Lunar Exploration Analysis Group
Report to the Planetary Science Subcommittee
30 September 2016

exploration science resources commerce

LRO NAC – The Mountains of the Moon near Plaskett

LEAG Meeting 1-3 November 2016
USRA HQ, Maryland

http://www.hou.usra.edu/meetings/leag2016/

Meeting goals:

- Integrate the perspectives and interests of the different stakeholders (science, engineering, government, & private sector) to explore common goals of lunar exploration.
- Use the results of recent and ongoing missions to examine how science enables exploration and exploration enables science.
- Provide a forum for community updates and input into the issues that affect lunar science and exploration.

General Themes:

- Commercial Space Opportunities - Impact on Lunar Science and Exploration
- New Views of the Lunar Regolith
- New Lunar Mission Concepts
- Lunar Capabilities Roadmap
- Building a Moon Village

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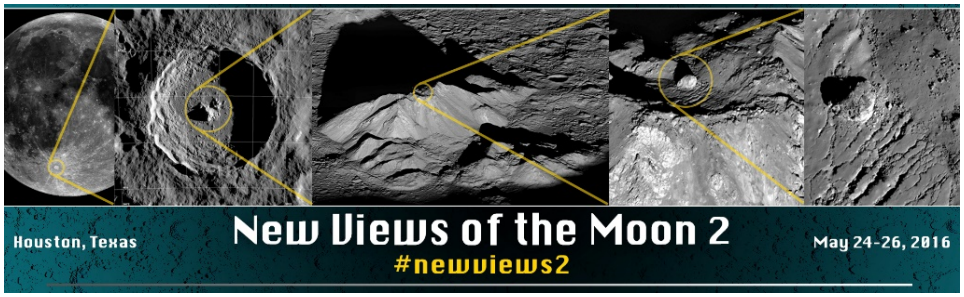
LEAG Activities 2016



- **New Views of the Moon 2 – Steering Committee:** Lisa Gaddis, Brad Jolliff, Sam Lawrence, Steve Mackwell, Clive Neal, Chip Shearer.
- Chapter co-leads identified and most have accepted;
- First workshop occurred 24-26 May 2016 @ LPI. http://www.hou.usra.edu/meetings/newviews2016/
- >120 international participants
- Requests for new chapters (3 approved by the steering committee).
- Excellent student/early career participation & thanks to SSERVI Central for providing travel stipends.
- 2017 – NVM-2 Europe, Münster, Germany
- 2018 – NVM-2 Asia, Japan.

LEAG Activities 2016 (cont.)

- **SKG-2-SAT (Review of SKG Document)**
  - Chip Shearer, Chair
  - Now available @ http://www.nasa.gov/exploration/library/skg.html
  - Comments welcomed and already received.
- **Human Exploration Proving Ground SAT**
  - Mark Jernigan and Clive Neal co-chairs;
  - On hold until early 2017.
- **LEAG Technology Roadmap**
  - Georgiana Kramer, David Lawrence co-chairs;
  - Two telecon meetings have been held and writing assignments have been issued;
  - Draft report scheduled 1st December 2016.

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Science Nuggets

LRO Special Issue Volume 1

Icarus 2016, Volume 273 (15 July)

- **28 manuscripts** covering original research on a a range of topics, including lunar volatiles, regolith properties, cratering and impacts, volcanism, and topography. Many of the analyses presented in the volume include cross-comparison of results from other missions, including ARTEMIS, LADEE, and GRAIL. Includes nearly all members of LRO science team, significant contributions from scientists outside the LRO team and strong international participation.

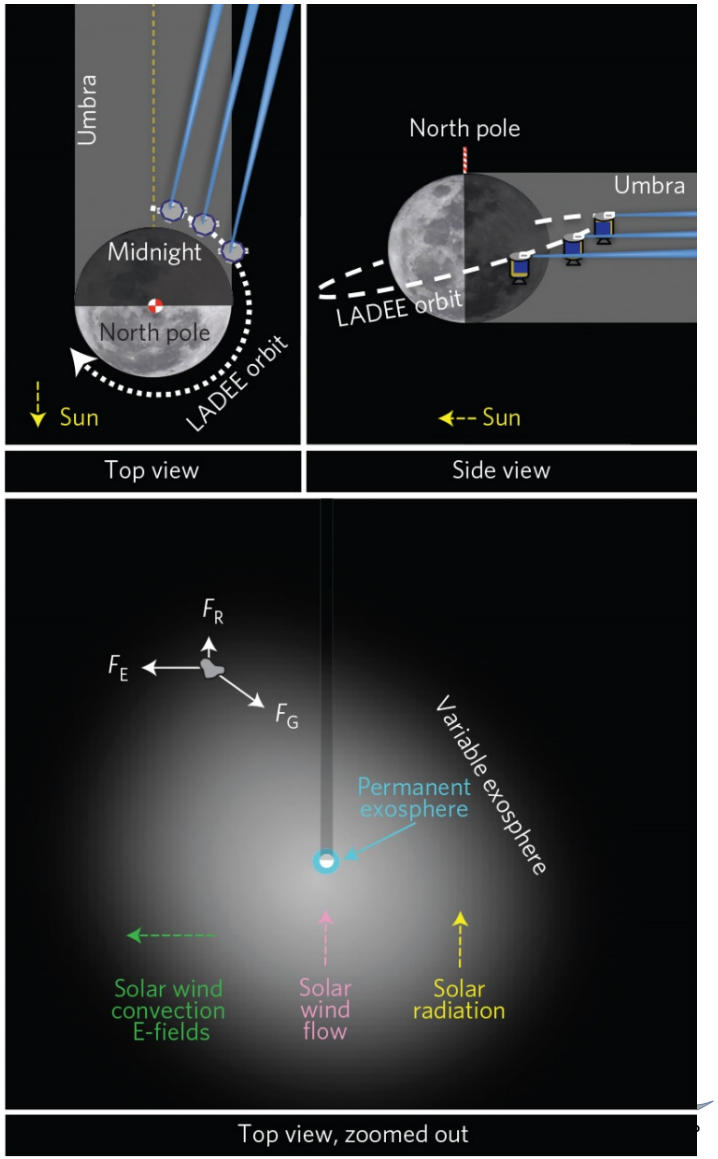
  http://www.sciencedirect.com/science/journal/00191035/273

- Stay tuned for Volume 2!
- Special PSS issue on LRO and future Exploration coming up!

Evidence for a dynamic nanodust cloud enveloping the Moon

Wooden D.H. et al. (2016) *Nature Geoscience* **9,** 665-668

- LADEE detected a permanent dust exosphere around the Moon with particles as small as 300 nm.
- LADEE also detected a fluctuating dust exosphere of smaller particles (20-30 nm).
- The spatially and temporally fluctuating dust exosphere is due to variations in the meteoroid impact rates.
- The findings suggest that similar nanodust exospheres (and the particle ejection and transport processes that form them) may occur at other airless bodies.



GRAIL, LLR, and LOLA constraints on the interior structure of the Moon

Matsuyama I., et al. (2016) *Geophysical Research Letters* **43**, 8365-8375 .

- Results do not favor the presence of a low rigidity transition layer between a liquid outer core and mantle.
- If a transition layer exists, its rigidity is constrained to $43^{+26}/_{-9}$ GPa, with a preference for the high rigidity values.
- The total (solid and liquid) core mass fraction relative to the lunar mass is constrained to $0.0098^{+0.0066}/_{-0.0094}$ and $0.0198^{+0.0026}/_{-0.0049}$ for interior structures with and without a transition layer, respectively, narrowing the range of possible giant impact formation scenarios.

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D-poor hydrogen in lunar mare basalts assimilated from lunar regolith

Treiman A.H., et al. (2016) *American Mineralogist* 101, 1596-1603

- Apatite grains in lunar mare basalts contain hydrogen that ranges in D/H ratio by more than a factor of two.
- For most of these basalts, the D/H ratios in their apatite grains decrease with measures of the host basalts' time spent at elevated temperature, specifically the Fe-Mg homogenization of their pyroxenes.
- This relationship suggests that low D/H values were acquired during thermal processing (cooling on the surface).
- This light hydrogen is likely derived from solar wind implanted into the lunar regolith (with dD from –125‰ to –800‰), and could enter basalts either by assimilation of regolith or by vapor transport from regolith heated by the flow.