LEAG Report

Planetary Sciences Subcommittee

January 26, 2011

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Chip Shearer, chair
Jeff Plescia, deputy-chair
Clive Neal, former chair
Mike Wargo, executive secretary

Summary of LEAG Activities I

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New Chair: Oct 1st, 2010 – Charles Shearer.

Annual Meeting: Sept. 14-16, 2010 Holiday Inn Capitol, Washington DC.

- How can the Moon be used as a target for Solar System Exploration, Science, Commerce, Education and Technology Development?

Annual Meeting: November, 2011 Lunar and Planetary Institute, Houston, TX.

LEAG sponsored Workshop. June 13-15, 2011, Lunar and Planetary Institute, Houston, TX.

Wet vs. Dry Moon. Exploring volatile reservoirs and implications for the evolution of the Moon.

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Summary of LEAG Activities II

Analysis:

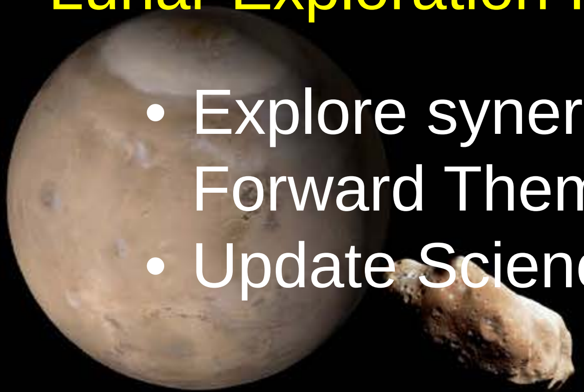
- Lunar Sample Acquisition and Curation Reviw (LSACR)
- SWG-SAT: “Report on Status of Lunar Regolith Simulants and Demand for Apollo Lunar Samples”

LEAG Town Hall Meetings:

- 42nd Lunar and Planetary Science Conference (March 9, 2011).
- Lunar Science Forum (July 2011).

Lunar Exploration Roadmap Updates:

- Explore synergies with Small Bodies in the Feed Forward Theme.
- Update Science Theme on the basis of new data.



Summary of LSACR 1

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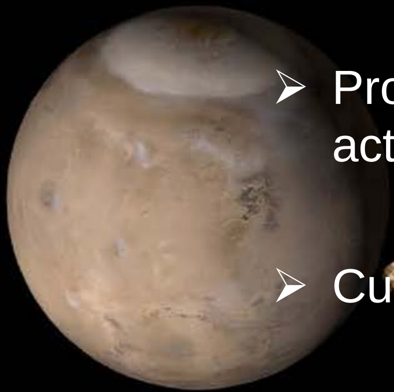
Request:

- NAC S-07-C-9 Sample Collection, Documentation, Containment and Curation.
- NRC 4R Updating Lunar Sample Collection Techniques and Curation Capabilities'.
- CAPTEM and LEAG, jointly, are requested to review lunar sample acquisition, curation and the potential distribution of samples for scientific studies, with consideration including but **not limited to the following:**

  - ➢ Impact of sample return on critical engineering requirements for human return to the Moon.
  - ➢ Protocols for sampling and curation during lunar surface activities.
  - ➢ Curation protocols and facilities on Earth.



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Summary of LSACR 2

Themes:

Part 1. Surface activities for sample acquisition and curation

Sample Acquisition Tools
Instrumentation for sample selection
Sample packaging and preservation
Sample contamination control
Sample mass and volume
Power needs
Crew training
Communication and Flight Control
Protocols for Sampling and Curation on the Moon

Part 2. Curation protocols & facilities on Earth.

Summary of LSACR 3

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Approach Part 1. Surface activities for sample acquisition and curation:

Sample Acquisition Tools

- *Lessons learned from the Apollo Program*
- *Advances since the Apollo Program*
- *Capabilities for sampling the lunar surface*
  - *Sortie missions*
  - *Outpost activities*
- *Specific engineering requirements.*
- *Analyses needed prior to establishing recommendations.*
- *Findings.*

Summary of LSACR 4

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Approach Part 2. Curation protocols & facilities on Earth:

- *Introduction*
- *Current Facilities*
- *Lessons Learned*
- *Future Needs:*
  - *Protocols*
  - *Contamination issues*
  - *Facility needs*
  - *Storage Capacity*
  - *Special Samples*
  - *Staffing and Miscellaneous*
- *Findings*

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Summary of LSACR 5

Findings Part 1:

- 56 findings.

Examples of Findings Part 1:

- Environmentally sensitive sample issues: A general use Special Environmental Sample Container should be designed based on lessons learned from their use during the Apollo Program.
- Mass-volume issues: Any mission architecture involving humans on a planetary surface should be able to accommodate a return mass of 200 to 250 kg of geological samples and sample containers.
- Contamination issues: Contamination of lunar samples has many potential sources. Therefore, there is a need to establish programmatically acceptable guidelines for general materials selection and control protocols for specific manufacturing and surface finishing processes.

Summary of LSACR 6

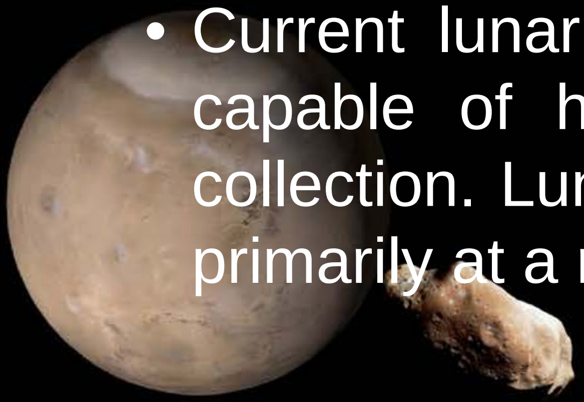
Findings Part 2:

- An additional 25 findings are tied to curation on Earth.

Examples of Findings Part 2:

- Curation needs to be involved right at the beginning of designing sample return missions. Moving the samples from landing site to JSC should follow Genesis and Stardust.

- Current lunar sample facility at JSC is unique. It is capable of handling a significantly larger dynamic collection. Lunar sample storage growth should occur primarily at a remote site (White Sands).



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Summary of LSACR 7

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Modification to Analysis:

- The purpose of the white paper was to provide sample science input into the design of the Constellation architecture.
- The “Constellation Program” was cancelled.
- However, many of the findings within this white paper are relevant to future human exploration of a planetary surface.
- Insert new preamble into the white paper.

Workshop on Lunar Volatile Reservoirs

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Workshop on Lunar Volatile Reservoirs

Conveners:

Chip Shearer (University of New Mexico)
Malcolm Rutherford (Brown University)
Greg Schmidt (NASA Ames Research Center)

Sponsors:

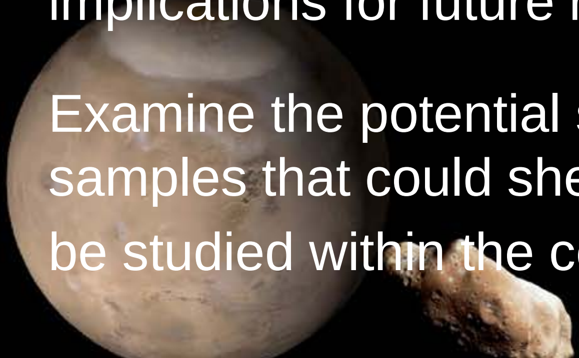
LEAG, CAPTEM, NLSI, LPI, Steckler Program.

Purpose:

Discuss and integrate mission observations, laboratory measurements, and theoretical models for the volatile behavior and reservoirs on the Moon.

The potential role of volatiles in shaping the evolution of the Moon, and implications for future robotic and human exploration of the Moon.

Examine the potential scientific importance of sealed Apollo Program samples that could shed light on these observations and how they should be studied within the context of a well thought out sample consortium.



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Workshop on Lunar Volatile Reservoirs

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Themes:

- Lunar polar volatiles: environment, distribution and behavior (Session organizers: Bussey, Spudis, Vondrak)
- Volatiles on the lunar surface (Session organizers: Pieters, King, Wooden, Bogard).
- Indigenous volatile reservoirs (Session organizers: Rutherford, McCubbin).
- Role of volatiles in fundamental lunar processes (Session organizers: Elkins-Tanton, Stolper, Rutherford).
- Future visions for the exploration and utilization of lunar volatiles (Session organizers: Shearer, Schmidt, Lofgren).

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Recommendations

Planetary Science and Exploration Subcommittee

LEAG supports the issuance of the next NLSI CAN.

Technology synergies (1) among human destinations and (2) between human and robotic missions.

Select Science Results

Nominally hydrous magmatism on the Moon. *McCubbin et al. Proc. National Acad. Sci. (2010) 107, 11223-11228. (LASER Program)*

The Chlorine Isotope Composition of the Moon and Implications for an Anhydrous Mantle. *Sharp et al. Science (2010) Vol. 329 no. 5995 pp. 1050-1053 (Cosmochemistry and LASER Programs).*

Lunar apatite with terrestrial volatile abundances. *Boyce et al. Nature (2010) 466 (7305): 466 DOI: 10.1038/nature09274 (Cosmochemistry Program).*

The variety of lithologies in the Yamato-86032 lunar meteorite: Implications for formation processes of the lunar crust. *Yamaguchi et al. Geochimica et Cosmochimica Acta (2010) 74, 4507–4530 (NLSI, Cosmochemistry Programs).*

Stochastic late accretion to the Earth, Moon, and Mars. *Bottke et al. Science (2010)330, 1527–1530 (NLSI and Cosmochemistry Programs).*

Calibrating several key lunar stratigraphic units representing 4 billion years of lunar history within Schrödinger Basin. *O'Sullivan et al. in Recent Advances in Lunar Stratigraphy (2010) Geological Society of America Special Paper (NLSI).*

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Select Science Results

Global Silicate Mineralogy of the Moon from the Diviner Lunar Radiometer. *Greenhagen et al., Science, September 17, 2010 (LRO).*

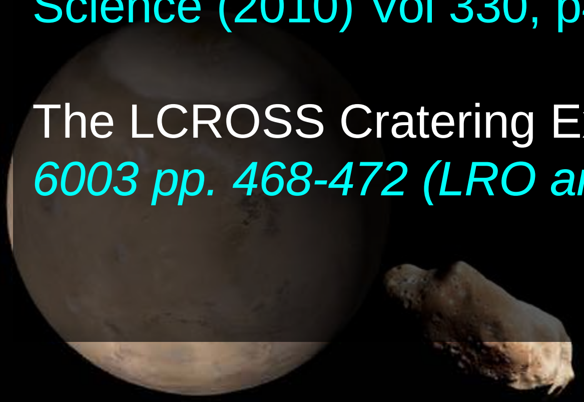
Highly Silicic Compositions on the Moon. *Glotch et al., Science, September 17, 2010 (LRO)*.

Global Distribution of Large Lunar Craters: Implications for Resurfacing and Impactor Populations. *Head et al., **Science**, September 17, 2010 (LRO).*

Diviner Lunar Radiometer Observations of Cold Traps in the Moon's South Polar Region. *Paige et al. Science (2010) Vol 330, p479-482 (LRO).*

Diviner Lunar Radiometer Observations of the LCROSS Impact. Hayne et al. Science (2010) Vol 330, p477-479 *(LRO and LCROSS).*

The LCROSS Cratering Experiment. *Schultz et al. Science (2010) Vol. 330 no. 6003 pp. 468-472 (LRO and LCROSS).*



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