



MEXAG



Mercury Exploration Assessment Group (MExAG)

June 14, 2021

Steven A. Hauck, II, MExAG Chair

Case Western Reserve University



MExAG Steering Committee



Steven A. Hauck, II
Case Western Reserve U.
Chair



Carolyn Ernst
JHU APL
Vice-Chair



Ronald J. Vervack, Jr.
JHU APL
Exosphere Discipline Member



Kathleen Vander Kaaden
Jacobs/NASA JSC
Geochemistry Discipline Member



Christian Klimczak
U. of Georgia
Geology Discipline Member



Catherine L. Johnson
UBC & PSI
Geophysics Discipline Member



Gina DiBraccio
NASA GSFC
Magnetosphere Discipline Member



Ariel Deutsch
NASA ARC
Early Career Member



Gang Kai Poh
Catholic U./ NASA GSFC
Early Career Member



Suzanne Imber
U. of Leicester
International Liaison



Shoshana Weider
NASA HQ
NASA Liaison

MExAG Organization

- As part of its continuing stand-up process, the MExAG SC has created two types of subcommittees.
 - Working Groups (WG): Strategic priorities, indefinite duration, rotating membership
 - Ex: Communications WG, IDEA WG
 - Task Groups (TG): Highly focused, short duration, task-specific membership
 - Ex: Outreach Capabilities TG, Goals Document Definition TG

NF-5

- MExAG notes its disappointment that the delay in NF-5 extends the NF cadence by two years.
- MExAG also notes that NASA's announcement of the NF-5 delay explicitly permits consideration of new discoveries since *Vision and Voyages* through the on-going Decadal Survey process – an approach that addresses MExAG's prior concern that NF-5 was unable to consider new discoveries and new destinations.

MExAG Activities

- Goals Document development ongoing
- Outreach TG exploring if/how MExAG can support Mercury-related outreach going forward
- Presentation to Decadal Survey Mercury/Moon Panel on Mercury Technology Needs
- MExAG Newsletter 3 released
- Facilitated Mercury AGU Special Session
- MExAG 2022 Annual Meeting planning begins this summer

Upcoming Mercury Meetings and Events

- MExAG Goals Document virtual town halls in the Fall
- Fall AGU Meeting: 13–17 December 2021
- EPSC, 13 – 24 September 2021
- Mercury 2022: Current and future science of the innermost planet, 7–10 June 2022
- BepiColombo:
 - Venus Flyby 2, 11 August 2021 at 552 km altitude
 - Mercury Flyby 1, 1 October 2021 at 200 km altitude

MExAG: <https://www.lpi.usra.edu/mexag>

Twitter: [@ExploreMercury](https://twitter.com/ExploreMercury)

MExAG



VEXAG



Request for PAC Advocacy #1

The problem of providing long-term power to surface assets in hostile environments has now been studied extensively. However, there is still no clear long-term solution (other than radioisotope/nuclear power) for providing months or more of power for mobility and/or temperature control. This long-term capability is needed to answer key science questions at bodies including Venus. Given that the development of such capability is expected to take a decade at a minimum, **VEXAG encourages NASA STMD to restart the assessment and development of long-duration power systems surface applications for hot and cold surfaces.**

Examples include the Mercury dayside, Io, Enceladus, Titan, Venus, Triton etc.

Request for PAC Advocacy #2

Laboratory measurements represent fundamental research and are critical for calibrating instruments and interpreting data from current, historical, and future planetary missions. The restructuring of the SSW program that created a focus on hypothesis-driven science *excluded fundamental research*. Even laboratory equipment proposals are now tied to hypothesis-drive science in R&A programs.

There are three possible approaches to remedying this problem:

1. Create a new program element dedicated to Planetary Fundamental Research.
2. Add language to the SSW solicitation to include funding of fundamental research that does not focus on testing a hypothesis based on a specific target of study.
3. Loosen restrictions on the percentage of a proposal (in other programs) that can be laboratory-based (e.g., from 10% to 25%).

29: Target(s) of Study

If 'Comparative Planetology' was selected as the Target of Study in the previous question, please indicate the objects you do not check any of the boxes.

- Mercury
- Venus
- Earth
- The Moon
- Mars
- Saturn
- Jupiter
- Neptune/Uranus
- Comets
- Asteroids
- TNOs
- Satellites/moons
- Dust/meteorites
- N/A

30: Type of Task

- Lab Study/Experimental
- Field Based/Analogue
- Sample Analysis
- Theoretical, Computational, Modeling
- PSD Mission Data Analysis
- Non-PSD Mission Data Analysis (e.g. Hubble, Venus Express)
- Analysis of Ground-Based Data
- Mapping

Example from
SSW
submission on
nspires

Note that a
“Target of Study”
is required

Examples of Fundamental Research

Note how many of these are broadly applicable to multiple Solar System bodies!

- Development of unmixing algorithms for Raman spectroscopy
- Simulations of dielectric breakdown on airless bodies
- Shifts of spectral features and variations in optical constants under varying P and T
- Maturation of optical constant theory
- Variation of LIBS spectra with plasma temperature and effects on quantitative analysis
- Development of machine learning algorithms customized to planetary questions



LEAG



The logo for the Lunar Exploration Analysis Group (LEAG) features the letters 'LEAG' in a bold, sans-serif font. A stylized white rocket trail starts from the bottom right and curves upwards and to the left, ending in an arrowhead that points towards the letter 'A'. The background of the logo is a dark blue space scene with a large, detailed moon in the center, several smaller planets or moons in various colors (yellow, red, green, blue), and a starry field. The entire logo is set within a circular frame with a blue border.

LEAG

Lunar Exploration Analysis Group Updates

Dr. Amy L. Fagan, LEAG Chair

Presented to NASA Planetary Advisory Committee

14 June 2021



NF5 Candidate Missions for Lunar Science Remain Highly Valued

- **South Pole Aitken Sample Return (SPA-SR) mission and Lunar Geophysical Network (LGN) have been identified as high priority missions and would achieve science goals as identified by several documents:**
 - 2003 Decadal Survey, *New Frontiers in the Solar System*;
 - 2007 National Research Council Report, *Scientific Context for the Exploration of the Moon*
 - 2013 Decadal Survey, *Visions and Voyages*
 - 2018 *Advancing Science of the Moon* Specific Action Team Report
- LGN has also undergone a NASA-funded Planetary Mission Concept Study (2019-2020)
- LGN and SPA-SR are recognized by the community as high-priorities in current decadal survey white papers
- **Neither were selected as New Frontiers missions, but the science objectives have not yet been achieved by other missions and there are no planned missions to address the preponderance of science objectives with future missions; therefore, it is critical that these remain on the list as potential missions regardless of upcoming human exploration missions**



The Value of the Lunar Reconnaissance Orbiter

- **The Lunar Reconnaissance Orbiter's (LRO) data and ongoing operational cadence is critical to lunar science; lunar surface exploration; and human space flight.**
- LRO will mark 12 years in lunar orbit on June 23, 2021, and is the longest continuously operational spacecraft in lunar orbit, ever.
 - Currently in its 4th Extended Mission, which ends in September of 2022, and the next extended mission proposal will be submitted in mid-January of 2022
 - Fuel reserves will take the orbiter through 2025, but how much beyond that depends on the use of fuel for changing the orbit, momentum unloads, and phasing the LRO orbit to observe landings/impacts
 - LRO has generated over 1.2 Pb of data in the PDS, including maps, shapefiles, and derived products. LRO currently occupies over 70% of the entire volume of data in the PDS.
 - ~40% of the LRO peer-reviewed publications are led by early career authors on the LRO teams.
 - In addition to providing superb science, the LRO team has great experience-base of working on a lunar mission that we should tap.
- **LRO has dramatically increased and continues to add to our understanding of the Moon as well as supporting early career researchers, therefore, LRO should be maintained for the preservation of and continued capability for lunar surface operations.**



Equity, Diversity, Inclusion, and Accessibility should remain a priority

- **Continued work by NASA and the Analysis Groups are encouraging and should continue to be fostered to develop a stronger community.**
- Reminder of LEAG 2020 Finding 4.1:
 - LEAG recognizes the need to include diversity, equity, and inclusion in all aspects of our work and our community. This mindset is critical as we work together towards beyond Earth exploration during a global pandemic that impacts individuals in different ways.
 - Beyond earth exploration is an endeavor that impacts all of humanity, and therefore needs to be done thoughtfully and inclusively. The current community of implementers does not reflect all aspects of society, so we must be aware of this fact while we strive to do better.



Next Annual LEAG Meeting: Aug 31-Sep 3

- **Theme: Lunar Science and Exploration in the next 5 years**
 - Engage and showcase the early career community
 - VIRTUAL; 31 Aug. – 2 Sep. 2021
- **Incorporating LEAG strategies for the present and future**
 - Implementation of the Lunar Exploration Roadmap
 - Guided by 2020 Findings, particularly related to continued support and enthusiasm for Artemis, Base Camp, VIPER, and CLPS
 - Featuring updates from NASA HQ, Artemis program, CAB, current and planned lunar missions, etc.
- **Abstracts for contributed talks that specifically address one or more of the following themes:**
 - Highlights from the Lunar Reconnaissance Orbiter (LRO);
 - Landing sites and science goals;
 - Future lunar orbital concepts and assets (including but not limited to airborne and orbital remote sensing);
 - Future lunar surface concepts and assets;
 - Future lunar sample analysis concepts and assets (including but not limited to ANGSA, curation/facilities, technological developments, and instrumentation capabilities or requirements)



Request for More Information Regarding Strategic Plans For ESSIO and entities contained therein

- **Exploration Science Strategy and Integration Office (ESSIO)**

- ESSIO remains somewhat nebulous to the community, as it does not appear on an SMD Org chart and there is no website.
- What are the primary Goals, individual Objectives, and identified Investigations of ESSIO?

- **Lunar Discovery and Exploration Program (LDEP)**

- We applaud LDEP having its own budget line and request a better understanding of specifically how the funding will achieve decadal science priorities including how Artemis will be integrated.
- How does LDEP fit strategically within ESSIO, as LDEP controls several entities (e.g., CLPS), yet ESSIO executes LDEP and ESSIO also controls PRISM (which relies on CLPS providers)?

- **Commercial Lunar Payload Services (CLPS)**

- What is the planned strategic evolution of the program including, but not limited to, potential for sample return; mobility; surviving the lunar night; orbital opportunities; pre-deployment of Artemis assets.
- Beyond the traditional lunar science and exploration community there is also great interest in the LEAG Commercial Advisory Board (CAB) members for more information on the future of CLPS.

- **Payloads and Research Investigations on the Surface of the Moon (PRISM)**

- It is somewhat ambiguous to the community the process by which PRISM selections operate, therefore we request specific information regarding who, when, and how these selections are made.



Request for Updates to Artemis Program

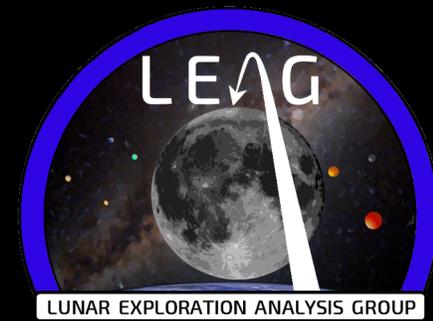
- The lunar science and exploration community continue to be excited about the Artemis program, and are eager to move forward. We request updates regarding specific details of several items.
- To assist with community communication, **we also request that these updates be made available at a centralized website (e.g., ESSIO)** where we can access recent charts of updates provided at workshops and meetings. This increases the accessibility of information for the community.
- **Updated TIMELINES (including est. dates) for:**
 - Artemis III landing;
 - Artemis Base Camp development and execution;
 - Selection of: landing site(s); astronauts; science team; instrument calls
- **Updated Information Regarding PROCESS for Selections of:**
 - Landing site selections;
 - Who selects the landing sites and when/how can community feedback be included beyond the initial RFIs?
 - Science team selections;
 - What will the science team be doing? For example, will there be a specific “backroom” team and a field training team?
 - What is envisioned for a competed science team? For example, will it be competed as a team or as individuals, who are then combined into a team?
 - instrumentation selection;
 - How and when will instruments be selected for Artemis?



Request for Clarification/Information of the use of CAN funding vehicles for some flight programs

- **We request clarification for why some major instrument flight programs (e.g., PRISM) are required to use Cooperative Agreement Notice (CAN) funding vehicles, whereas others may not.**
- NASA flight programs are typically awarded as contracts
 - Contracts are loaded with overhead and fees that are appropriate given the facilities, risks, reporting, and oversight involved in delivering and operating flight hardware.
- It would benefit the community to have clear explanations for why some flight programs require a CAN funding vehicle, so institutions can make better plans for whether to submit responses
 - CANs are neither contracts nor grants and have their own rules. They may be difficult for some institutions.
 - CANs have increased sponsor oversight and reporting requirements that require overhead expenditures that may not be recovered on lower grant overheads.
 - CANs for flight programs will make use of labs and facilities that are paid for using capital budgets derived from fee. CAN's do not allow fee to be added, so the facilities must be used "for free."
 - CANs for flight programs increase the level of risk to the institution, which will not have fee to cover unallowable expenses that might arise.

June 2021 LEAG Summary



- South Pole Aitken Sample Return and Lunar Geophysical Network will address high-priority science goals and therefore should be retained as potential missions for New Frontiers 5, regardless of upcoming human exploration missions.
- LRO, as the longest continuously operations spacecraft operating in lunar orbit, remains critical for the preservation of and continued capability of lunar surface operations and therefore should be maintained.
- Equity, diversity, inclusion, and accessibility remain priorities for the planetary science community to develop a stronger workforce.
- Planning for 2021 Annual meeting underway (Aug 31-Sep 3).
- **Humans are going to the Moon with many science opportunities and an entire community behind them to spur them on. LEAG requests for clarification, updates, and additional information from NASA regarding several items are critical for the continued success of lunar science and exploration as well as for exploration beyond the Moon:**
 - Request for more information regarding the strategic plan for ESSIO and entities contained therein.
 - Request for updates regarding specific details of the Artemis program.
 - Request for clarification/information regarding the use of CANs for some, but not all, instrument flight programs.



MEPAG



Mars Exploration Program Analysis Group (MEPAG)

MEPAG Report to Planetary Science Advisory Committee

R Aileen Yingst, Chair

14 June 2021

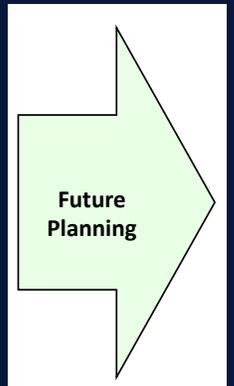
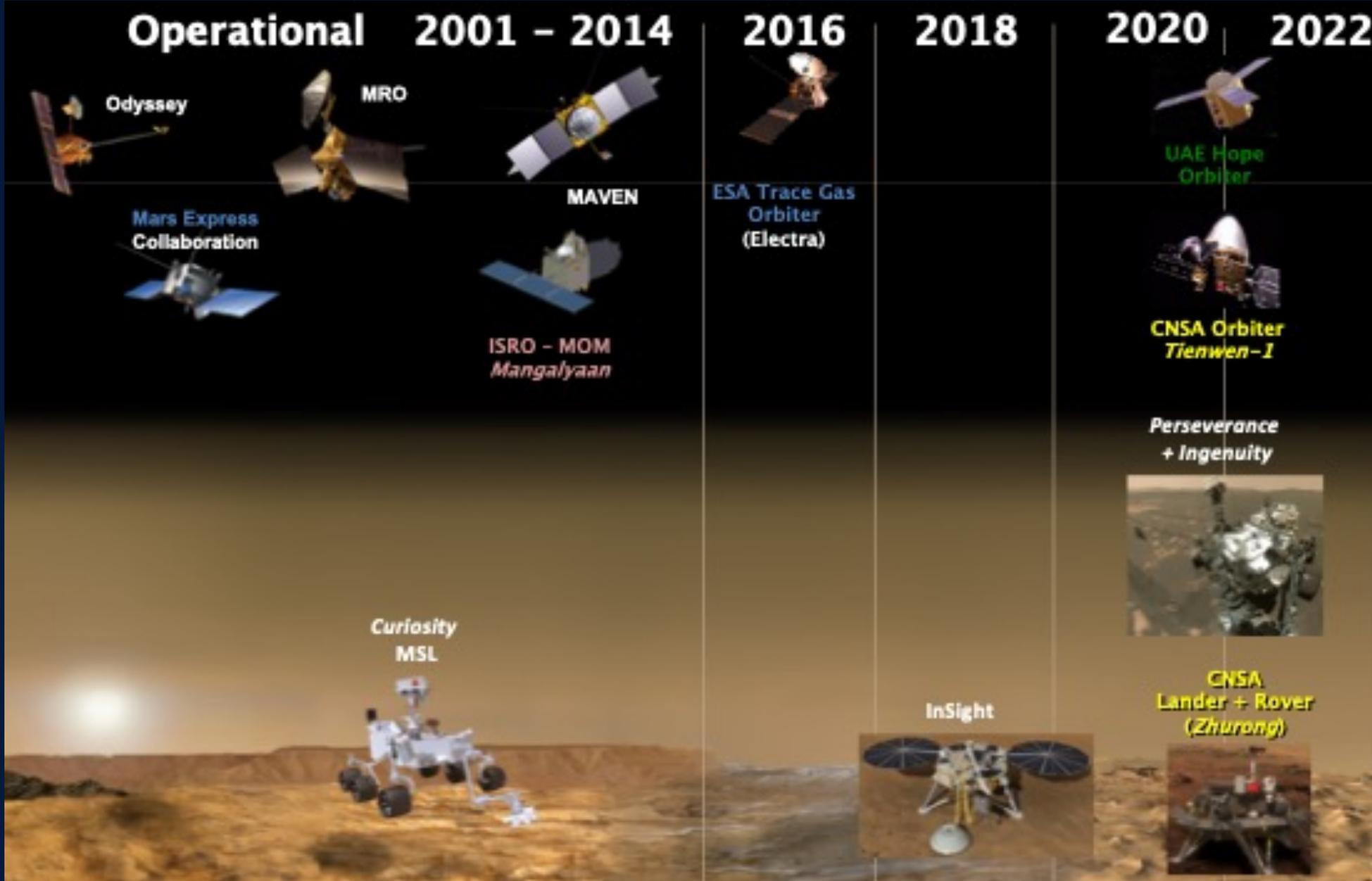


Perseverance Navcams 360-Degree Panorama: This panorama, taken on Feb. 20, 2021, by the Navigation Cameras, or Navcams, aboard NASA's Perseverance Mars rover, was stitched together from six individual images after they were sent back to Earth. Credit: NASA/JPL-Caltech

MEPAG Programmatics

- Steering Committee (Chair: R. Aileen Yingst (PSI), appointed June 2019)
 - W. Calvin (Univ. Nevada Reno)
 - **J. Eigenbrode (GSFC; rotating off)**
 - D. Banfield (Cornell)
 - J. Filiberto (LPI; DEIA representative)
 - S. Hubbard (Stanford University)
 - S.S. Johnson (Georgetown University)
 - K. Lynch (LPI; DEIA representative)
 - J. Johnson (past Chair, JHU/APL)
 - M. Meyer (NASA HQ)
 - D. Beaty, R. Zurek (JPL)
 - J. Bleacher/P. Niles (HEOMD, NASA HQ) Ex Officio members
- Goals Committee (D. Banfield, Chair) **New member**
 - **Goal I <Life>** (J. Stern, GSFC; A. Davila, ARC)
 - **Goal II <Climate>** (D. Brain (Univ. Colorado), **Claire Newman**)
 - **Goal III <Geology>** (B. Horgan, Purdue, Becky Williams, PSI)
 - **Goal IV <Human Exploration>** (J. Bleacher, NASA HQ HEOMD; M. Rucker, P. Niles JSC)

Mars Exploration Program Analysis Group (MEPAG)



ExoMars
Lander + Rover
in 2023

MEPAG Active Findings

Mars Sample Return

- MEPAG commends the great effort between the Mars Exploration Program (MEP) and the Mars Sample Return (MSR) program to communicate smoothly and effectively, including the MOA between MSR & MEP. MEPAG will continue to assess how well the organization, balancing of duties, and lines of communication are working, as the challenges of coordinating a complex, international program arise.

Mars Exploration Program

- MEPAG encourages NASA to address the important MASWG report requested by the mid-term Decadal review. MEPAG believes that it defines the non-MSR aspects of the MEP and as a standalone report, it should be assessed on its own rather than waiting for the Decadal Survey report. MEPAG is ready to stand up committees that would investigate further the recommendations of this report.

MEPAG Active Findings

Mars Exploration Program – Mars Ice Mapper

- The community continues to follow the progress of Mars Ice Mapper, and recommends early input from the Mars community as plans develop. (Detail in back-up)

NASA Humans to Mars

- MEPAG is excited about the first stages of discussions regarding humans to Mars but is concerned regarding the lack of input the Mars community has had in the initial formation of science objectives for human exploration of Mars. Science community input into HEOMD architectures at the earliest stages will be crucial for coordination and better understanding of knowledge needed for a successful human mission to Mars. MEPAG intends to continue to publicize and support efforts that seek to broaden community input and open discussion, especially early in the process before any major architectural decisions are made.

Mars Exploration Program Analysis Group (MEPAG)

- MEPAG Virtual Meeting #12 scheduled for June 21, 1-5pm EDT.
- Agenda will cover updates from the Mars Exploration Program and Mars Sample Return, Mars Ice Mapper, current Mars missions, and strategic planning around the MASWG report.

PST	Topic	Speaker
	MEPAG & MEP Updates	
10:00 AM	MEPAG Update	R. A. Yingst
10:10 AM	MEP Status	E. Ianson M. Meyer J. Parrish
10:40 AM	Mars Ice Mapper: Next Steps	E. Ianson M. Meyer
11:10 AM	Discussion	All
	Strategic Planning	
11:40 AM	MSR Update	J. Gramling
11:55 AM	Break	
12:05 PM	MASWG Key Points for a Near-Term Program	B. Jakosky
12:15 PM	MEP Strategic Planning	J. Parrish
12:35 PM	Discussion (goal should be leading questions and general guidance - this is the start of the conversation)	All
	Mars Mission Updates (TBC)	TBC
12:55 PM	Perseverance (talk about GZ planning)	K. Farley
1:10 PM	Ingenuity	T. Tzanetos
1:20 PM	Insight	B. Banerdt
1:35 PM	MSL	A. Vasavada
1:50 PM	Wrap-Up	R. A. Yingst
2:00 PM	End	



Backup slides



Recent MEPAG Activities

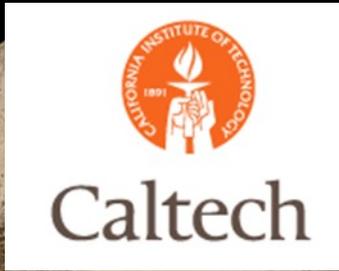
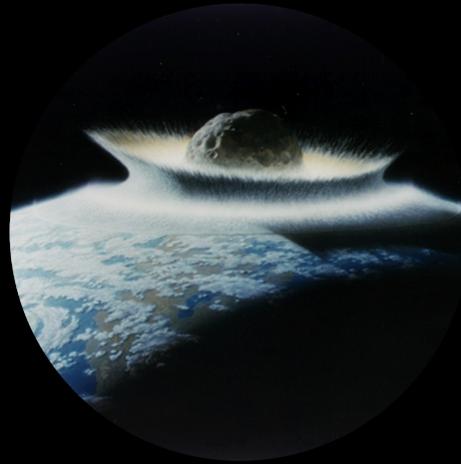
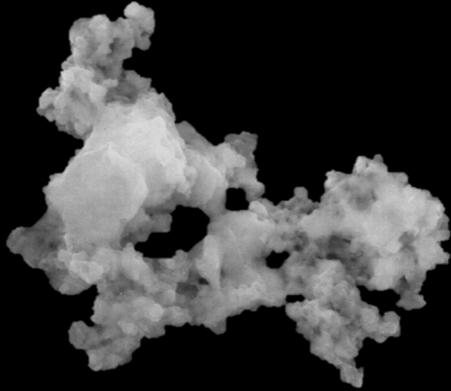
➤ From MEPAG Virtual Meeting #11

- Mars Ice Mapper (MIM) international partners (CSA, JAXA, NASA, ASI) have signed a Statement of Intent (SOI); MOU in work
 - NASA Agency-directed SMD mission in support of Moon to Mars/Humans to Mars strategy
 - May include communication satellite network
 - MEPAG looking forward to hearing more at a future virtual meeting, including release of white paper detailing measurement approach and possible formation of a Mission Design Team (MEPAG finding)
 - MDT could assess ability to meet resource measurement goals and any opportunities for additional measurements to enhance mission science (e.g., ICE-SAG)
- MIM is a possible example of future dual-purpose science/precursor missions preparing for eventual human missions
 - Agency seeking to outline compelling science goals for human explorers on Mars
 - One example being looked at by a study group is extracting, analyzing and possibly returning ice cores from Mars
 - MEPAG has fielded SAGs on similar topics in the past and looks forward to helping these discussions as appropriate.



SBAG





Bonnie J. Buratti, SBAG Steering Committee Chair

June 14, 2021 NASA Planetary Science Advisory Committee (PAC)

Virtual Meeting

The Steering Committee

Present Steering Committee (Green rotate off in August 2021)

Elena Adams (APL), Technology Lead

Maitrayee Bose (Arizona State Univ.)

Bonnie Buratti (NASA JPL/Caltech), Chair

Michael Busch (SETI Inst.)

Terik Daly (APL), Early Career Secretary

Mike DiSanti (NASA GSFC)

Jessie Dotson (NASA Ames), Planetary Defense Lead

David Gerdes (Univ. of Michigan)

Mihaly Horanyi (Univ. of Colorado, Boulder)

Stefanie Milam (NASA GSFC)

William O'Hara (Sierra Nevada Corp.), Human Exploration Lead

Jennifer Scully (NASA JPL/Caltech)

New Members for three year term:

Timothy Titus (USGS, Flagstaff)

Henry Hsieh (Planetary Science Institute)

Justin Atchison Technology Lead

Stephanie Jarmak (SWRI) Early Career Secretary (2.5
year term)

Steering Committee selects Chair and Steering Committee members from among nominations, applications. General membership open.

SBAG Representatives

Thomas Statler NASA Headquarters Liaison

Jake Bleacher Human Exploration and Operations Mission Directorate (HEOMD) Liaison

Paul Abell (JSC) HEOMD Observer

Key Recent Findings

ARECIBO SCIENCE RECOVERY

- 1. SBAG recommends that NASA support additional asteroid radar observations at other facilities in order to meet a portion of the scientific and planetary defense goals previously accomplished by the Arecibo Observatory.** These steps are outlined in a white paper (https://www.lpi.usra.edu/sbag/documents/SBAG_RadarRecovery_20210217.pdf) (Summary follows these findings.)
- 2. SBAG also recommends that NASA continue to consult with NSF and/or other relevant agencies about the Arecibo collapse and the process for deciding what happens next with the site, in order to ensure that the implications for NEO observations are adequately included.**

(Full text at <https://www.lpi.usra.edu/sbag/findings/>)

Key Recent Findings

99942 APOPHIS STUDY TEAM

SBAG encourages NASA to use resources at its disposal to identify the key science that can be addressed from the 2029 Earth flyby of asteroid Apophis and to also investigate spacecraft and ground-based opportunities to support this event. During the 2029 Earth flyby, Apophis will be a target of opportunity for both planetary science and planetary defense. The recent Apophis T-9 Years Workshop demonstrated the great community interest in this once-per-thousand-year event, and identified the encounter physics as a major area of interest for both the scientific and hazardous asteroid mitigation communities. The SBAG community concludes that the next steps in preparation for this event are focusing activity into a formal Science Definition Team or similar entity, as well as investigating how existing spacecraft and ground-based assets could enhance the science return from this event.

(Full text at <https://www.lpi.usra.edu/sbag/findings/>)

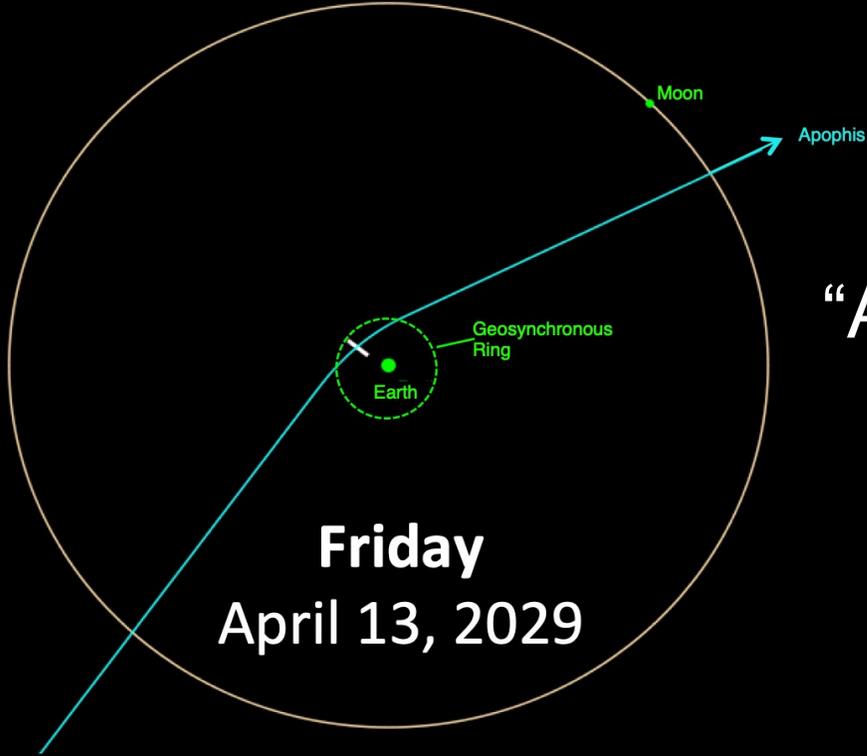
Apophis 2029

340m asteroid passing within 5.8 Earth-radii.

“A once-per-thousand year natural experiment.”

- 300 X More massive than Tunguska body.
- 5000 X More massive than Chelyabinsk body.

Knowledge opportunity for the science of planetary defense.



Friday
April 13, 2029

Figure credit: P. Chodas (JPL)

Key Science Questions / Uncertainties:

- *Will tidal stresses by Earth induce any measurable effects?
-Seismic shaking? -Surface landslides? -Shape reconfiguring?*
- *Can measurements of effects produce significant scientific advances in our understanding of the surface and interior structure of Potentially Hazardous Asteroids ?*
- *How would measurements be implemented ?*

Shoemaker-Levy 9 “natural experiment” (1994)



BACKUP SLIDES

Table 1. SBAG's suggested improvements to current radar capabilities. (From the White Paper)

Facility	Description	Estimated additional cost to NASA	Comments
DSN: Goldstone	Increased radar observing time with GSSR and DSS-13	Operating costs	
Green Bank Phase 1 transmitter Phase 2 proposal	NEO observations Development of new transmitter	Operating costs \$30 million +	Collaborate with NSF
DSN: Canberra Receive with Parkes (Australia)	DSS-43 80 kW klystron New Parkes receiver	Operating costs ~\$300,000	Collaborate with CSIRO
Haystack	NEO observations with existing transmitters and receivers	Operating and startup costs	Operated by MIT, Lincoln Laboratory; requires proposal to NASA.
DSN: Madrid Receive with Sardinia (Italy)	DSS-63 or DSS-53 transmitters	Operating costs	Collaborate with INAF
EISCAT UHF EISCAT 3D (Scandinavia)	Available through 2025. Buildup of new system; available after 2022.		Encourage planetary radar observations by EISCAT consortium
TIRA (Germany)	NEO observations with existing transmitter and receivers.		Encourage planetary radar observations by Fraunhofer Institute, ESA.

Sample Statement of Task:

Apophis 2029 Science Definition Team

1. Quantify what, if any, physical signals might be induced by Earth-induced tidal torques / stresses that are uniquely generated by an encounter of less than 6 Earth-radii on a body as large as Apophis.
2. Evaluate the methods and capability to measure any induced signal, considering the science return from strictly ground-based assets as well as a range of different class *in situ* investigations.
3. Critically assess the knowledge advancement opportunity for the applied Science of Planetary Defense* of measuring an induced signal.
4. Critically assess whether substantial knowledge gains are achieved if a measurable signal falls below the level of detectability (null result).

* and fundamental planetary science



OPAG



Request for PAC Advocacy from OPAG Findings

Linda Spilker and Jeff Moore (OPAG Co-chairs)

Request for PAC Advocacy: Prevent Further Dragonfly Launch Delays

- The OPAG community notes that the Dragonfly launch has been delayed twice as a result of NASA Headquarters' resources prioritization, and not as a consequence of any mission underperformance. We recognize NASA HQ must make adjustments in light of unforeseen developments, such as the COVID-19 pandemic, and that HQ does not foresee further launch delays. However, OPAG is concerned that Dragonfly appears to be considered a lower priority compared to other missions that have launch dates in the late 2020s whose launch dates have not been not delayed. Further delays of the Dragonfly launch could have cascading impacts on the next New Frontiers mission (NF-5) and lead to conflicts in developmental resources and budgetary timeline.
- More transparency on decisions that result in launch delays would help alleviate the community concerns.

Request for PAC Advocacy: Radioisotope Thermoelectric Generators: Planning for future (outer planet) mission needs

- A recent RTG presentation stated that NASA is building a second NextGen RTG unit that will be ready to be fueled by 2026. Recent mission concept studies demonstrate that an Ice Giant Flagship mission will require at least two units of RTGs, each producing about 300 W or more of electrical power such as the NextGen RTGs. Thus, NASA's effort to prepare a second NextGen unit is critical to enabling an Ice Giant flagship mission in the 2030s; however, NASA has not announced a plan to fuel the second NextGen RTG unit.
- OPAG supports NASA continuing to work with DoE to ensure that the plutonium production is planned accordingly to fuel those two units on a schedule consistent with a potential Flagship mission to an Ice Giant planet to be launched in the early 2030s.
- NOTE: Other AGs may have similar concerns about future RTG needs. Development of a timeline and long-term plan for building and fueling future RTGs to support planetary missions over the next few decades would be valuable to the planetary science community.



ExMAG



A banner image showing a person in a white lab coat and blue gloves working with a sample in a laboratory setting. The background is dark and textured, possibly representing a planetary surface.

**Extraterrestrial Materials
Analysis Group (ExMAG)**

Extraterrestrial Materials Analysis Group (ExMAG)

PAC meeting June 2021

Barbara Cohen, Chair
ExMAG.community@gmail.com

Extraterrestrial Materials Analysis Group (ExMAG)

CAPTEM



ExMAG

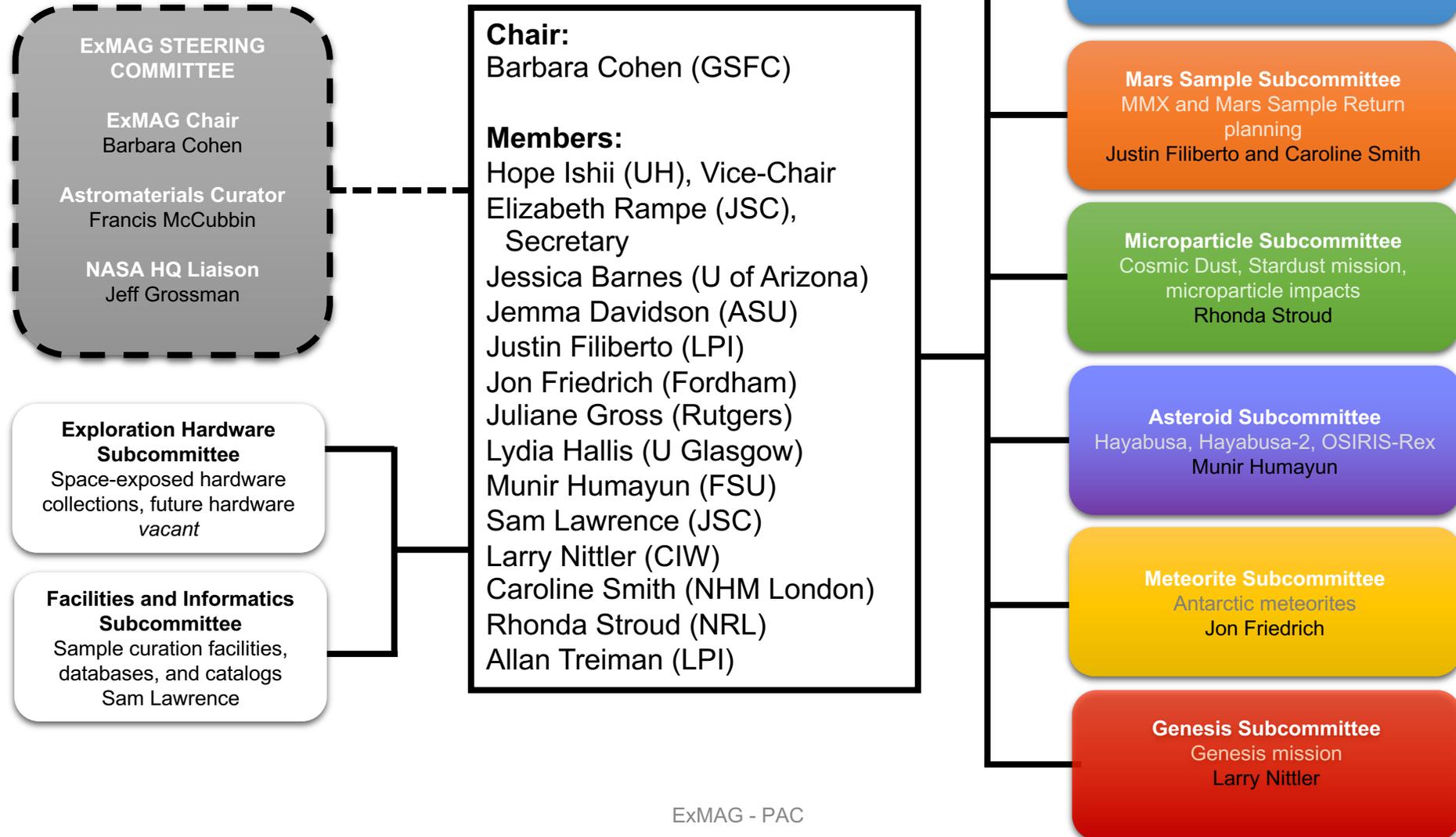
- Community-based analysis & advocacy
- ExMAG members and subcommittees will continue providing expertise and analysis on collection, allocation, and curation activities (Spring meeting)
- Expand its AG role to better serve the sample-analysis community; e.g., discuss initiatives, reports, missions, findings and studies as requested or initiated (Fall meeting)

Astromaterials Allocation Review Board (AARB)

- Allocations are being run as traditional NASA Review Panels separate from the AG function
- Review panels are initiated by the Astromaterials Curator and supported by NRESS
- Requests will continue to be submitted through email
- The ExMAG subcommittees contain substantial subject-matter expertise that the Curator may draw on when forming a Review Panel

Extraterrestrial Materials Analysis Group (ExMAG)

ExMAG membership



ExMAG activities

- We are still doing some housekeeping – chair transition, new charter approval, new name, subcommittee realignment, membership review, meeting planning, website – please be patient
- Open call for ExMAG membership applications in March 2021, will be implementing early-career and IDEA engagement in our membership
- Town Hall Virtual meeting, Feb. 25
 - Introduction to new ExMAG structure and changes from CAPTEM, Community Q&A
- Spring Meeting Virtual, April 7-8
 - Focused on curation and collections reports as per usual Spring CAPTEM meetings
 - NASA HQ briefing, New Frontiers 5 sample return mission language, Mars MSPG2 update
 - NASA JSC organizational and facilities reports
 - Astromaterials Curation & Allocation reports
 - Advanced Curation topics: ANGSA consortium model, Microbial ecology of Curation clean labs
 - Chang'e 5 sample return, Artemis curation planning, and Artemis III SDT
- Fall Meeting, Virtual, Sept/Oct timeframe
 - Focused on community needs for missions, facilities, etc.
 - Early-career contributions (lightning talks or special topics)

Spring Meeting 2021 Findings

New Frontiers 5

- The Advance Notice Regarding New Frontiers 5 (NF5) Announcement of Opportunity includes a Lunar South Pole - Aitken Basin sample return mission, as recommended by the Decadal Survey. However, in the Advance Notice, this mission is listed with the parenthetical (pending Artemis landing site selection(s) and science objectives). The Artemis III Science Definition Team Report is now available and ExMAG was briefed on it. ExMAG concurs with LEAG that the scientific goals of a South Pole-Aitken Basin sample return mission are unlikely to be addressed at the planned Artemis landing locations at the lunar south pole. **ExMAG recommends that NF5 proposals for such a mission should not be dependent upon Artemis program planning.** (*endorsed by LEAG*)
- Increasingly complex sample-return missions, such as cryogenic comet sample return, will require investment in curation infrastructure and community laboratory facilities. For sample-return missions, the actual costs for all aspects of curation, from planning through distribution and storage, including all required laboratory construction or modification, are required to be borne by the mission from inception to 2 years following sample return. Whereas missions with long cruise phases may be able to defer the costs of operation and scientific analysis to Phase E, this situation potentially penalizes sample-return missions that have to include early planning and construction/renovation of curation facilities and laboratories in Phases B-D. Therefore, the Midterm Review of the Decadal Survey recommended that NASA consider the budget for curation by sample return missions as a Phase E cost to ensure that sample return missions are on equal footing with other mission proposals and discourage unrealistically low budgets for sample curation. **ExMAG endorses the Midterm Review finding and recommends that the Curation Costs for sample return missions be considered outside the PI cost cap in the NF5 call.**

Spring Meeting 2021 Findings

Terrestrial Sample Collection activities

- For over four decades, the U.S. has performed annual meteorite recovery through ANSMET (the Antarctic Search for Meteorites Program) and periodic interplanetary dust particle (IDP) recovery through stratospheric flights. The meteorites recovered by ANSMET are vitally important for planetary research, providing scientists from around the world with samples of planetary bodies not easily obtainable by other means. These meteorites recovered by ANSMET thus far include the first meteorites recognized as lunar and martian, hundreds from 4 Vesta, primitive remnants from the earliest stages of our solar system's history, and new meteorites that have challenged our understanding of solar system formation and evolution, including that of our own planet. IDPs represent a uniquely primitive class of astromaterials with origins distinct from the larger meteorites, including cometary dust. The meteorites recovered in Antarctica and stratospheric IDPs motivate and inform preparations for, analyses during, and context following, missions to small bodies, moons, and planets, critical to maximizing science return from these missions. Due to the ongoing COVID-19 pandemic, the 2020-21 and 2021-22 ANSMET field seasons and stratospheric collection flights were canceled. **ExMAG recommends that NASA and NSF ensure the continuity of terrestrial sample collection efforts by resuming stratospheric flights and a robust ANSMET field season as soon as practical. (*endorsed by SBAG*)**

Spring Meeting 2021 Findings

Chang'E-5 Sample Availability

- The successful Chang'E 5 mission has returned the first new lunar sample return in decades. The samples' source is a unique location, a young mare basalt far from previous collection sites, holding the potential to dramatically change our understanding of solar system volcanic and impact history. NASA-funded researchers have a strong interest in working with these samples but understand that their collaboration with the People's Republic of China (PRC) is constrained by the Wolf Amendment, a Congressional limitation prohibiting bilateral exchanges between NASA-funded scientists and scientists and institutions in the PRC. Science is an international effort that is hindered when individuals face barriers to fully participating in science because of national policies. While recognizing that the US State Department has flagged human rights issues in the PRC as an area of concern, a scientific exchange similar to that conducted by the US and Soviet Union on Luna and Apollo samples in the 1970s could encourage scientific knowledge exchange to foster openness and diplomacy. Under current policy, Chinese national scientists are disallowed from receiving Apollo sample loans from the US collection. **ExMAG encourages NASA to explore a path to permit sample exchange and reciprocal sample loans between NASA and CNSA for the Chang'E-5 and Apollo samples** specifically, and potentially to broaden such a program to encompass the substantial Antarctic meteorite collections of both nations and future sample-return missions. Such an exchange would also alleviate individual researchers' concerns about working with Chang'E-5 samples using NASA funding, which could constitute a violation of the Wolf Amendment. (*endorsed by LEAG*)



MAPSIT





Mapping and Planetary Spatial Infrastructure Team (MAPSIT)

Report to Planetary Science Advisory Committee (PAC)
March 1–2, 2021 Meeting

Brad Thomson (Univ. Tennessee), *Chair*; Julie Stopar (LPI), *Vice Chair*; Brent Archinal (USGS), Ross Beyer (SETI/NASA Ames), Dani DellaGiustina (Univ. Arizona); Caleb Fassett (NASA/Marshall), *retiring 2021*; Lisa Gaddis (LPI), *retiring 2021*; Sander Goossens (NASA Goddard); Justin Hagerty (USGS); Trent Hare (USGS); Jay Laura (USGS); Pete Mougini-Mark (Univ. Hawaii); Andrea Naß (DLR, Germany); Alex Patthoff (PSI); Jani Radebaugh (Brigham Young Univ.), *past Chair*; David Williams (Arizona State Univ.)



Previous MAPSIT Findings (March 2021) included this item:

MAPSIT encourages the creation of a **PSDI for the Moon**, in collaboration with LEAG, LSIC, and other appropriate parties.

- With numerous lunar efforts from NASA, the commercial sector, and other space agencies underway, now is the ideal time to establish a lunar PSDI that benefits all.
- Similar to MAPSIT finding presented Nov. 2020.
- Note the workload required to create a lunar PSDI will be non-trivial; will likely have to proceed as a funded effort rather than staffed via volunteers on a best-effort basis



Current MAPSIT Finding

Progress report on creation of **Lunar Critical Data Products Specific Action Team (LCDP-SAT)**

- Builds off recommendations from Artemis III Science Definition Team report
- Draft Terms of Reference have been circulated to MAPSIT and LEAG. Team is not fully constituted, but several volunteers have stepped forward including Julie Stopar, Pete Mouginis-Mark, Brent Archinal, Trent Hare, and Ross Beyer from MAPSIT as well as Amy Fagan and others T.B.D. from LEAG.
- Among other charges, the team will assess and prioritize what new mission-derived cartographic products, including mosaics and topographic models, for the south pole could be developed using the highest quality data available and using the standard (possibly updated) lunar geodetic coordinate reference frame. As part of the assessment, the SAT will advance a notional production and sequencing strategy.
- The team is also requested to issue nonbinding findings detailing preliminary steps to enable a “Planetary Spatial Data Infrastructure” for the Moon, such as goals for deploying a lunar PSDI catalog/registry for the discovery of existing data products and the development of standards and best practices on how to characterize, capture, and represent uncertainty and distortion within the metadata for each product.
- Panel constitution should be complete within a few weeks. Report is due very soon: 1 Aug 2021 (MAPSIT Steering Committee suggested revising to Sep 31)



ExoPAG



ExoPAG Items of Interest

- ExoPAG are excited to support the interdisciplinary meeting “Exoplanets in our Backyard II” in 2022
- ExoPAG are discussing whether the group can do useful analyses on standardization of publishing quantitative exoplanet research results, to make them more useful in future archiving. That may require interfacing with the international community, as well as publishers of scientific futures. We will report more on this to the PAC in the future.