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Virtual Posters

Allton J. H. Jurewicz A. J. G.

Extension of Genesis Curation: Enabling Science with an Archive of Standards, Implants, and Flight-like Materials **[#3013]**

Overview: Since 2004, Genesis Curation at JSC has focused upon (1) characterizing and allocating samples from the more than 10,000 pieces of Genesis-flown collectors and (2) archiving the history of allocated collectors returned to the collection for future analyses. Genesis researchers were also allocated flight-spare material from JSC Curation for testing and/or making analytical standards. However, allocations of non-flown samples were relatively rare because, to expedite Genesis science, D. S. Burnett (Genesis PI, Caltech) and A. J. G. Jurewicz (ASU) were funded to aid all Genesis PIs – a task which included providing engineering test materials archived at Caltech pre-flight and ion implants into these materials. Implants with nominal fluences (i.e., the dose calculated using the ion current measured during implantation) are used for testing analytical hardware and developing analytical procedures (e.g., blanks, backgrounds, detection limits, quantifying etching rates). Calibrated implants (dose externally determined using RBS, ICPMS, etc.) into Genesis materials are necessary analytical standards, especially for quantifying SIMS measurements. Drivers of change: Drs. Burnett and Jurewicz are now emeritus, and their collection is slowly being migrated to JSC for future Genesis projects. The semi-conductor market is evolving and some flight-like materials (e.g., the Kyocera 6H sapphire) are no longer available for purchase. As environmental rules become strict, ion implants of some common elements are becoming less available and more expensive. For example, one vendor stopped implanting moderate doses of 56Fe because a gas they used during implantation has been banned. Impact on JSC Genesis Curation: Because analytical standards and uncalibrated implants are central to Genesis science, they will be archived at JSC. Physical storage, most tools for characterization, and the basic website (catalog and supporting information) are already in place but will require expansion and/or modifications. For implanted samples, JSC will need to develop a new internal database for: a) ion species implanted; b) the substrate into which ions are implanted; c) energy and dose of implant; d) extent of external calibration (if any). Revision of the allocation process and an additional public catalog is also required.

Fries M.

The South Pole Water Well (SPWW) Micrometeorite Collection at NASA **[#3011]**

NASA Curation is in the final stages of accessioning a large collection of micrometeorites (MMs) recovered from water wells used to supply the Amundsen-Scott South Pole Station. This collection is comprised of nearly 7,000 objects to include individual micrometeorites, water well sediment samples, and the collection hardware itself. Most of the MMs are mounted in grain mounts and have been size-sorted, classified, and subjected to preliminary SEM/EDS analysis. Some MMs remain in as-recovered condition. This collection will soon be announced as available for requests, and a comprehensive catalog will be published. This poster serves to describe the collection and outline the procedure for requesting samples.

Garvie L. A. J. Schrader D. L. Davidson J. Hines R. Stroud R. M.

Current State of the Buseck Center for Meteorite Studies at Arizona State University **[#3012]**

The Buseck Center for Meteorite Studies (BCMS) at Arizona State University (ASU) curates one of the largest university-owned meteorite collections. Established in 1961 as The Center for Meteorite Studies (CMS), BCMS curates close to 2200 falls and finds represented by over 40,000 specimens, in a modern, purpose-built, climate-controlled, curatorial facility (nicknamed ‘the vault’). Since 2008, the Center has added 102 falls to the collection. Notable examples for which we house significant masses include Aguas Zarcas, Dishchii'bikoh, Dong Ujimqin Qi, Glendale, Sutter's Mill, Tarda, Tiglit, and Tissint. The Center houses representative samples of nearly 40% of all classified iron meteorites, of which historic irons are particularly well represented in the collection. In addition, the Center curates a large collection of impact and related materials from Meteor Crater, together with over 500,000 tektites. The BCMS mission is to create and share new knowledge in the field of meteoritics and allied disciplines through 1) Cutting-edge research on understanding the origin of our Solar System and planets, including the pathways to forming habitable worlds; 2) Increased science return from spacecraft-based exploration through laboratory-based analysis of planetary materials; 3) Curation and distribution of one of the finest meteorite collections in the world; and 4) Broad dissemination of the latest scientific results and education at local, national, and global scales. The BCMS has an active loan program with 785 meteorites loaned for research and education within ASU and worldwide since 2017. Educational engagement across all levels is integral to the BCMS mission. The Center maintains an active online presence, and offers loanable K–12 classroom modules, that are aligned to the National Science Education Standards, to K-12 students and educators. Additional information about requesting loans, outreach programs, and subscribing to the Center Newsletter can be found at: meteorites.asu.edu.

Glotch T. D.

***Nano-IR Imaging and Spectroscopy at Stony Brook University* [#3010]**

The Stony Brook University Vibrational Spectroscopy Laboratory (http://cpex.labs.stonybrook.edu/tglotch/) has recently added a neaspec neaSNOM near-field infrared (nano-IR) instrument capable of broadband IR imaging, point spectroscopy, and hyperspectral imaging at spatial scales from ~3-50 nm/pixel. The instrument was jointly funded by the NASA LARS program and SSERVI and is maintained by Prof. Tim Glotch as a Stony Brook University service facility. We encourage those interested in nano-scale spectroscopic characterization of samples to contact us about potential collaborations. Samples can be prepared as thin sections, thick sections, FIB sections, or ultramicrotome sections, making nano-IR characterization highly complementary to other micro- and nano-analytical techniques, including micro-FTIR, Raman, and high-resolution transmission electron microscopy. For at least the next 2 years, instrument use will be free of charge, although we anticipate charging a modest hourly rate beginning in the fall of 2024. Current instrument use is focused on the analysis of Earth and planetary materials as well as functional materials of interest to the solid-state physics community. We anticipate leveraging the capabilities of the instrument for planetary returned sample analyses in the immediate and near future. Researchers interested in discussing nano-IR measurements of their samples should contact Tim Glotch at timothy.glotch@stonybrook.edu.

Hanna R. D. Ketcham R. A. Maisano J. A. Colbert M. W. Edey D. R.

***UTCT: High-Resolution X-Ray CT Facility Enabling Planetary Science Research* [#3003]**

X-ray computed tomography (XCT) is a 3D analytical technique that is highly beneficial, and in some cases critical, for investigating planetary materials. While the number of labs with XCT scanners is growing, most are lacking either in their instrumentation capabilities (i.e., imaging resolution and energies, sample size range) or in the expertise required to extract the highest-quality image data and follow-on analysis. The University of Texas High-Resolution X-ray CT Facility (UTCT) serves a broad range of scientists worldwide, from academia, industry, and government, working in the earth and planetary sciences and ancillary fields. UTCT also functions as a premier center for technique development and research applications of XCT in the geosciences, including extraterrestrial materials. UTCT operates a suite of XCT instruments capable of imaging a wide array of sample sizes and types – from submicron imaging of small samples (~mm scale) to lower-resolution imaging of large samples (up to ~75 cm in height and ~45 cm in diameter, depending on sample density). Other specialized scanning capabilities include: 'SubpiX', which utilizes precise shifting of the detector to double the scan resolution for large objects; X-ray diffraction contrast tomography (DCT) for the 3D distribution of crystallographic orientations in sufficiently small samples (currently, < 2 mm); and experimental cells for scanning samples under controlled environmental conditions of temperature and pressure. UTCT has a dedicated staff possessing a combined ~100 years of scientific XCT experience that assists users in the interpretation and analysis of their data and conducts annual short courses that provide in-depth training on the acquisition, visualization, and quantitative analysis of XCT data. Potential investigators can contact UTCT via email or phone to inquire about scanning a sample and to discuss feasibility and cost estimates. Scanning at UTCT is conducted on a cost-recovery basis, with UT providing ~23% institutional support, NSF providing ~25% support to UTCT as a shared multi-user Earth Sciences (EAR) Facility, and the remainder derived from other NASA and NSF grants and scanning fees. Typical scans for planetary samples run ~$250-$500/sample but can be higher or lower depending on resolution and data requirements. More information about UTCT can be found at http://www.ctlab.geo.utexas.edu/, and inquiries sent to Dr. Romy Hanna (romy@jsg.utexas.edu).

Kita N. T. Zhang M.

***WiscSIMS Laboratory for In-Situ Isotope Analysis of Extraterrestrial Samples* [#3001]**

Wisconsin Secondary Ion Mass Spectrometer Laboratory (WiscSIMS) at the University of Wisconsin-Madison is equipped with CAMECA IMS 1280, a large magnetic-sector SIMS, and specializes in high precision in-situ stable isotope analyses of minerals at 1-10 µm lateral resolutions. WiscSIMS laboratory has been funded for 15 years by NSF Earth Science Instrumentation and Facilities Program as a National Facility for Stable Isotope Geochemistry. The laboratory has focused on development of stable isotope analyses (C, O, Si, and S) of geological samples at sub‰ precision and accuracy. The performance of WiscSIMS IMS 1280 has been significantly improved by multiple commercial upgrades and in-house modifications, such as 6 sample airlock system, RF Plasma Ion Source, FC amplifiers with 10^12 ohm resistors, monochromatic UV-light optical microscope and sample viewing software, and sample stage navigation system using QGIS program. Under the support from NASA research programs, we have developed high precision SIMS oxygen 3-isotope analyses and 26Al-26Mg chronology of extraterrestrial samples, such as Ca, Al-rich inclusions (CAIs) and chondrules in primitive meteorites, micrometeorites, interplanetary dust particles, comet Wild 2, and asteroid return samples. The highest precision of ?0.3‰ (2SD) in oxygen 3-isotope ratios is obtained for silicate, oxide, and carbonates using ~10 µm spot sizes, while ?2‰ precisions are achieved for a 2 µm small spot size. The precision of inferred initial (26Al/27Al) ratios for CAIs and chondrules is better than 10% and 10-20%, corresponding to the precisions of relative ages of ?0.1 Ma and 0.1-0.2 Ma, respectively. The results of SIMS analyses are crucial for understanding the sources and evolution of primitive solids in the early Solar System. Applications for SIMS instrument time for cosmochemistry research should be sent to Noriko Kita (kita@wisc.edu) with a brief description of the project and samples. The WiscSIMS Oversight Board (John Valley, Chair) allocates instrument time according to the scientific merits and feasibility of the project. Laboratory website: https://geoscience.wisc.edu/research/wiscsims-laboratory/.

Lehnert K. A. Ji P. Mays J. Downs R. R. Richard S. M. Profeta L. Figueroa J. D. Johansson A. Bennett C. Haenecourt P.

***Archiving Astromaterials Data at the Astromaterials Data System: An Update* [#3005]**

Collection, curation, and analysis of astromaterials are core elements of planetary sciences. Human and robotic sample collection and return missions such as Apollo, Stardust, Genesis, and Hayabusa have created invaluable specimen collections of rocks, soil, and dust particles from the Moon, asteroids, and interplanetary space, and new collections will be created by current and future sample-return missions such as OSIRIS-REx, Artemis, and MARS. Broad dissemination of the data acquired on these astromaterials samples is vital to leverage the gigantic investments in sample-return missions; support new scientific inquiry and new data-driven research paradigms; help prevent unnecessary use of the precious samples by avoiding duplicate analysis; and provide learning opportunities beyond the immediate astromaterials research community for researchers, students, and instructors from other disciplines and the general public. Since 2019, NASA has funded the Astromaterials Data System (https://www.astromat.org) to serve as a repository for astromaterials data submitted by researchers and to restore historical data for advanced data access via the Astromat Synthesis database. The Astromat Repository helps investigators comply with funders' and publishers' policies for FAIR data as a trusted repository with services that include interactive online submission with guidance for properly documenting, licensing, releasing, and citing content; review of submitted content; DOI registration with DataCite; long-term archiving; and user support and training.In 2022, NASA has supported a Special Study, executed by the Astromaterials Data System (AstroMat), to gather requirements for an Astromaterials Data Archive that can fulfill the demands of NASA's Open Science and data archiving policies, international repository standards, and requirements for astromaterials data generated as part of sample-return missions, specifically of the OSIRIS-REx Sample Analysis Data Management Plan. AstroMat's current capabilities fulfill many of the requirements pertaining to the collection, acquisition, curation, and publication of astromaterials samples data, but need to be enhanced in order to serve as the future archive of astromaterials data generated by both missions and research projects. This presentation will provide an overview of the planned development and implementation of the Astromaterials Data Archive as an expansion of the Astromaterials Data System.

Safonova M. Chandra B. Nair B. G. Raj H. Arora D. Gajjar D. Srivastava R. Ghatul S. Datey A. Chakravortty D. Mohan R. Murthy J.

SAMPLE — Stratospheric Altitude Microbiology Probe for Life Existence — A Balloon Borne Payload System for Cosmic Dust Collection in Stratosphere **[#3002]**

The Earth possesses many environmental extremes that mimic conditions on extraterrestrial worlds. However, many of these habitats are vastly underexplored, for example, the stratosphere. Earth's stratospheric conditions at 30–40 km altitude are very similar to the surface of Mars: with same pressure, average temperature, and even same levels of solar UV and proton radiation, and Galactic cosmic rays. Microbial (bacteria and fungi) habitation in troposphere is known and well documented, however, very little is known about the true upper limit of the Earth's biosphere. Stratosphere provides a good opportunity to study the existence or survival of life in these conditions. Despite the importance of this topic to astrobiology, stratospheric microbial diversity/survival remains largely unexplored, probably due to significant difficulties in the access and in ensuring the absence of contamination. To conduct a detailed study into this, we are developing the balloon-borne payload system SAMPLE (Stratospheric Altitude Microbiology Probe for Life Existence) to collect dust samples from stratosphere and bring them in to a suitable laboratory environment, where further study will be conducted in establishing the possibility of microbial life in the upper atmosphere. The payload consists of pre-sterilized sampling chambers designed to collect and contain the dust samples and get them back to the surface without contamination during the flight, and a controller which will determine the altitude of the payload system to actively monitor the opening and closing of the collection chambers. For additional contamination control, we will have two extra chambers, one of which will fly but not open, and one that will remain closed on the ground. Other on-board devices include environmental sensors, GPS tracking devices, cameras to monitor the balloons and an FTU (Flight Termination Unit) to terminate the flight on completion of the sample collection. A microcontroller board with the necessary sensors (GPS, barometer, etc.) is designed and programmed (in C language) to open and close the collector tray at an appropriate height of ~25 km. The embedded device platform Arduino Uno serves as the primary controller, where the C language is used to write the implementation code. The collector measures altitude using a GPS module and a BMP180 pressure sensor that are both connected to the Arduino board. A parachute attached to the payload ensures the safe descent of the payload on its way back to the surface. On retrieving the payload, the sampling chambers (including controls) will be sent to a suitable laboratory where the samples will be examined for the presence and the nature of collected material.

Sun L. Lucey P. G. Zeigler R. A. Shearer C. ANGSA Science Team

***A Spectral Imaging System Attachment to Glovebox for Preliminary Examination of Extraterrestrial Materials* [#3004]**

Spectral images were measured for the Apollo double drive tubes 73001/2 from outside of the glovebox during the preliminary examination of the samples. Using the spectral images, we extracted the compositional distributions, mineralogies, and maturity variation along the core samples, which have provided guidance to sample requests for detailed analysis. However, our spectral measurements were only limited to less than 2.5 microns due to measuring through the borosilicate glass wall of the glovebox, which has prevented us from detecting volatiles, e.g., OH/H2O. A glovebox having a small (cm scale) infrared window made of diamond would allow us to detect volatiles for future extraterrestrial samples. With this infrared window, we can attach spectrometers measuring from visible and near-infrared (0.4-3 microns) to mid and thermal infrared (3-15 microns), as well as Raman spectrometer, which allows us to detecting the sample at micron-scale and obtain more information on compositions, mineralogy, maturity, volatile and organic concentrations. This spectral imaging system allows us to measure pristine samples within a glovebox, thus won’t cause any contamination or damage to the samples.

Thompson M. S. Snead C. J. Keller L. P. Treiman A. H.

***Hands-On Training for the Handling and Manipulation of Small Extraterrestrial Samples* [#3009]**

The handling and manipulation of small extraterrestrial samples requires specialized skills, equipment, and techniques. NASA has recognized the importance of developing capabilities in the community to handle small (<100 µm) particles in the interest of maximizing the scientific return of existing (e.g., cosmic dust, Stardust, Hayabusa, Hayabusa2) and anticipated collections (e.g., OSIRIS-REx). With this in mind, the Lunar and Planetary Institute (LPI) and the Astromaterials Research and Exploration Sciences (ARES) directorate at NASA Johnson Space Center (JSC) have collaborated to offer four fall training opportunities at JSC focused on the handling and manipulation of small extraterrestrial materials. In the spring of 2022, the fifth sample handling workshop was offered in coordination with Purdue University, exploring the possibility of expanding access to the trainings through additional regional opportunities to further serve the sample analysis community. Traditionally, these workshops host between 4-6 participants for 2.5 days of hands-on instruction and practice. The workshops have served participants at a wide range of career stages, from graduate students to tenure track faculty. Any individual who has a research project that would utilize small samples from NASA collections is encouraged to apply. The LPI offers some financial support to offset the cost of participation.The workshops begin with instruction in the tools and techniques needed to handle small particles, including strategies for particle manipulation and the applications of micromanipulators. Instruction then moves to embedding particles and the methodology for sectioning samples via ultramicrotomy. After hands-on experience with ultramicrotomy, the workshop discusses other sample preparation techniques (e.g., FIB-SEM). These handling and sample preparation techniques are applicable to a wide range of analytical applications including SIMS, NanoSIMS, SEM, TEM, etc. Participants each have an opportunity to prepare samples via this process from end-to-end, from handling to section preparation. Instructors also offer insight into the types of equipment that work best for handling and preparing these samples and make recommendations as to the general laboratory supplies needed to achieve these results. Through these workshops we have expanded access to specialized NASA collections and shared decades of experience and knowledge with each other and the community.