

THE NASA FACILITY FOR ASTROMATERIALS RESEARCH AT THE JOHNSON SPACE CENTER – A NATIONAL LABORATORY FOR PLANETARY RESEARCH. J. I. Simon¹, A. Burton¹, E. L. Berger¹, L. P. Keller¹, T. C. Prissel¹, E. Rampe¹, K. Richter¹ ¹ARES, Code XI3, NASA-JSC, 2101 NASA Parkway, Houston, TX 77058, USA (justin.i.simon@nasa.gov).

Introduction: The Astromaterials Research and Exploration Science (ARES) Division at the NASA Johnson Space Center houses a unique combination of laboratories, instruments, infrastructure, technical expertise, and other assets for conducting broad-based world-class planetary research. These facilities have been accessed for decades by hundreds of external scientists, including faculty, post-docs, students, and interns, most at no-cost and on a collaborative basis. With funding through NASA's Planetary Science Enabling Facilities (PSEF) program, we have established the NASA Facility for Astromaterials Research (NFAR) to expand access to and enhance these laboratories for a diverse and inclusive external user base, focusing on training of the next generation of scientists and, thus, maximizing the science return from research funded by R&A programs in NASA's Planetary Science Division (PSD). NFAR enables new planetary sample analyses, making new scientific discoveries possible, including training the next generation of planetary scientists. NFAR laboratories are co-located with JSC Curation that houses the NASA-controlled astromaterials collections, thus enabling direct access to both research and curation expertise, to facilitate specialized sample handling and analysis of allocated samples to sample PIs, particularly those affiliated with institutions that historically have limited access to or lack in-house analytical or experimental facilities.

NFAR Laboratories: ARES laboratories operate using a coordinated analysis approach, where multiple analyses are performed on samples in a systematic and sequential pathway (from least-destructive to most-destructive) from hand-samples down to the atomic scale, to maximize science return from precious materials. The NFAR laboratories provide access and training to three major laboratory types within ARES: 1) Astromaterials Sample Analysis, 2) Planetary Process Simulation, and 3) Robotic-mission Analog Research (Figure 1).

The **Astromaterials Sample Analysis** facilities encompasses the *Electron-beam Analysis Laboratories* housing a suite of scanning and transmission electron microscopes (SEM and TEM), electron microprobe analyzers (EPMA), focused ion beam (FIB), and support equipment, the *NanoSIMS Laboratory* with ion polishing support, the *Center for Isotope Cosmochemistry and Geochronology* with facilities supporting inductively-coupled-plasma mass spectrometers and thermal ionization mass spectrometer where samples are either chemically processed and purified in the clean laboratories or

introduced by laser ablation. The *Light Element Analysis Lab* focuses on stable isotope mass spectrometry that was recently expanded to include a laser fluorination line for high precision triple oxygen isotope analysis of silicates, and the *Soluble Organics in Astromaterials Laboratory* that includes instrumentation for liquid and gas chromatography-mass spectrometry systems. Insoluble organic materials are analyzed in situ using an ARES-designed and -built microprobe two-step laser mass spectrometer system.

The **Planetary Process Simulation** facilities include the *Experimental Petrology Laboratories* with a 1-bar furnace laboratory to simulate high-temperature, ambient pressure, conditions on a range of astromaterials and piston cylinder and multi-anvil apparatuses for high-pressure experimental petrology. The *Experimental Impact Laboratory* currently houses three separate accelerators: a horizontal 5.56-mm light-gas gun (LGG) (<8 km/sec), a vertical gun that features interchangeable barrels (<3 km/s), and a 25-mm flat-plate accelerator (FPA) (up to 70 GPa), which can launch a variety of projectiles at targets to simulate impacts on the surfaces of the solid bodies of the Solar System.

The **Robotic-mission Analog Research** facilities focus on robotic-mission analog studies and experiments, measurements, and analog research to further interpret data returned from planetary missions and characterize geological processes on planetary bodies. These laboratories contain flight-like versions of instruments operating on martian rovers, including: the CheMin X-ray diffractometer on the Mars Science Laboratory (MSL); the laser-induced breakdown spectrometer on ChemCam and SuperCam on MSL and Mars 2020; the evolved gas analyzer in the Sample Analysis at Mars (SAM) instrument suite on MSL; and the SHERLOC deep-UV Raman spectrometer on Mars 2020. ARES hosts the field's largest collection of extensively characterized rock, mineral, and glass samples in an analog sample library for validation of mission science data. Additional instrumentation includes visible near-infrared spectrometers, Fourier transform infrared spectrometer, Mössbauer spectrometers, vibrating sample magnetometer, magnetic susceptibility bridge, and an electron magnetic resonance spectrometer.

Facility Access: Access to NFAR can be requested by external users via short proposals, and proposals will be reviewed on a rolling basis. Access request proposals are prioritized such that NASA-funded research in active PSD R&A proposals have the highest priority,

followed by users performing research relevant to PSD R&A programs such as proof-of-concept studies to support new R&A proposals. Additional consideration is given to access requests from early-career/next-generation scientists, under-represented minorities, and those PIs from minority-serving institutions. Available instrument time for external users varies across the NFAR labs but is typically 10-20%, at no cost to the external user (travel expenses and per diem would not be provided by NFAR and would be the responsibility of the external user). Both independent and collaborative proposals with ARES scientists are encouraged. Generally, external users would be supported and assisted by ARES staff during their time on-site performing analyses. Independent operation of individual instruments by external users is possible and is approved at the discretion of the individual ARES instrument lead scientist.

New access proposals would first be evaluated for feasibility by ARES instrument scientists/lab leads. Once a proposal's feasibility is established, it would then be evaluated by a Proposal Review Panel (PRP) for scientific merit. If a proposal is considered not feasible, it would be returned with review comments to aid the proposer in submitting a revised proposal. The PRP makes access recommendations to the ARES Research Office Branch Chief. Access proposals are reviewed and selected quickly (<6 weeks), and ranked according to their scientific merit, technical feasibility, and the availability of the required resources. The proposal review score combines the proposal strengths and perceived weaknesses and is the major factor in allocating facility access to external users. The ranked recommendations of the PRP are presented to the ARES Research Office Branch Chief who would determine the final allocations.

Proposals to use NFAR labs are limited to <5 pages and are required to address the following:

- **General Information:** Including title, user information (name and affiliation), and contact information (email and phone).
- **Description of Proposed Research at NFAR:**
 - Describe the scientific purpose of the investigation and its relevance to NASA PSD.
 - Identify labs to be accessed and justify the use of NFAR resources and capabilities. Proposers are strongly encouraged to consult with the NFAR lab leads regarding their proposed research projects.
 - Description of the samples and procedures and explain the basis for the time request. How many visits needed to complete the investigation? How many days per visit? Time frame for entire project with milestones.
 - Describe the users' previous experience relevant to the proposed research and any preliminary or proof-of-concept results.
- **Sample Issues:** Describe any sensitive material/safety concerns for the NFAR laboratories, e.g., will hazardous chemicals and materials, biohazards, etc. be used.
- **Data Management:** User provided Data Management Plan consistent with PSD requirements for R&A proposals.

Users are encouraged to discuss potential proposals with ARES/NFAR staff prior to submission. Finally, publications that result from data obtained from the NFAR laboratories will acknowledge the facility award in the acknowledgements section.

Inquiries and requests for information should be directed to Dr. Aaron Burton (aaron.burton@nasa.gov).

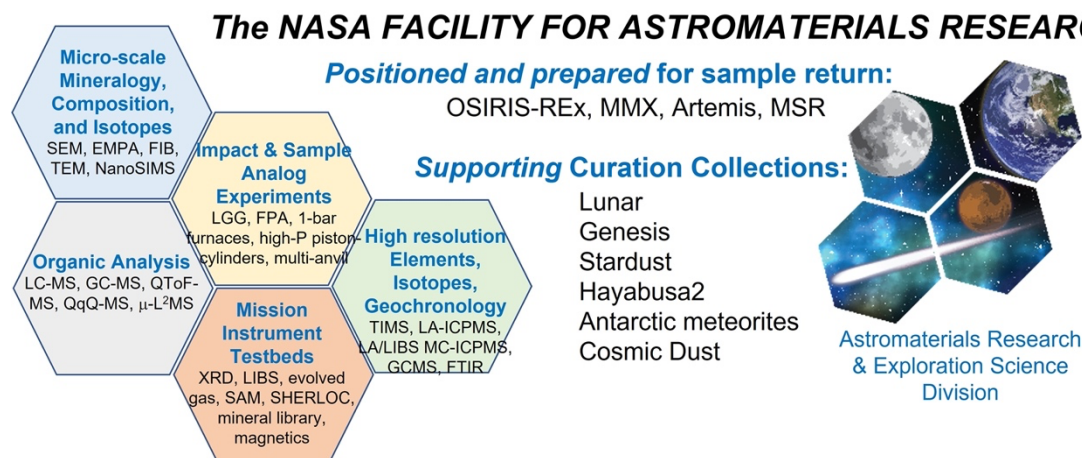


Figure 1. The NFAR structure and connectivity – coordinated analysis among ARES laboratories for world-class sample analysis and support of NASA PSD R&A programs.