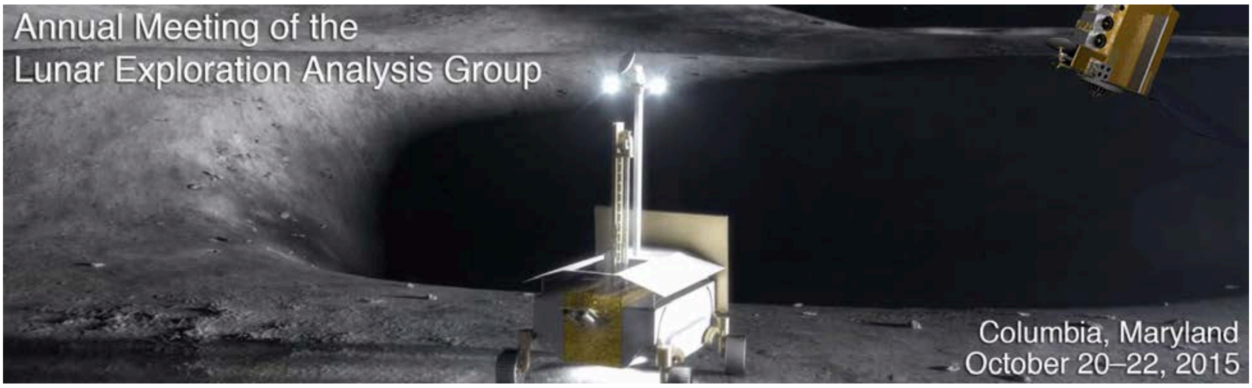

Annual Meeting of the Lunar Exploration Analysis Group

October 20 – 22, 2015
Meeting Program

LPI Contribution No. 1863

LUNAR AND PLANETARY INSTITUTE

USRA

Annual Meeting of the Lunar Exploration Analysis Group

October 20 – 22, 2015 • Columbia, Maryland • USRA Headquarters

Institutional Support

NASA Lunar Exploration Analysis Group (LEAG)

Universities Space Research Association (USRA)

Lunar and Planetary Institute (LPI)

NASA Solar System Exploration Research Virtual Institute (SSERVI)

National Aeronautics and Space Administration (NASA)

Science Organizing Committee

James Carpenter, *ESA-ESTEC*

Jasper Halekas, *University California Berkeley*

Samuel Lawrence, *Arizona State University (Program Chair)*

Stephen Mackwell, *Lunar and Planetary Institute (Convener)*

Clive Neal, *University of Notre Dame (Convener)*

Noah Petro, *NASA Goddard Space Flight Center*

Jeffrey Plescia, *Johns Hopkins University/Applied Physics Laboratory*

Bob Richards, *NASA Ames/Moon Express*

Greg Schmidt, *NASA Ames Research Center*

Charles Shearer, *University of New Mexico*

Student Travel Awards Provided By:

Recipients

Sergio Cordova, *The University of Texas at El Paso*

Julie D. Stopar, *Arizona State University, Tempe*

Carolyn Crow, *University of California, Los Angeles*

Lunar and Planetary Institute 3600 Bay Area Boulevard Houston TX 77058-1113
LPI Contribution No. 1863

Technical Guide to Sessions

Tuesday, October 20, 2015

8:30 a.m.	USRA Conference Center	Community Updates
1:30 p.m.	USRA Conference Center	Current and Recent Mission Updates and Strategies for Future Lunar Exploration and Science

Wednesday, October 21, 2015

8:30 a.m.	USRA Conference Center	A Volatile Moon
1:30 p.m.	USRA Conference Center	Resource Longevity and Prospecting
5:00 p.m.	USRA Education Gallery	Poster Session

Thursday, October 22, 2015

8:30 a.m.	USRA Conference Center	In Situ Resource Utilization
11:00 a.m.	USRA Conference Center	A Dynamic Moon I
1:30 p.m.	USRA Conference Center	A Dynamic Moon II
2:55 p.m.	USRA Conference Center	Advanced Concepts
4:25 p.m.	USRA Conference Center	Meeting Wrap-Up

Abstracts for this meeting are available in electronic format via the workshop website at www.hou.usra.edu/meetings/leag2015/ and can be cited as Author A. B. and Author C. D. (2015) Title of abstract. In *Annual Meeting of the Lunar Exploration Analysis Group,* Abstract #XXXX. LPI Contribution No. 1863, Lunar and Planetary Institute, Houston.

Program

Tuesday, October 20, 2015
COMMUNITY UPDATES
8:30 a.m. USRA Conference Center

Providing the lunar community with updates from NASA and LEAG,
as well as other relevant entities and events.

Chairs: **Clive Neal**
Sam Lawrence

8:30 a.m. Neal C. R. *
Welcome and Logistics

8:35 a.m. Neal C. R. *
LEAG Update

8:50 a.m. Green J. G. *
Planetary Science Division Update

9:10 a.m. Gerstenmaier W. *
HEOMD Update

9:30 a.m. Crusan J *
Advanced Exploration Systems Update

9:50 a.m. Rall J. *
NAC Structure and the Role of the Analysis/Assessment Groups

10:05 a.m. Bussey D. B. J. *
ISECG White Paper and White Paper Community Input

10:30 a.m. Lee T. S. * Chang B. C. Shin H. Lee J. Lee J.
Vision and Plan for Korea Lunar Resource Prospecting **[#2069]**
Korea successfully launched its first space rocket in 2013. This achievement has promoted Korea Space Program including Korean Lunar Exploration Program. And now Korea has a vision and plan for Korea Lunar Resource Prospecting.

10:45 a.m. Carpenter J. D. * Houdou B. Huffenbach B. Fisackerly R. Landgraf M. De Rosa D. Schiemann J. Patti B.
Exploring the Moon Together: ESA's Plans for Lunar Exploration Through International Cooperation **[#2026]**
An update on ESA's current lunar exploration activities and plans for future lunar exploration through international partnerships.

11:00 a.m. Landgraf M. * Carpenter J. Sawada H.
HERACLES Concept - An International Lunar Exploration Study **[#2039]**
HERACLES is an ESA-led architecture study by various agency members of the ISECG to define an end-to-end scenario of human-robotic lunar exploration. The architecture has the objective to prepare human missions and to perform science.

11:15 a.m. Abbud-Madrid A. * Gertsch L. S. Boucher D.
The Space Resources Roundtable: Past, Present, and Future Activities of an Organization Focused on Space Resources Utilization **[#2076]**
This presentation will address the important role that the Space Resources Roundtable (SRR) plays on all issues related to the In-Situ Resource Utilization (ISRU) of lunar, asteroidal, and martian resources.

11:30 a.m. Ostrach L. R. * Robbins S. J. Anderson F. S. Barlow N. G. Head J. W. Plescia J. B. Crater Workshop Participants
Report on the Workshop on Issues in Crater Studies and the Dating of Planetary Surfaces: Significance to Lunar Investigations **[#2042]**
The Workshop on Issues in Crater Studies and the Dating of Planetary Surfaces was held 19–22 May 2015 at JHU-APL. Here, we present key findings and recommendations from this Workshop to LEAG and the greater science and crater counting community.

11:45 a.m. Clegg-Watkins R. N. * Valencia S. N. Runyon K.
Bridging the Lunar Generation Gap: NextGen and LEAG **[#2017]**
The Next Generation Lunar Scientists and Engineers seek to create collaborations with the Lunar Exploration Analysis Group that will help the younger generation prepare to become the leaders in lunar science and exploration.

Tuesday, October 20, 2015
CURRENT AND RECENT MISSION UPDATES AND STRATEGIES FOR FUTURE LUNAR EXPLORATION AND SCIENCE
1:30 p.m. USRA Conference Center

Status of current and recent lunar missions will be presented along with strategies for future lunar exploration and science.

Chairs: **Noah Petro**
Mark Robinson

1:30 p.m. Elphic R. *
LADEE Results: Implications for Exploration and Sciences **[#2083]**
The LADEE mission gathered information on the Moon's tenuous gas and dust exosphere, with some surprising results. The solar wind and meteoroid streams play a role in sustaining both.

1:45 p.m. Poppe A. R. * Halekas J. S. Fatemi S. Delory G. T.
ARTEMIS' Perspective on a Dynamic Moon **[#2032]**
We report on the dynamic nature of lunar-plasma interactions using recent observations by the twin-probe ARTEMIS spacecraft.

2:00 p.m. Petro N. E. * Keller J. W.
The Lunar Reconnaissance Orbiter: Revolutionizing Our Understanding of the Dynamics of Planets and the Role of Volatiles in the Solar System **[#2062]**
LRO is producing a dataset unrivaled in planetary science. With an increasing baseline of measurements, LRO data has revealed the Moon's surface and environment to be dynamic. The LRO dataset has value in forming how we understand the solar system.

2:15 p.m. Keller J. W. * Petro N. E.
Future Exploration of the Moon Enabled by the Lunar Reconnaissance Orbiter **[#2080]**
LRO data is a resource for planning missions to the Moon, including locating landing sites, resources, and planning of traverses. We will discuss this and future targeting of areas of exploration.

2:30 p.m. DISCUSSION

3:00 p.m. Spudis P. D. *
A Robotic Prospecting Architecture for the Moon **[#2022]**
A variety of robotic missions are needed to characterize the deposits and environment of the lunar poles prior to resource exploitation. I describe a sequence of missions, measurements, and instruments to obtain this critical strategic information.

3:15 p.m. Robinson M. S. *
A Focused Path to Extend Human Presence Beyond Low Earth Orbit **[#2082]**
Developing a sustainable long-term architecture to move humans out of low Earth orbit and into the solar system requires a focused path built around a series of achievable objectives within a structured time frame.

3:30 p.m. Plescia J. B. * Schmitt H. H.
The Moon's Role in Human Exploration of the Solar System **[#2043]**
Cislunar space and the surface provide the chance to conduct space science and allows us to test systems and operations prior to deep space missions, to extract resources, and to demonstrate U.S. national interest and serve as a source of inspiration.

3:45 p.m. Gruener J. E. * Suzuki N. H. Carpenter J. D.
International Coordination of Lunar Polar Volatiles Exploration **[#2033]**
The International Space Exploration Coordination Group (ISECG) has established a study team to coordinate the worldwide interest in lunar polar volatiles, and in particular water ice, in an effort to stimulate cooperation and collaboration.

4:00 p.m. Kelso R. M. *
MoonRIDERS: NASA and Hawaii's Lunar Surface Flight Experiment for Late 2016 **[#2001]**
This briefing will update the MoonRIDERS lunar surface flight experiment project between NASA-KSC, PISCES, and two Hawaii high schools investigating critical lunar dust-removal technologies. Launch planned in early 2017 on GLXP mission.

4:15 p.m. Beldavs V. Z. Dunlop D. * Crisafulli J. Foing B.
The International Lunar Decade — 2017–2029: Framework for Concurrent Development of Enabling Technologies, Infrastructures, Financings, and Policies for Lunar Development **[#2055]**
The International Lunar Decade (ILD) planned for launch in 2017 provides a framework for long-term international collaboration in the development of technologies, infrastructures, and financing mechanisms for lunar development.

4:30 p.m. DISCUSSION

Wednesday, October 21, 2015
A VOLATILE MOON
8:30 a.m. USRA Conference Center

Mapping of and variations in lunar volatile deposits, plus future missions defining such deposits for use of In Situ Resources to further exploration.

Chairs: **Dana Hurley**
James Carpenter

8:30 a.m. Hardgrove C. * Bell. J. Thangavelautham J. Klesh A. Starr R. Colaprete T. Robinson M. Drake D. Johnson E. Christian J. Genova A. Dunham D. Williams B. Nelson D. Babuscia A. Scowen P. Cheung K. M. McKinney T. Taits A. Hernandez V. Wren P. Thoesen A. Godber A. Beasley M.
The Lunar Polar Hydrogen Mapper (LunaH-Map) Mission: Mapping Hydrogen Distributions in Permanently Shadowed Regions of the Moon's South Pole **[#2035]**
LunaH-Map is a 6U CubeSat that will carry two neutron spectrometers and produce high spatial resolution maps of near-surface hydrogen (H) within PSRs at the lunar South Pole. LunaH-Map will map H at <10km/pixel to place constraints on H distributions.

8:45 a.m. Clark P. E. * Malphrus B. Reuter D. MacDowall R. Folta D. Mandell A. Brambora C. Patel D. Farrell W. Petro N. Banks S. Hohman K. Hruby V.
The Lunar Ice Cube Mission **[#2025]**
Lunar Ice Cube, a science requirements-driven deep space exploration 6U CubeSat mission, has just been selected for the NASA NextSTEP slot on the EM1 launch.

9:00 a.m. Cohen B. A. * Hayne P. O. Greenhagen B. T. Paige D. A.
Lunar Flashlight: Exploration and Science at the Moon with a 6U CubeSat **[#2008]**
The Lunar Flashlight mission, manifested on the SLS EM-1 flight scheduled for 2018, will illuminate permanently shadowed regions at the lunar south pole to measure the abundance and distribution of surface water ice for human resource utilization.

9:15 a.m. Archinal B. * Lee E. Weller L. Richie J. Edmundson K. Laura J. Robinson M. Speyerer E. Boyd A. Bowman-Cisneros E. Wagner R. Nefian A.
Update on High-Resolution Geodetically Controlled LROC Polar Mosaics **[#2040]**
We describe progress on high-resolution (1 m/pixel) geodetically controlled LROC mosaics of the lunar poles, which can be used for locating illumination resources (for solar power or cold traps) or landing site and surface operations planning.

9:30 a.m. Mazarico E. * Nicholas J. B.
Illumination Modeling of the Lunar Poles, and Its Benefits to Exploration and Science Investigations **[#2041]**
The modeling of illumination conditions from a topographic model is an important tool for exploration planning and for scientific understanding of volatile distribution. We present results for the lunar poles, and discuss new uses of such models.

9:45 a.m. Colaprete A. * Shirley M. Heldmann J. Wooden D. H.
The Final Minute: Results from the LCROSS Solar Viewing NIR Spectrometer **[#2051]**
This paper summarizes new results from the LCROSS solar viewing spectrometer which indicated water ice and vapor present over the impact site four minutes after impact.

10:00 a.m. McClanahan T. P. * LEND Team Parsons A. M. Williams J. P. Mazarico E.
Diurnally Varying Hydrogen Volatiles or Regolith Temperature? Mare and Highlands Studies of the Moon's Diurnally Modulating Epithermal Neutron Flux Using LRO's LEND, Diviner, and LOLA Instruments **[#2073]**
In this study we seek to discriminate the source of variation that is diurnally modulating the Moon's neutron emission flux. We characterize the neutron emission flux from the topography in the northern mare and highlands regions.

10:15 a.m. Hayne P. O. *
New and Evolving Views of the Moon's Volatiles from the Lunar Reconnaissance Orbiter **[#2068]**
We present results from all seven LRO investigations, and discuss attempts to synthesize the disparate information to create a self-consistent model for lunar volatiles.

10:30 a.m. Stickle A. M. * Hurley D. M. Patterson G. W. Cahill J. T. S. Retherford K. D. Gladstone G. R. Greathouse T. K. Mandt K. E. Hendrix A. R. Egan A. Kaufmann D. Pryor W. Feldman P. Stern A.
Comparisons of LRO LAMP and Mini-RF Datasets Within Anomalous Polar Craters **[#2065]**
LAMP, Mini-RF/Craters at the lunar poles/Is there water ice?

10:45 a.m. Hibbitts C. A. *
Measurements to Understand the Origin and Evolution of Hydroxyl and Water on the Illuminated Moon **[#2067]**
Infrared spectral imaging of the illuminated Moon over 2.6 to 3.6 microns enable us to more fully understand the sources, sinks, and evolution of water on the Moon.

11:00 a.m. Benna M. * Hurley D. M. Stubbs T. J. Mahaffy P. R. Elphic R. C.
Observations of Meteoroidal Water in the Lunar Exosphere by the LADEE NMS Instrument **[#2059]**
The NMS instrument has detected signatures of water group neutrals in the exosphere of the Moon as sporadic, short-lived signal increases above instrument background (spikes).

11:15 a.m. Hurley D. M. * Cook J. C. Retherford K. D. Greathouse T. K. Gladstone G. R. Mandt K. Grava C. Kaufmann D. Hendrix A. R. Feldman P. D. Pryor W. Stickle A. Cahill J. Killen R. M. Stern S. A.
Contributions of Solar Wind and Micrometeoroids to the Inventory of H_2 in the Moon's Exosphere **[#2061]**
LAMP observations of H_2 in the Moon's exosphere link the solar wind as a source of H and micrometeoroid release of implanted H as H_2.

11:30 a.m. DISCUSSION

Wednesday, October 21, 2015
RESOURCE LONGEVITY AND PROSPECTING
1:30 p.m. USRA Conference Center

Upcoming lunar missions/concepts/instrumentation for resource prospecting are presented along with implication for volatile deposit longevity.

Chairs: **Jerry Sanders**
John Gruener

1:30 p.m. Colaprete A. * Elphic R. C. Andrews D. Sanders G. McGovern A. Vaughn R. Heldmann J. Trimble J.
Resource Prospector: Mission Goals, Relevance, and Site Selection **[#2050]**
The talk will review the Resource Prospector goals, relevance, and current status of site selection.

1:45 p.m. Andrews D. * Colaprete A. Quinn J. Bluethmann B. Chavers G. Trimble J.
Resource Prospector: Mission Overview and Current Activities **[#2053]**
This abstract will provide an overview and current status of the Resource Prospector mission.

2:00 p.m. McGovern J. A. * Colaprete A. Bussey D. B. Stickle A.
Resource Prospector: A Landing Site Survey **[#2079]**
This work describes a process used on RP to search for landing sites near the lunar poles with access to: evidence of surface/subsurface volatiles, reasonable terrain for traverse, direct to Earth communications, and sunlight for power.

2:15 p.m. Quinn J. Smith J. * Captain J. Paz A. Colaprete A. Elphic R. Zacny K.
Resource Prospector: The RESOLVE Payload **[#2046]**
NASA has been developing a lunar volatiles exploration payload named RESOLVE. Now the primary science payload on-board the Resource Prospector (RP) mission, RESOLVE, consists of several instruments that evaluate lunar volatiles.

2:30 p.m. Elphic R. C. * Colaprete A. Heldmann J. L. Deans M. C.
Field Testing Near-IR and Neutron Spectrometer Prospecting: Applications to Resource Prospector on the Moon **[#2045]**
The Resource Prospector payload includes a near-infrared spectrometer and neutron spectrometer for surficial and near-surface volatile prospecting. Here we describe results from a field test in the Mojave Desert using the two instruments.

2:45 p.m. Teodoro L. F. A. * Elphic R. C. Colaprete A. Roush T. Kleinhenz J. E.
Molecular Diffusion of H_2O in Lunar Regolith During Lunar Resources Prospector Mission Sample Acquisition **[#2058]**
In the context of NASA's Resource Prospector (RP) mission to the lunar poles, we study 3-D models of volatile transport in lunar regolith.

3:00 p.m. Zacny K. * Paulsen G. Quinn J. Smith J. Kleinhenz J.
Lunar Resource Prospector Drill **[#2006]**
We report on development and testing of a 1 m class drill for capture and transfer of volatiles-rich sample onboard the Resource Prospector rover.

3:15 p.m. Heldmann J. L. * Colaprete A. C. Elphic R. C. Bussey B. McGovern A. Beyer R. Lees D. Deans M. C. Otten N. Jones H. Wettergreen D.
Rover Traverse Planning to Support a Lunar Polar Volatiles Mission **[#2007]**
We present notional traverse plans for NASA's Resource Prospector mission for a lunar polar rover and utilize this mission architecture and associated constraints to evaluate whether a suitable landing site exists to support an RP flight mission.

3:30 p.m. Carpenter J. D. * Fisackerly R. Aziz S. Houdou B.
Exploring Cold Trapped Volatiles from Stationary Landers and Mobile Rovers: ESA Activities for Resource Prospecting at the Poles **[#2027]**
An overview of ESA activities in the area of measuring cold trapped volatiles in-situ, including the PROSPECT package for the Russian Luna-27 mission and the development of mobile platform capabilities that could be applied to future missions.

3:45 p.m. Visscher P. * Edmundson P. Ghafoor N. Jones H. Kleinhenz J. Picard M.
Lunar Rover Drivetrain Development to TRL-6 **[#2009]**
The LRPDP and SPRP rovers are designed to provide high mobility and robustness in a lunar working environment and are compatible with various lunar surface activities. TRL-6 testing is scheduled for late 2015 on the rover drivetrain components.

4:00 p.m. Jordan A. P. * Wilson J. K. Stubbs T. J. Schwadron N. A. Spence H. E. Izenberg N. R.
Implications of Dielectric Breakdown Weathering for the Lunar Polar Regolith **[#2011]**
Dielectric breakdown weathering may significantly affect lunar regolith in permanently shadowed regions. We estimate how it may evolve the distribution of grain sizes and properties, which could have operational implications for rovers.

4:15 p.m. Chin G. * Sagdeev R. Su J. J. Murray J.
Probing Planetary Bodies for the Structure of Subsurface Volatiles: Geant4 Models of Fast, Epithermal, and Thermal Neutron Emission of Varying Stratigraphy of Water Bearing Regoliths **[#2023]**
Varying ratios of thermal versus epithermal neutron emissions are diagnostics of the depth in which hydrogen/water layers are buried within the top 1-2 meters of the regolith.

4:30 p.m. DISCUSSION

Wednesday, October 21, 2015
POSTER SESSION
5:00 p.m. Education Gallery

Farrell W. M. Killen R. M. Delory G. T. Bleacher L. V. SSERVI DREAM2 Team
DREAM2 at 2 Years **[#2038]**
Summary of the SSERVI DREAM2 team results that apply to resource prospecting and dynamics at the Moon and other airless bodies.

Clark P. E. Himwich Z. M. Natarajan A. M. Vo H. N.
Science Payloads and Advanced Concepts for Exploration (SPACE) Tool **[#2010]**
We have developed an online CubeSat design tool, geared towards deep space exploration based on a specific mission requirement. With the development of this tool, we hope to move towards a standardization of the CubeSat paradigm.

Estrada J. J.
The ELASCA Project: A Proposed Lunar Analog Construction Simulation **[#2030]**
Presentation of the ELASCA Project: A lunar analog construction simulation designed to test, research, and develop strategies for overcoming the logistical challenges of building on the Moon.

Mardon C. Mardon A. A. Fawcett B. G.
The Use of Side-Looking Airborne Radar in the Discovery of Meteorites in the Antarctic **[#2024]**
An examination of the various historical uses of radar in locating Antarctic meteorites and suggestions about potential future uses.

Gaddis L. R. Hare T. Lawrence S. Stopar J. Skinner J. Hagerty J.
A New Era of Exploration of Lunar Alphonsus Crater **[#2056]**
This is a summary of new remote sensing data that supports in-situ exploration of pyroclastic deposits in Alphonsus crater.

Nagihara S. Nakamura Y. Taylor P. T. Williams D. R.
Restoration of 1975 Apollo Heat Flow Experiment Thermocouple Data from the Original ALSEP Archival Tapes **[#2019]**
Data from the only in-situ measurements of lunar heat flow were not fully processed at the conclusion of the Apollo program. This study attempts to restore the previously unprocessed portion of the data from the original ALSEP archival data tapes.

Dunlop. D. Holder. K.
An Evolved International Lunar Decade Global Exploration Roadmap **[#2016]**
An Evolved Global Exploration Roadmap (GER) reflecting a proposed International Lunar Decade is presented by an NSS chapter to address many of the omissions and new prospective commercial mission developments since the 2013 edition of the ISECG GER.

Neumann G. A. LRO and GRAIL Teams
The Size of Lunar Impact Basins Determined by Gravity and Topography Data **[#2071]**
The identification and scale of lunar basins is reassessed in the light of the topography and gravity from the Lunar Reconnaissance Orbiter and GRAIL missions.

Peplowski P. N. Beck A. W. Lawrence D. J.
Distribution of Plagioclase-Rich Materials in the Lunar Highlands as Inferred from Lunar Prospector Thermal Neutron Measurements **[#2054]**
We calibrate Lunar Prospector neutron data in terms of bulk composition, and infer the distribution of plagioclase in the feldspathic highlands terrane. Results are consistent with locations of PAN, and support complex crustal formation processes.

Stopar J. D. Robinson M. S. Denevi B. W. Lawrence S. J.
LROC NAC Photometry: Preliminary Results and Relative Reflectance of Small Impact Melt Deposits **[#2063]**
LROC NAC photometry suggests that the low-reflectance deposits (often interpreted as impact melt) at many small, fresh craters may simply be low in reflectance relative the continuous ejecta and are similar in reflectance to more distal materials.

Zimmerman M. I. Farrell W. M. Poppe A. R.
Micromagnetosphere Formation on the Moon **[#2049]**
Kinetic simulations of the solar wind's interaction with lunar crustal magnetic fields reveal formation of micromagnetospheres where ions are deflected by strong electric fields. Future missions should measure magnetic field structure at the ground.

Wilson J. K. Schwadron N. Spence H. E. Jordan A. P. Looper M. D. Townsend L. W.
Shallow Lunar Hydrogen and Forward-Scattered Albedo Protons **[#2064]**
The CRaTER instrument on LRO has tentatively identified a thin layer of hydrogen in the lunar regolith, and is conducting a separate series of tests to verify the discovery.

Eppler D. B.
Yet Another Lunar Surface Geologic Exploration Architecture Concept (what, again?): A Senior Field Geologist's View **[#2028]**
Lunar geological exploration should be founded on key elements that form an integrated operational concept, including mission class, crew makeup and training, surface mobility assets, and field tools and IT assets.

Eubanks T. M. Maccone C. Radley C. F.
Lunar Farside Radio Astronomy Base Facilitated by Lunar Elevator **[#2014]**
Dr. JD-Wörner, DG of ESA intends to align ESA to develop a "Moon Village" on the far side for radio astronomy and other purposes. This would encourage new infrastructure reducing transport costs. A lunar lift greatly facilitates this vision.

Gulick S. P. S. Morgan J. V.
IODP-ICDP Expedition 364: Drilling the K-Pg Impact Structure **[#2084]**
Scientific drilling of the Chicxulub impact structure is scheduled for April 2016. A 1500-m hole (Chicx-03A) will be drilled offshore that will penetrate the crater's peak ring.

Thursday, October 22, 2015
IN SITU RESOURCE UTILIZATION
8:30 a.m. USRA Conference Center

In Situ Resource Utilization is one of the key factors to a sustainable human spaceflight program. Concepts are presented, including the economic implications of ISRU.

Chairs: **Kurt Klaus**
Rob Kelso

8:30 a.m. Taylor L. A. *
Status of Lunar Regolith Simulants — An Update **[#2012]**
LEAG-CAPTEM Simulant Working Group performed a study of lunar simulants in 2010 at the instruction of NASA-NAC. However, it was lost in the gray literature. Improper simulants continue. A proposal will be put forth for a remedy to this enigma.

8:45 a.m. Miller C. E. * Wilhite A. Kelso R. Cheuvront D. McCurdy H.
Economic and Technical Assessment of an Evolvable Lunar Architecture Leveraging Commercial Partnership **[#2005]**
PI will present results of NASA-funded economic assessment of an evolvable lunar architecture that leverages commercial partnership. Analysis suggests that a lunar industrial base to mine propellant can be established within NASA's existing budget.

9:00 a.m. Cordova S. * Delgado A. Shafirovich E.
Fabrication of Construction Materials from Lunar and Martian Regolith Using Thermite Reactions with Magnesium **[#2029]**
The paper summarizes the results of studies on combustion of lunar and martian regolith simulants with magnesium conducted in 2010–2015 at the University of Texas at El Paso.

9:15 a.m. Kelso R. M. *
Planetary Basalt Construction of a Launch/Landing Pad – PISCES Project Update **[#2002]**
Provide a briefing on the progress of a joint project between the PISCES and NASA to develop and demonstrate technologies associated with planetary robotic construction using basalt: called "Additive Construction with Mobile Emplacement" (ACME).

9:30 a.m. Lawrence S. J. * Stopar J. D. Jolliff B. L. Speyerer E. J. Robinson M. S.
Lunar Surface Traverse and Exploration Planning: What Makes a "Good" Landing Site? **[#2074]**
As part of a campaign to determine landing site locations for science and ISRU activity, we develop a defensible morphometric envelope for landed missions using LRO data to analyze the morphometric parameters of historical lunar landing locations.

9:45 a.m. Thornton J. Huber S. Peterson K. Hendrickson D. *
Astrobotic: Commercial Service for Lunar Resource Payload Delivery **[#2066]**
This paper describes how commercial delivery is enabling access to the Moon for resource payloads. Topics addressed: impediments to resource development, commercial approaches to delivering resource payloads, and traction seen with the market.

10:00 a.m. Cowley A. * Haefner T. Beltzung J. C. Meurisse A.
Spaceship EAC – Fostering Activities Relevant to Lunar Exploration and ISRU **[#2037]**
This presentation would cover the Spaceship EAC initiative, which aims to foster activities within ESA that are relevant to future human spaceflight and lunar exploration. We present our work in the area of regolith processing to date.

10:15 a.m. West W. Heldmann M. Scull T. Samplatsky D. Gentry G. J. Duggan M. Klaus K. *
Comparative Assessment of Delivering Consumable Resources Versus In-Situ Resource Utilization for Moon and Mars Habitats Life Support Systems **[#2020]**
Life support consumables are a significant mass driver in human spacecraft and exploration surface habitats. Utilization of local resources could further reduce resupply needs. We quantify the resupply needs of habitats on the Moon and Mars.

10:30 a.m. DISCUSSION

Thursday, October 22, 2015
A DYNAMIC MOON I
11:00 a.m. USRA Conference Center

Observations from recent and current missions are presented that show the dynamic nature of our Moon.

Chairs: **Paul Hayne**
Ryan Clegg-Watkins

11:00 a.m. Patterson G. W. * Bussey D. B. J. Stickle A. M. Turner F. S. Jensen J. R. Nolan M. Yocky D. A. Wahl D. E. Mini-RF Team
Mini-RF on LRO and Arecibo Observatory Bistatic Radar Observations of the Moon **[#2060]**
Mini-RF has been operating in a bistatic architecture over an approximately 2.5 year period in an effort to understand the scattering properties of lunar terrains as a function of bistatic (phase) angle.

11:15 a.m. Speyerer E. J. * Robinson M. S. Povilaitis R. Z. Wagner R. V.
Dynamic Moon: New Impacts and Secondaries Revealed in High Resolution Temporal Imaging **[#2052]**
Using repeat LROC NAC observations under identical lighting conditions, we discovered hundreds of new, resolved impact craters and thousands of smaller primary and secondary surface changes.

11:30 a.m. Mandt K. E. * Greathouse T. K. Retherford K. D. Gladstone G. R. Jordan A. P. Lemelin M. Koeber S. D. Bowman-Cisneros E. Patterson G. W. Robinson M. Lucey P. G. Hendrix A. R. Hurley D. Stickle A. M. Pryor W.
LRO-LAMP Detection of Geologically Young Craters in Lunar South Pole Permanently Shaded Regions **[#2021]**
We present a new method for detecting fresh craters on the Moon using the LRO-LAMP and provide comparison with other LRO datasets. We also present a new method for setting an upper limit for the age of young craters detected with this method.

11:45 a.m. Mahanti P. * Robinson M. S. Thompson T. J.
Characterization of Lunar Crater Wall Slumping from Chebyshev Approximation of Lunar Crater Shapes **[#2081]**
A method for characterization of crater rim slumping from crater shapes.

Thursday, October 22, 2015
A DYNAMIC MOON II
1:30 p.m. USRA Conference Center

Chairs: **Paul Hayne**
Ryan Clegg-Watkins

1:30 p.m. Livengood T. A. * Williams D. R.
Is the Moon Really a Surface-Bounded Exosphere? **[#2070]**
It is commonly accepted that the lunar surface environment is a surface-bounded exosphere, nearly pure vacuum. Empirical support for this claim is remarkably scant and recent measurements disagree.

1:45 p.m. Sarantos M. * Killen R. McLain J.
Carbon-Bearing Volatiles: Surface Abundance Estimates from Exospheric Content Considerations **[#2048]**
This work investigates how the deposition of carbon-bearing volatiles through the exosphere is affected by topography and lunar soil type.

2:00 p.m. Chi P. J. * Wei H. Y. Farrell W. M. Halekas J. S.
Selenogenic Ion Cyclotron Waves: ARTEMIS Observations and Implications for the Lunar Exosphere **[#2047]**
The ARTEMIS spacecraft near the Moon have detected narrowband ion cyclotron waves during the lunar passes through the Earth's magnetotail. The observations suggest a possible connection to the ions escaping from the lunar exosphere.

2:15 p.m. Schwadron N. A. * Wilson J. K. Looper M. D. Jordan A. Spence H. E. Blake J. B. Case A. W. Iwata Y. Kasper J. C. Farrell W. M. Lawrence D. J. Livadiotis G. Mazur J. Petro N. Pieters C. Smith S. Townsend L. W. Zeitlin C.
Possible Albedo Proton Signature of Hydrated Lunar Surface Layer **[#2044]**
We discuss here the implications of recent LRO/CRaTER observations of the proton albedo suggesting sensitivity to a thin (1–10 cm) hydrous layer near the surface.

2:30 p.m. Spence H. E. * Schwadron N. A. Wilson J. K. Jordan A. P. Winslow R. Joyce C. Looper M. D. Case A. W. Petro N. E. Robinson M. S. Stubbs T. J. Zeitlin C. Blake J. B. Kasper J. C. Mazur J. E. Smith S. S. Townsend L. W.
Particle Radiation Environments and Their Effects at Planetary Surfaces: Lessons Learned at the Moon by LRO/CRaTER and Extension to Other Planetary Objects **[#2031]**
We examine the energetic particle ionizing radiation environments and their effects at airless planetary surfaces throughout the solar system.

Thursday, October 22, 2015
ADVANCED CONCEPTS
2:55 p.m. USRA Conference Center

Advanced lunar exploration/science concepts, including mission design and instrumentation, are presented.

Chairs: **Brad Jolliff**
Clive Neal

2:55 p.m. Zacny K. * Nagihara S. Hedlund M. Fitzgerald Z.
Percussive and Pneumatic Heat Flow Probe Developments for Lunar Landers **[#2015]**
We report results from development and testing of two approaches to heat flow probes deployment on the Moon: percussive and pneumatic.

3:10 p.m. Carroll K. A. * Hatch D. Ghent R. Stanley S. Urbancic N. Williamson M. C. Garry W. B. Talwani M.
Near-Term Lunar Surface Gravimetry Science Opportunities **[#2036]**
Three near-term mission opportunities are discussed for lunar surface gravity surveys, employing a 1 milliGal repeatability planetary surface gravimeter (VEGA). For each mission, the scientific and/or resource exploration objectives are discussed.

3:25 p.m. Fouch M. J. * Yu H. Dai L. Plescia J. B. Barnouin O. S. Garnero E. J. Schmerr N. Strohbehn K. Liang M. West J. D.
Development of a Next-Generation Microseismometer System for a Lunar Geophysical Network Mission **[#2072]**
We are developing a next-generation seismic system for deployment and operation in the lunar environment. Ongoing testing will bring the entire system to TRL 5, providing a low-risk seismic system for the Lunar Geophysical Network mission.

3:40 p.m. Jolliff B. L. * Shearer C. K. Petro N. E. Papanastassiou D. A. Liu Y. Alkalai L.
Science Rationale for South Pole-Aitken Basin Locations for Sample Return **[#2077]**
Analysis of samples from South Pole-Aitken Basin will change our understanding of the early evolution of the lunar crust, the bombardment history of the inner solar system, and the volcanic and magmatic history of the Moon.

3:55 p.m. Anderson F. S. * Draper D. Christensen P. R. Olansen J. Devolites J. Harris W. Whitaker T. J. Levine J.
Deciphering Solar System Chronology with Lunar In-situ Dating: The MARE Discovery Mission **[#2034]**
We have proposed a discovery mission called the Moon Age and Regolith Explorer (MARE) that will land southwest of the Aristarchus Plateau, providing new measurements of age and petrology, addressing major questions of lunar and solar system chronology.

4:10 p.m. MacDowall R. J. * Lazio T. J. W. Burns J. O.
Low Frequency Radio Astronomy from the Lunar Surface **[#2075]**
A low frequency lunar radio observatory is a desirable scientific investment. The stable surface offers advantages for antenna array deployment to image radio emission using aperture synthesis. A far-side array avoids terrestrial radio interference.

MEETING WRAP-UP

Discussion and summary of the meeting results.

4:25 p.m. Neal, C. *
Meeting Summary, Action Items, Findings