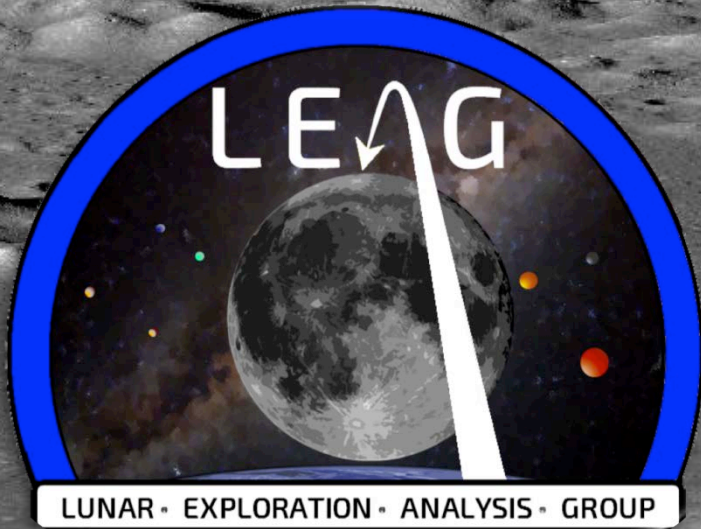


LUNAR EXPLORATION ANALYSIS GROUP

ESF UPDATE/TOWN HALL 2017



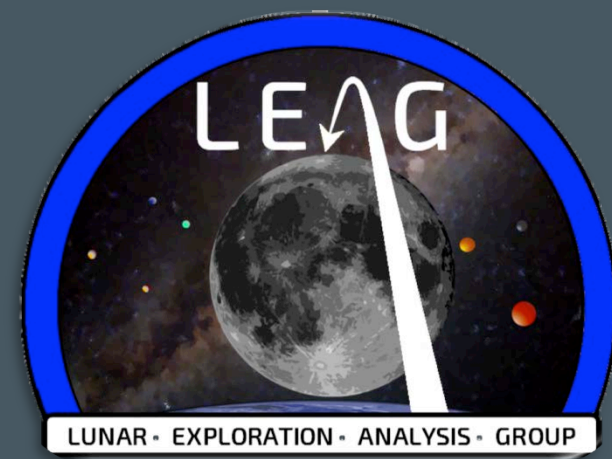
MEET the EXECUTIVE COMMITTEE of the LUNAR EXPLORATION ANALYSIS GROUP

- Clive Neal (Chair) - University of Notre Dame
- Sam Lawrence (Vice-Chair) - NASA JSC
- Jeff Plescia (Past Chair) - JHUAPL
- Noah Petro (LRO Rep and Secretary) – NASA GSFC
- Louise Prockter (Community Liaison) - LPI
- Jasper Halekas (ARTEMIS Rep) - University of Iowa
- Ryan Clegg-Watkins (NGLSE Rep) -WUSTL
- Dana Hurley (Lunar Volatiles) - JHUAPL
- Jerry Sanders (ISRU) – NASA JSC
- Kurt Klaus (Commercial Advisory Board Chair) – LPI
- James Carpenter (ESA Rep) - European Space Agency

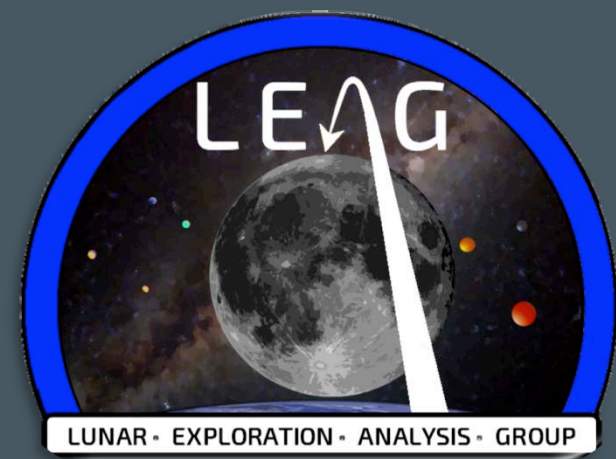


LEAG ACTIVITIES SINCE THE LEAG TOWN HALL @ LPSC

- LPSC LEAG Networking Session – thank you Moon Express! Over 145 lunatics attended!
- New Views of the Moon, 2 – Europe.
- Back to the Moon CAB workshop.
- moon vs. Moon!
- Decadal Survey Mid-Term review – Sam.
- South Korea and the LEAG Roadmap.



LEAG ACTIVITIES SINCE THE LEAG TOWN HALL @ LPSC

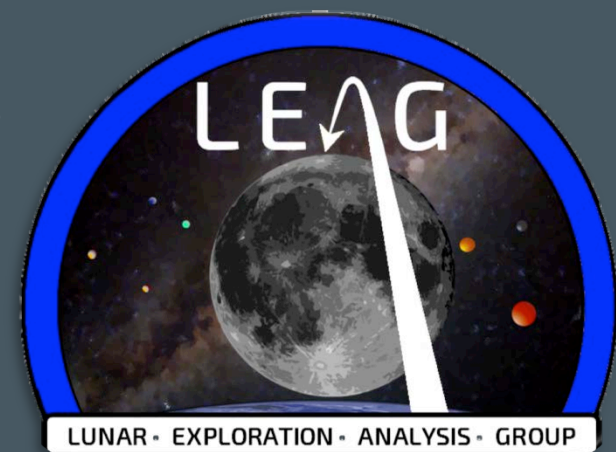


- Advances in Science on the Moon (ASM) SAT (SCEM).
- NEXT SAT-conduct an assessment of potential future lunar missions that could be carried out over the next five years. Being formulated.
- LEAG ISECG SAT.
- Lunar Capabilities Roadmap.
- LEAG Annual Meeting 10-12 October 2017.
- Landing Site Selection Workshop.
- L-DAP
- NVM-2, Asia

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LEAG NETWORKING SESSION @ LPSC

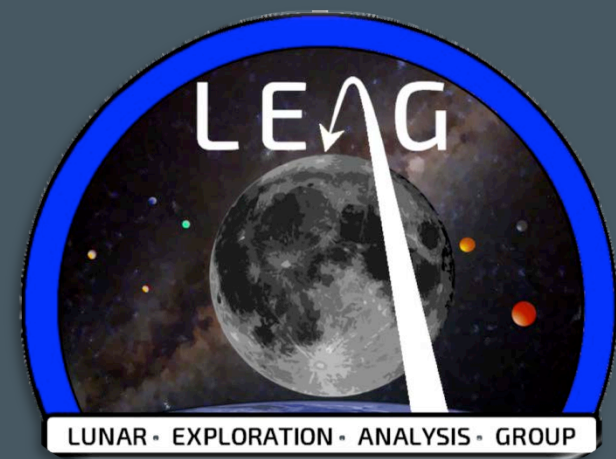
- Thank you Moon Express! >145 lunatics attended!



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NEW VIEWS OF THE MOON, 2 - Europe

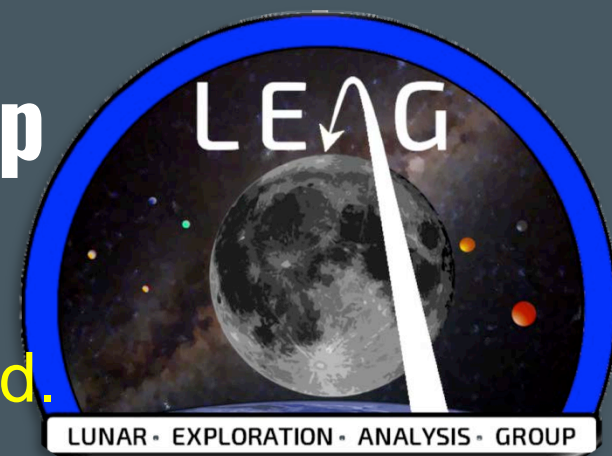
- 98 attendees (25 Students and 73 Professionals).



Hosted at the University of Münster in Germany by Carolyn van der Bogert and Harry Hiesinger
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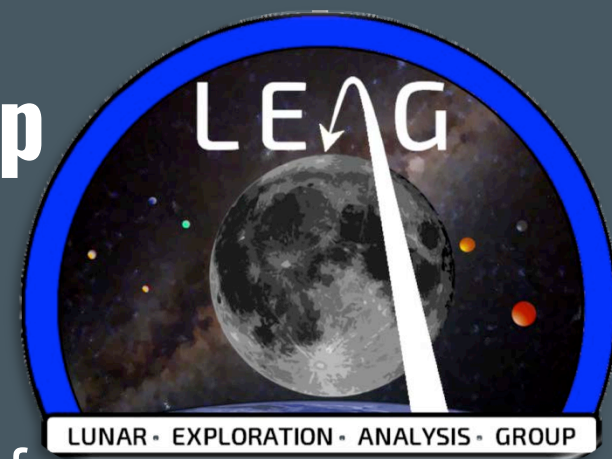
Back to the Moon CAB Workshop

CAB = LEAG Commercial Advisory Board.



- CHAIR: Kurt Klaus, **LPI**
- LEAG Chair: Clive Neal, **Notre Dame**
- LEAG VC: Sam Lawrence, **NASA JSC**
- Kyle Acierno, **iSpace**
- Jason Aspiotis, **Finsophy (Financial Technology)**
- Dallas Bienhoff, **Cislunar Space Development Corporation**
- Dale Boucher, **Deltion**
- Joshua Brost, **SpaceX**
- Thomas Diedrich, **Airbus**
- Leslie Gerstch, **MUST**
- Sam Gunderson, **Blue Origin**
- Dan Hendrickson, **Astrobotic**
- Jeff Hopkins, **Astrobotic**
- Susan Jason, **Surrey Satellites**
- Jim Keravala, **Off World Consortium**
- David Kornuta, **United Launch Alliance**
- Bernard Kutter, **United Launch Alliance**
- Eva-Jane Lark, **Investment Advisor**
- Sean Mahoney, **Masten Space Systems**
- Maria Antonietta Perino, **Thales Alenia Space Italia**
- Bruce Pittman, **NASA Ames**
- Sridhar Ramasubban, **Team INDUS**
- Eric Reiners, **Caterpillar**
- Bob Richards, **Moon Express**
- Melissa Sampson, **United Launch Alliance**
- George Sowers, **Sowers Space Solutions**
- Kris Zacny, **Honeybee Robotics**

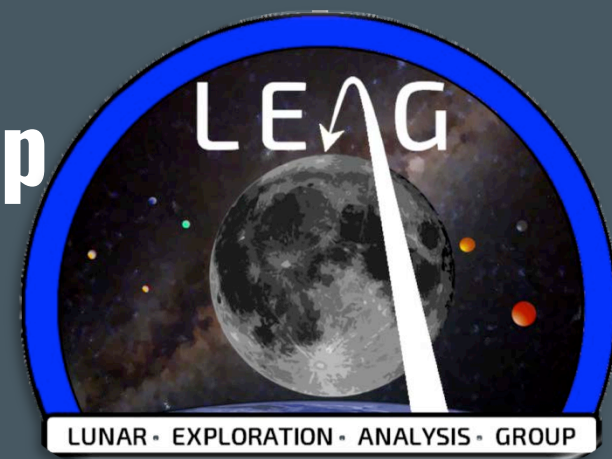
Back to the Moon CAB Workshop



Finding 1: A permanent regulatory framework for commercial lunar missions is part of a current Congressional discussion, embedded in the American Space Commerce Free Enterprise Act of 2017. The ASCFE framework builds on the ‘Mission Approval’ that Moon Express received from the USG in 2016. The meeting participants fully support these efforts as part of the ASCFE.

Finding 2: NASA can enable rapid development of the commercial lunar industry by offering to be a customer. The sooner NASA does this, the faster commercial capabilities will be developed. The range of capabilities offered would reflect the breadth of investigations that NASA could offer.

Back to the Moon CAB Workshop



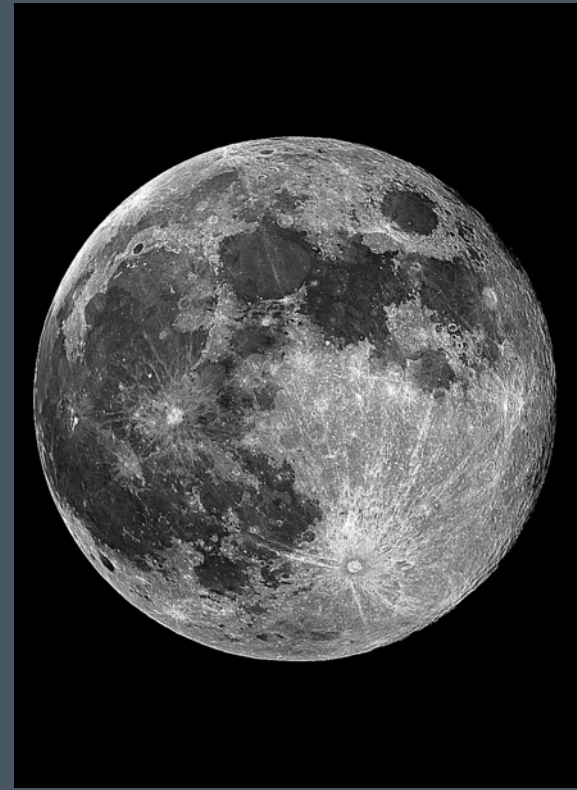
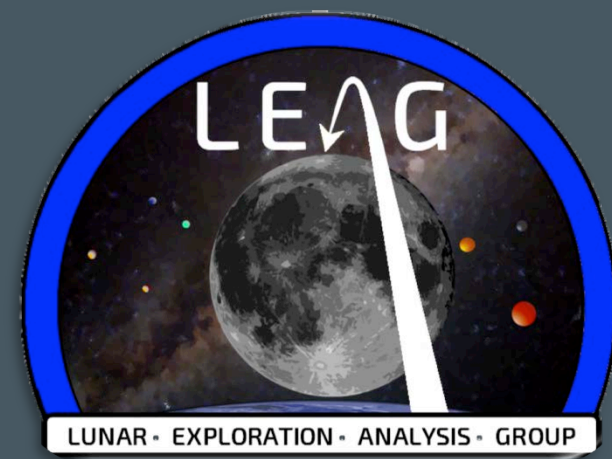
Finding 3: In addition to paying for payload flights, NASA should strongly consider buying transportation services, samples and/or data. In order for this to succeed, the nature of the samples/data required must be adequately specified.

Finding 4: NASA should consider public-private partnerships for particularly difficult or risky activities to share the risk, increase mission cadence and the probability of success, and enhance the business case for the commercial partner.

CONCLUSION: There is a lot of enthusiasm for commercial lunar missions and capabilities of the private sector could enable a new era of lunar science and exploration.

moon vs. Moon!

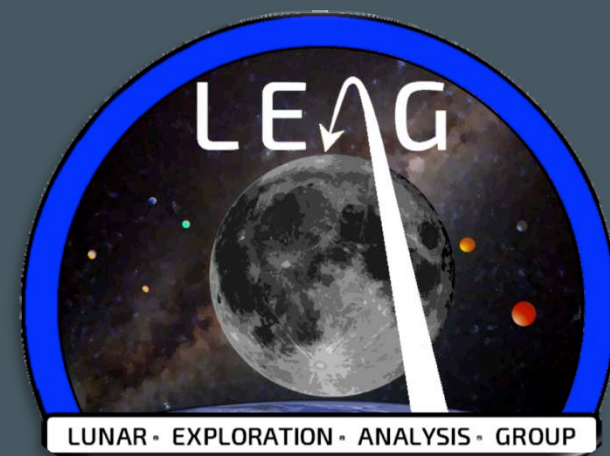
- The name of our only natural satellite!
- What an exchange on the Lunar-L!
- Letter being drafted and will be sent to HQ.
- If you want to sign the letter send me an email: neal.1@nd.edu or cneal@nd.edu



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Decadal Survey Mid-Term Review

- Sam Lawrence presented the lunar perspective to the mid-term review panel.



A WORLD FULL OF WONDER AND OPPORTUNITY THE LUNAR EXPLORATION ANALYSIS GROUP VIEWPOINT FOR THE 2013-2023 DECADAL MIDTERM REVIEW

Clive Neal, LEAG Chair

Samuel Lawrence, LEAG Vice-Chair



Spectacular impact craters, volcanism, and tectonism interact in this LRO view of Posidonius – one of many destinations for future exploration!

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Decadal Survey Mid-Term Review



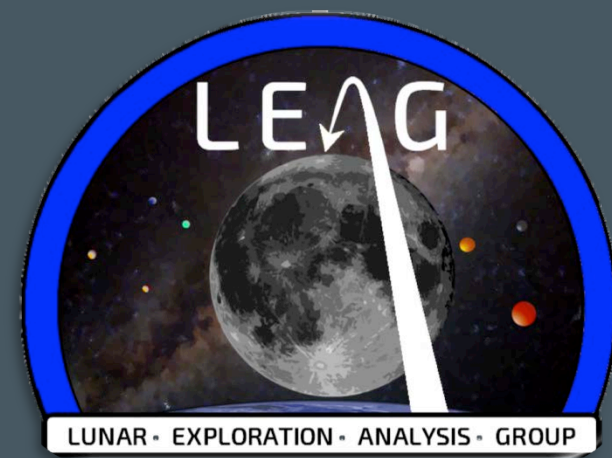
OUTLINE FOR THE LEAG PERSPECTIVE

- LEAG Overview
- Review of Moon-related topics in “Visions and Voyages for Planetary Science in the Decade 2013-2022” (VV2011)
- Advances in Lunar Science Decadal Priorities since 2011
- Advances Beyond Decadal Priorities
- New Frontiers 4 Special LEAG Finding
- The Value of LRO Extended Science Missions
- New Opportunities for the Next Decadal

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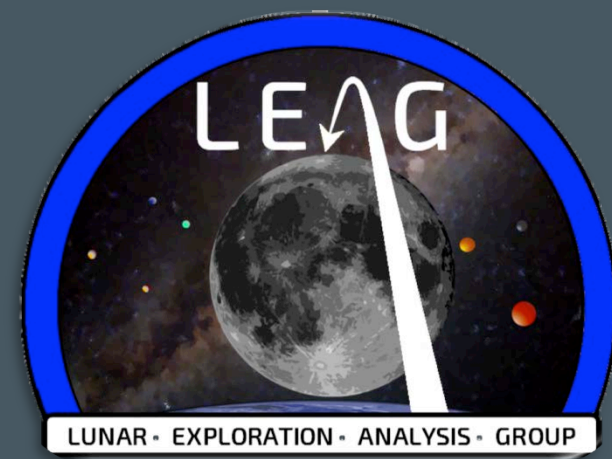
South Korea and the LEAG Roadmap

- Formulating their Lunar Exploration Roadmap (LER).
- Wanted to know how LEAG put together our LER.
- Presentation and discussion about roadmapping - your LER is having influence.
- KPLO is an important mission!



ASM-SAT

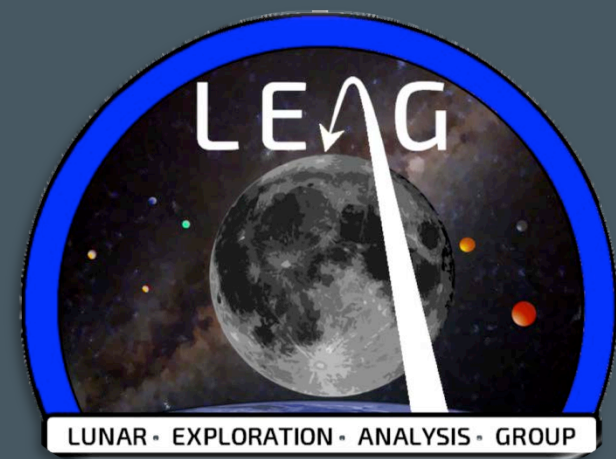
- Advances in Science on the Moon (ASM) SAT
- Brett Denevi (JHUAPL) and Sam Lawrence (JSC) Co-chairs
- *LEAG has been called into action by the Planetary Science Division of the Science Mission Directorate to form the Advances in Science of the Moon Special Action Team [ASM-SAT]. ASM-SAT will conduct a review of progress over the last decade made to address the major lunar science priorities described in the 2007 National Academies report “The Scientific Context for the Exploration of the Moon,” commonly referred to as the SCEM Report.*



NEXT-SAT

NEXT SAT - conduct an assessment of potential future lunar missions that could be carried out over the next five years.

Chair: Sam Lawrence (JSC)



NEXT-SAT will assess a number of specific themes:

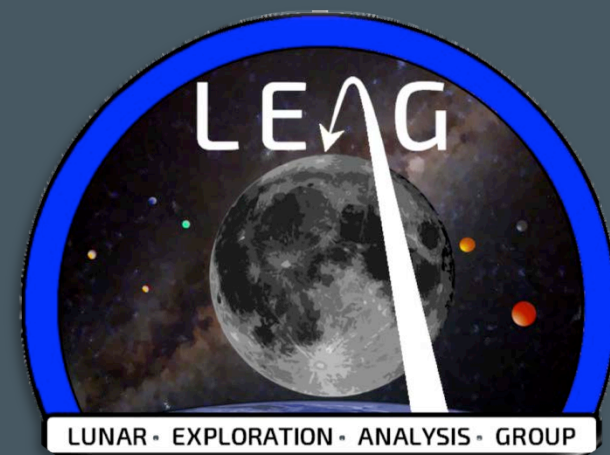
- Lunar missions needed to address new lunar science questions revealed by progress in lunar sample studies as well as results from recent lunar missions (including LADEE, GRAIL, and the on-going Lunar Reconnaissance Orbiter) mission.
- Viable on-ramps for potential commercial involvement.
- Desirable precursor instruments and/or missions to enhance human exploration and address Strategic Knowledge Gaps.
- Activities or new modes of operation that could be employed by existing lunar assets (e.g., ARTEMIS or LRO) to facilitate future discoveries or surface activities.
- Identify potential technology developments that would enhance lunar and Solar System science.

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LEAG ISECG-SAT

IISECG – International Space Exploration Coordination Group. <http://www.globalspaceexploration.org/wordpress/>

Co-Chairs: Dana Hurley (JHUAPL) and Sam Lawrence (NASA-JSC)



Planned Lunar Polar Landed Missions:

CNSA: Chang'E-P1 (2021), Chang'E-6 (2023), and Chang'E- P2 (2025)

NASA: Resource Prospector (2022)

Roscosmos: Luna 27 (2021), Luna 28 (2024)

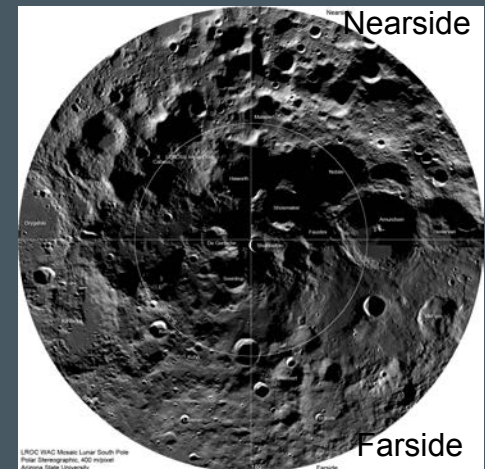
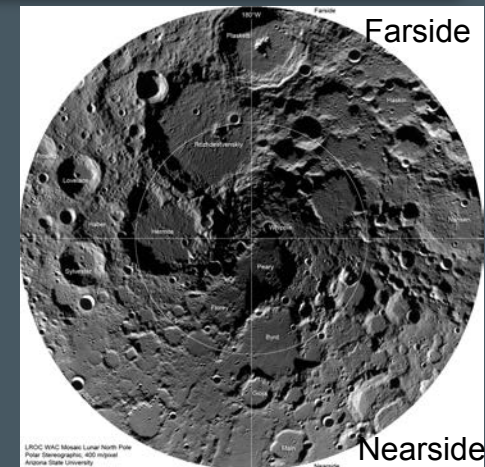
ESA: Luna 27 (2021), HLEPP (2025)

JAXA: SELENE-R (2022), HLEPP (2025)

CSA: HLEPP (2025)

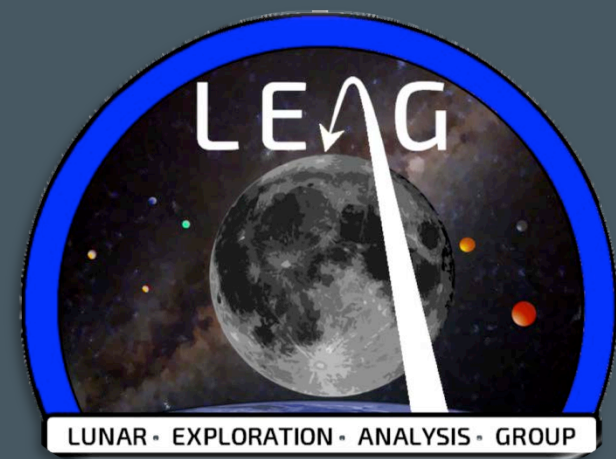
(Korean Lander: 2022?)

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LEAG ISECG-SAT

IISECG – International Space Exploration Coordination Group. <http://www.globalspaceexploration.org/wordpress/>



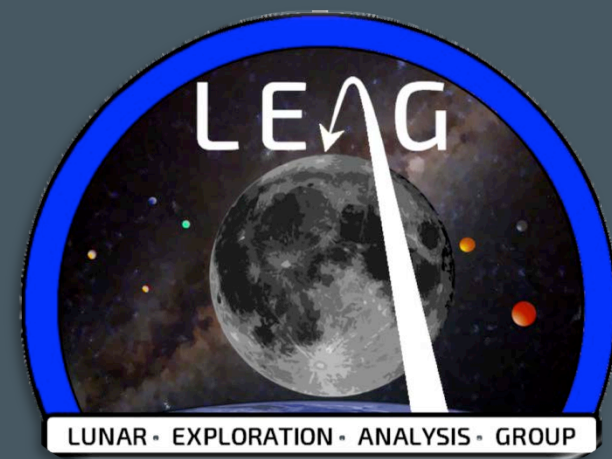
- International team of experts.
- Will review mission goals and parameters for each mission.
- Input to focus on options for these missions to answer science and exploration questions related to the resource potential of lunar polar volatiles.

LEAG SAT is asked to provide input and suggestions on:

- Landing sites.
- Orbital plans.
- Payload complement/instrumentation.
- Measurement objectives.
- Communications architectures.
- Sample return or analysis efforts.
- Instrumentation calibration and/or validation.
- Data sharing and the potential for joint or multilateral science investigator teams.

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Lunar Capabilities Roadmap



- **Lunar Capabilities Roadmap**

- George Kramer and David Lawrence co-chairs.
- Draft report is close to being completed – watch the web site.

A Lunar Capabilities Roadmap (LCR) is required to highlight what capabilities are critical in the initial stages of the return to the Moon, which in turn requires identification of initial technological investments that need to be made. Such investments will support not only the Lunar Exploration Roadmap, but also the Global Exploration Roadmap (GER) developed by the International Space Exploration Coordination Group (ISECG), and the LEAG LER implementation document.

LEAG Annual Meeting

LEAG Annual Meeting 10-12 October 2017
USRA HQ, Columbia, MD.

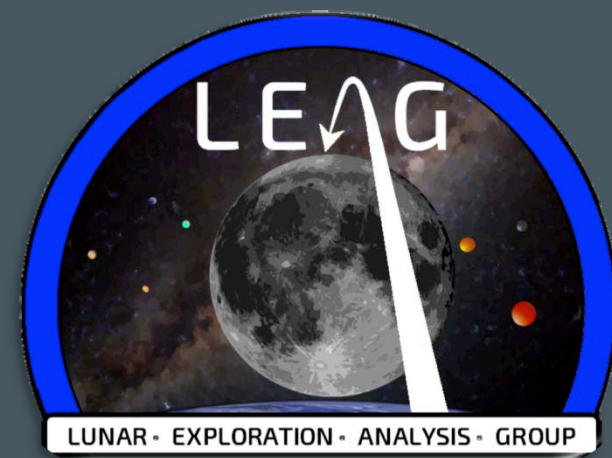
<https://www.hou.usra.edu/meetings/leag2017/>

Theme: **Science Enabled by Getting to the Surface**

Meeting Goals:

- Explore science-exploration-commercial synergies that focus on NASA's Strategic Knowledge Gaps (SKGs) and lunar resources.
- Facilitate the establishment of public-private partnerships for lunar exploration including humans to the surface of the Moon.
- Provide a forum for community updates and input into the issues that affect lunar science and exploration.

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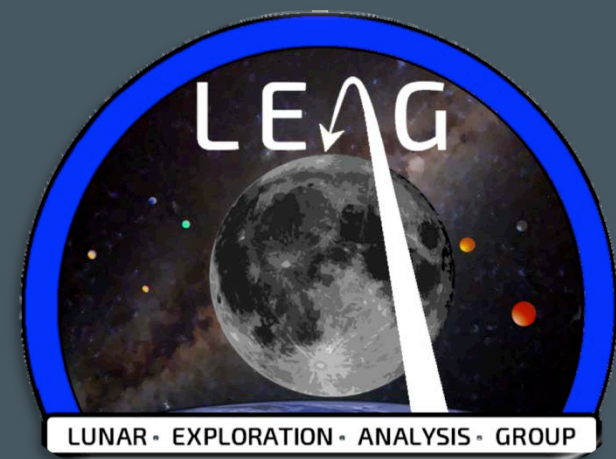




EARLY CAREER FOLKS!
APPLY FOR THE 2017 LUNAR EXPLORATION ANALYSIS GROUP
BERNARD RAY HAWKE
NEXT LUNAR GENERATION CAREER DEVELOPMENT AWARD

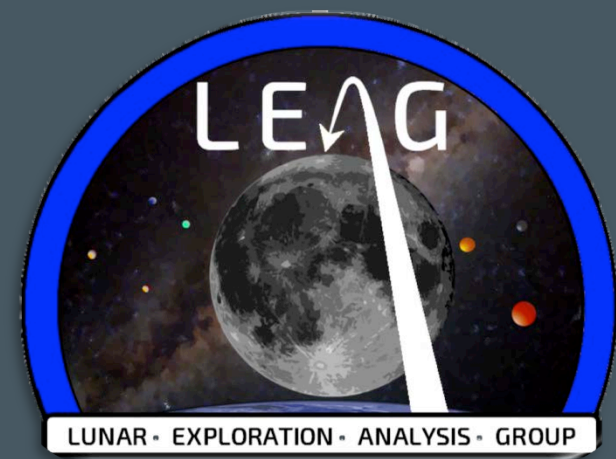


Landing Site Selection Workshop – Jan 2018



- SSERVI-LEAG Community Workshop.
- A set of scientifically prioritized lunar surface targets, representing a broad community consensus, is needed to take advantage of the emerging commercial opportunities for getting to the lunar surface.
- Targets should include both in-situ analysis and sample return (beyond SPA Sample Return now under competition in NF-4).
- This workshop is intended to come up with this prioritized list.
- Greg Schmidt & Clive Neal co-chairs. Stand-by for more details.....

Lunar Data Analysis Program (L-DAP)



- **Step 1:** 31 August 2017
- **Step 2:** 8 November 2017
- The Lunar Data Analysis Program (LDAP) program funds research on the analysis of recent lunar missions in order to enhance their scientific return.
- LDAP broadens scientific participation in the analysis of mission data sets and funds high-priority areas of research that support planning for future lunar missions.

LPSC 49

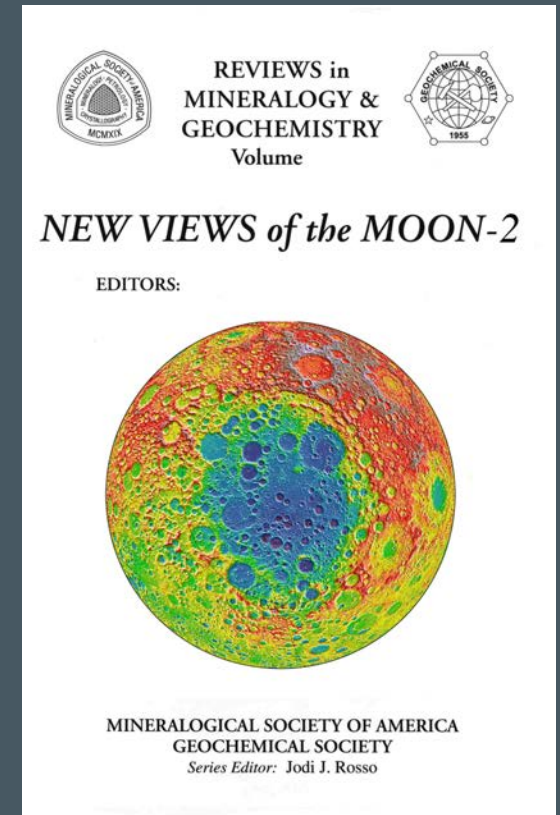
- Sam Lawrence – becomes LEAG Chair
- Reconstituted Executive Committee
- A new era of opportunity for the lunar community!



New Views of the Moon 2 - Asia



- Third and final workshop in the New Views of the Moon-2 series.
- Focused on "What's Next?"
- Hosted by JAXA in Tokyo, Japan.
- April, 2018 – exact dates TBD.
- Travel grants will be available.





“PROGRESS

is not a shot in the dark,

but a series of LOGICAL STEPS.”

-Robert H. Goddard

The Future of Lunar Exploration
Depends
on
YOU!

FOLLOW the ROADMAP

<http://bit.ly/2kRrN9m>