom right to top left, with the particle embedded at the top of the track. Stardust samples will be extracted from the aerogel, curated and processed at JSC. Curation practices will be similar to those used for Interplanetary Dust Particles, which are handled in JSC's Cosmic Dust cleanrooms.

Genesis: Launch July 2001, sample return August 2004. The NASA *Genesis* mission will collect solar wind ions and atoms. After launch, the Genesis spacecraft will journey 1.5 million km sunward to the Earth-Sun L1 point and collect solar wind samples for approximately two years, before returning to Earth. JSC is responsible for sample curation and overall mission contamination control. The latter included the clean storage and subsequent installation of the collector materials into the payload hardware, as well as the precision cleaning of the disassembled flight payload hardware.

Below: JSC personnel precision clean *Genesis* flight hardware with ultra-pure water to prevent terrestrial contamination of future solar wind samples.

Below: Solar wind will embed into hexagonal wafers made of very pure and very clean materials. Wafer materials include silicon, germanium, diamond-coated silicon, vitreloy and aluminum-coated, gold-coated and bare sapphire.



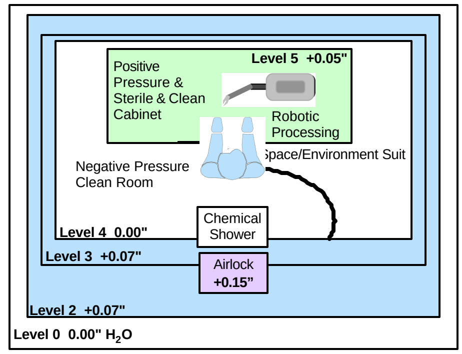
Next page: R. Paynter/JPL tests the functionality of the precision-cleaned and fully reassembled *Genesis* payload canister. The flight payload hardware was cleaned by JSC and reassembled and tested by JPL in JSC's Class 10 cleanrooms.

MUSES-C: Launch July 2002, sample return June 2007. Japan's Institute for Space and Astronautical Sciences (ISAS) *MUSES-C* mission will be the first asteroid sample return mission. NASA will be providing scientific and technical assistance. After the 2002 launch, *MUSES-C* is scheduled to arrive at asteroid 1998 SF36 in September 2005. The *MUSES-C* spacecraft will briefly touch down on the asteroid surface to collect up to three powdered or chipped asteroid surface samples, and return them to Earth in 2007 for laboratory analysis. After the initial one year preliminary examination period at ISAS, Johnson Space Center will receive 10% of the returned sample mass for curation and distribution world-wide.

Mars: First sample return mission launch 2011, first sample return 2014. The NASA Mars Program consists of a set of missions designed to understand the climate and volatile history of Mars; search for evidence of past or present life on Mars; and assess the nature and inventory of the resources on mars. As part of this program, Mars Sample Return missions will robotically collect and return samples from Mars to the Earth.

To prepare for these missions, Johnson Space Center is studying a variety of issues including: how to build a clean biobarrier environment that will protect both Mars samples from terrestrial contamination and the Earth from sample contamination; robotic handling of samples; and processing of samples under a Mars-like environment, such as at sub-freezing temperatures.

Below: concept for clean biocontainment of Mars samples, utilizing air pressure differences.



Conclusions: Based on these and other mission experience, several important lessons have been learned regarding the curation element of sample return missions. The primary lesson is that curation starts at the beginning, during planning and mission design phases. Important considerations during these stages include: the material composition and cleanliness of sample-handling and adjacent hardware, sample collection and preservation methods, in-flight contamination, existence of and requirements for a sample receiving/curation facility, and compatibility of the return sample canister with the receiving/curation facility. Additionally, reference coupons are important in that they can be used to provide an archive of flight materials and pre-flight sample environment conditions via witness plates. Lastly, in order to extract the maximum useful science return from the samples, it is important to document the handling history of the pre-flight sample collector/container environment, the in-flight environment and the collection context.

Ideally, it would be advantageous to have samples from every solar system body to study with all the laboratory resources on Earth. Though challenging to implement, future sample return missions may venture to Europa, Venus, and Mercury as well as to a comet nucleus or to additional near-Earth asteroids. As part of mission design, curation techniques and practices will also need to keep pace to meet the challenges of new missions.