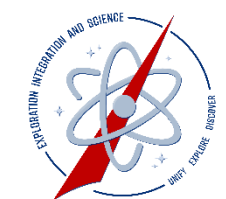


Astromaterials Research and Exploration Science / NASA Johnson Space Center

Johnson Space Center Astromaterials Research Office ISFM Review

John W. Alred,
Manager

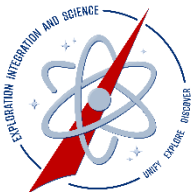
PAC Meeting
November 30, 2020



Guiding Principles for JSC ISFM Implementation



- Reduce amount of time spent writing proposals while continuing to do excellent science
 - Increase availability for review panel service and community service activities
- Provide stable support for critical laboratories that serve the external scientific community and/or multiple internal users
 - Experimental impact laboratory
 - E-beam / ion-probe instruments (SEMs, TEMs, FIB, nanoSIMS, EMPA)
 - Isotope cosmochemistry laboratory (ICP-MS, TIMS)
- Support early career scientists by covering salaries, providing instrument access at no charge, and mentoring for proposal writing by mid- and senior-level scientists



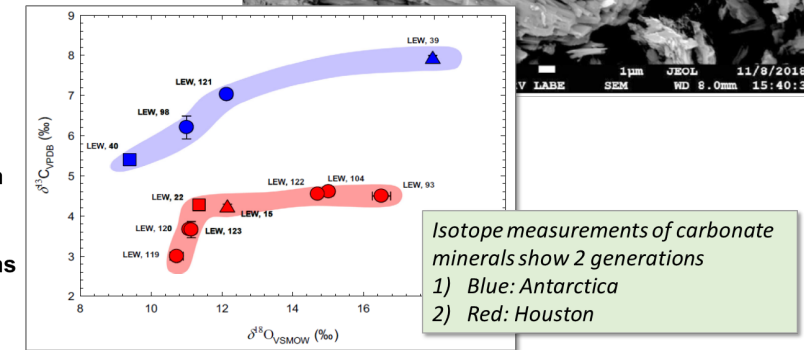
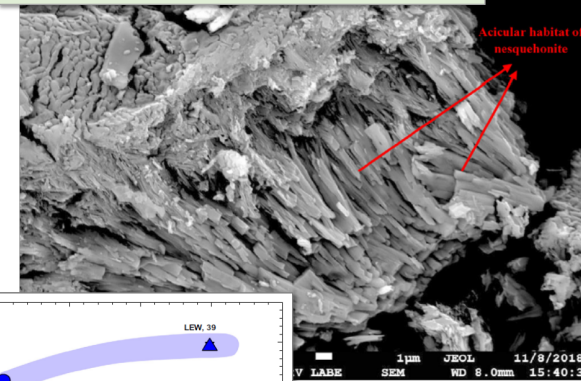
Science from JSC ISFM

- 94 articles submitted to to peer-reviewed journals in 2020
- 15 First-authorships of white papers submitted to decadal surveys

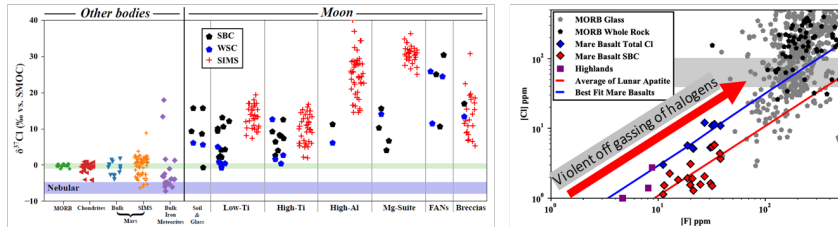
Oxygen and carbon stable isotope composition of the weathering Mg-carbonates formed on the surface of the LEW 85320 ordinary chondrite: Revisited.
El-Shenawy et al. Meteoritics and Planetary Science (2020) doi: 10.1111/maps.13553

- (Big) LEW 85320 is the largest meteorite collected in Antarctica and contains evidence for weathering in Antarctica – required special handling
- Because of special handling and its large size - a second generation of secondary minerals were shown to be forming in Houston
- Isotope measurements track the history of water in this meteorite on Earth
- Carbonate formation in this meteorite is analogous to conditions present on Mars

SEM image of LEW 85320 showing Mg-rich carbonate that formed in Houston



NASA Graduate Fellow and ARES scientists use the non-traditional chlorine isotope system and halogen contents of Apollo samples to confirm the Giant Impact Moon formation hypothesis



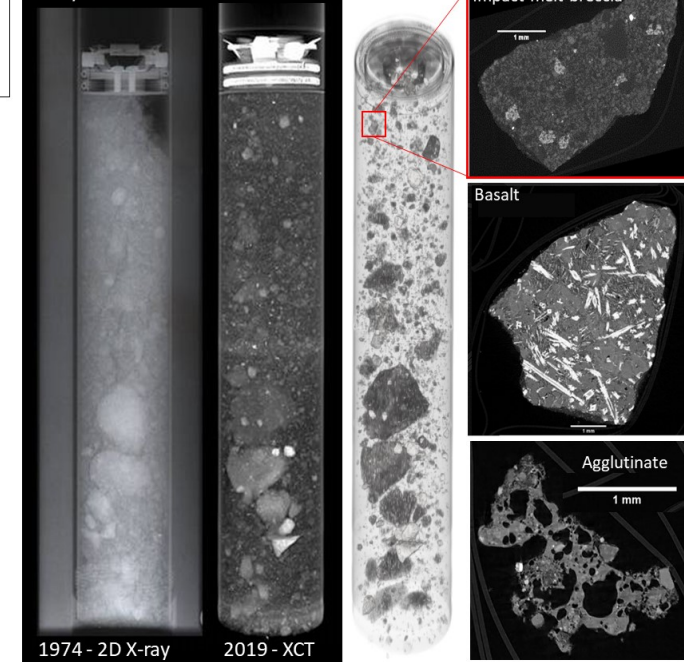
Anthony Gargano (student), Zachary Sharp, Charles Shearer, Justin Simon, Alex Halliday, and Wayne Buckley (2020) Chlorine isotope compositions and halogen contents of Apollo return samples, *Proceedings to the National Academy of Sciences*

Lunar materials contain uniquely high chlorine isotope values Lunar materials are depleted in fluorine and chlorine 1Dx relative to Earth

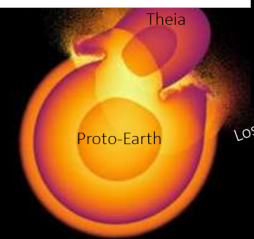
Apollo Next Generation Sample Analyses Initiative (ANGSA): Preserving and Curating the Moon – X-Ray Computed Tomography

- Sample 73002 is part of a 2-foot long “drive tube” of lunar regolith collected from a landslide deposit near Lara Crater at the Apollo 17 site.
- Scanned the entire core tube prior to extrusion using X-Ray Computed Tomography (XCT) to facilitate non-destructive rapid detection of minerals, lithic clasts, and void spaces within the drive tube. The XCT data has helped to identify and avoid potential pitfalls before, during, and after opening the core.
- XCT scanning of more than 50 individual >4 mm clasts removed from the core during dissection has revealed a wealth of information about the mineralogy and textures in these clasts, and has led to the unambiguous classification of many different rock types within the core.
- This non-destructive method is an invaluable source of information for the science community and critical when allocating specific lithologies (e.g., basalts or impact-melt breccias) for detailed analyses and targeted investigations.

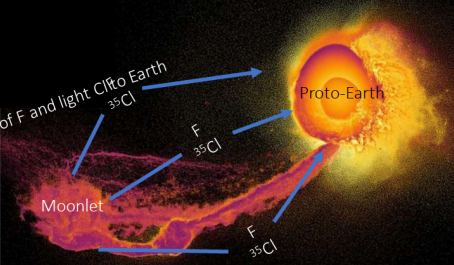
X-ray scans of 73002:



Stage 1: Giant Impact



Stage 2: Accretion of Proto-lunar disk



Stage 3: Present day



Image credit: Dr. Jacob Kegerreis (Durham Univ.)

Community Service and Mentoring



- Working with institutions (Prairie View A&M, University of Houston, Northern Arizona University, et al) for scientists to use JSC facilities.
- Mid-level and senior civil servant scientists worked with two early career contractor scientists resulting in two selected SSW proposals
- Rescheduling local workshops (sample prep; E-beam, etc.) for institutions (due to COVID-19)
- Community outreach
- HQ Review panels and NPP

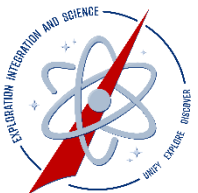
Astromaterials SME Engages Educators Across the Nation about Mars Rover Exploration

- On June 9, 2020, NASA Astromaterials Research and Exploration Science (ARES) Mars Scientist, Dr. Elizabeth Rampe, shared an overview of the Curiosity Rover and a preview of the Mars 2020 Mission.
- The event reached ~160 live participants and 110+ archived participants across 43 states, Washington DC, Puerto Rico, Canada, Mexico and South Africa.
- Numerous Science Activation partner audiences were reached including classroom teachers, Solar System Ambassadors, Museum staff, Librarians, Challenger Learning Center staff, Amateur Astronomers, educators from NASA Centers, and scientists.



Participant Quotes:

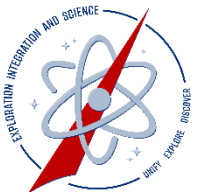
- ❖ *Not only did I improve upon my understanding of the what and where for Curiosity, I have a better understanding of what Perseverance will do.*
- ❖ *Thank you!!! Making the connections with what is really happening to the basic concepts we teach in middle school is critical!*
- ❖ *I liked the ability to interact with the speaker as she asked periodic questions that kept us engaged.*
- ❖ *I loved the approachability of the information for those of us who aren't geologists.*



Management of ISFM at JSC



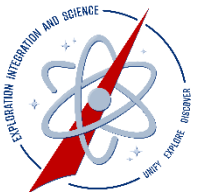
- Five Work Package Structure for ISFM Research
 - Coordinated Analysis
 - Mission Enabling Science
 - Geo- and Cosmochemistry
 - Organic Geo- and Cosmochemistry
 - Planetary Process Simulation
- Weekly meetings with Work Package Leads
- Bi-weekly meetings with all ISFM research scientists
- Incubator Process – Mini-Operation and Research Grants for ARES Scientists (MORGAS) proposals annually (started 2019) using local funds. Prepare ideas for level of inclusion into ISFM or ROSES.
- Quarterly review with ARES Division management



ISFM Working Well

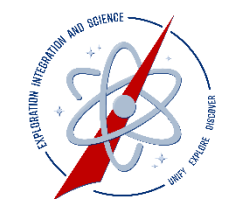


- Scientists have seen increased or sustained productivity
- Stability in funding has enabled more strategic decision-making for laboratories
- Enabled greater instrument access and more collaborations with external scientists
- More successful scientists have increased availability for mentoring of early career and underfunded scientists





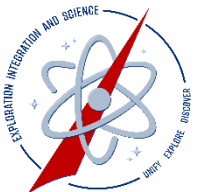
Back-up



JSC-Specific Considerations for ISFM



- Primarily an engineering center so workforce composition expectations are different (i.e., center goal is 25% CS / 75% CN)
- Historically, Research Office scientists have predominantly been funded through R&A + community service + some mission support
- Several multi-user laboratories that require stability with specialized staffing and service contract support
- The Research Office operates like a national laboratory, providing instrument access and expertise to a large number of external scientists
- The Research Office assists the Curation Office at JSC by providing laboratory analyses, analytical expertise, contamination control expertise, etc.



JSC Research Laboratory Facilities



- Electron Beam Analysis Labs (EBEAM)
 - TEM/SEM/EPMA/FIB plus support equipment
- NanoSIMS (Nanoscale Secondary Ion Mass Spectrometry) Lab
 - Semi-Clean and Clean Labs for small particle prep
 - Ultramicrotome, micro-manipulators, specialized optical microscopes
- L²MS Lab (Two-step laser desorption mass spectrometry)
- Soluble Organics in Astromaterials Laboratory (SOAL)
- Center for Isotope Cosmochemistry & Geochronology (CICG) Labs
- Fourier Transform Infrared Spectrometer (FTIR) – light element abundances
- Light Element Analysis Laboratory – stable isotopes
- Experimental Impact Laboratory (EIL)
- Experimental Petrology Laboratory (ExPet)
- Spectroscopy and Magnetism laboratory
 - Contains flight-like IR and Mossbauer spectrometers
- The Mars, Moon, Meteorite Evolved Gas Analysis (M3EGA) laboratory
 - Contains flight-like instruments on the Phoenix and MSL missions
- The X-ray diffraction laboratory for quantitative mineralogy
 - Contains a flight-like MSL-CheMin instrument
- Soil chemistry and mineralogy laboratory
 - For synthesizing and processing martian and lunar analog materials
- Analytical and General Chemistry laboratories
- Mars Analog Sample Collection

