

Lunar Science and Exploration: Activities of the Lunar Exploration Analysis Group (LEAG)

Steve Mackwell

LPI

G. Jeffrey Taylor

University of Hawai`i

Lunar Exploration Analysis Group

- Community based, **interdisciplinary** forum
- Analyzes scientific, engineering, technology, and operational issues associated with lunar exploration to support the Vision for Space Exploration
- Not limited to science — covers exploration activities, science, resource utilization, and commerce
- Reports findings and analysis to Exploration Systems Mission Directorate and Science Mission Directorate, through NASA Advisory Council

The Vision for Space Exploration

- “The fundamental goal of this vision is to advance U.S. scientific, security, and economic interests through a robust space exploration program.”—*Renewed Spirit of Discovery*, White House, January, 2004.
(www.whitehouse.gov/space/renewed_spirit.html)
- Goals:
 - Implement a sustained and affordable human and robotic program to explore the solar system and beyond;
 - Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
 - Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration; and
 - Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.

The Moon in the VSE

- *Renewed Spirit of Exploration*: “Use lunar exploration activities
 - to further science,
 - and to develop and test new approaches, technologies, and systems,
 - including use of lunar and other space resources,
 - to support sustained human space exploration to Mars and other destinations.”

LEAG Activities

- Workshop on Lunar Knowledge Requirements for Human Exploration, March, 2004
 - Examined state of knowledge of lunar basic and applied science
 - ORDT for LRO
- First formal meeting, January, 2005
 - Examined issues surrounding human missions:
 - Sorties vs single base
 - Role of Resource Utilization
 - Commercial involvement
 - Studied robotic measurements and experiments; set rough priorities
 - Developed list of technology demonstrations
- Specific Action Team: Nature of Second Lunar mission, March, 2005
- Specific Action Team: Science Activities and Site Selection, June-July, 2005

LEAG Activities ctd

- Co-sponsored “Space Resources Roundtable VII: LEAG Conference on Lunar Exploration”, October, 2005
- Specific Action Team: Review of Plans Developed by the RLEP 2 Measurement Team, March, 2006
- LEAG_TOP-SAT: Review of Themes and Objectives Phasing Document for Lunar Exploration Strategy, July, 2006
- LEAG_HAB-SAT: To assess the relative importance and time phasing of objectives in relation to the theme of Human Habitation of the Moon, Oct. 12-13, 2006
- LEAG_GEO-SAT: To assess the relative importance of Basic and Applied Science objectives in relation to the Science theme, Nov. 2006

Lunar Exploration Strategy Themes

Why are we going to the Moon?

Core Themes:

- Prepare for future human and robotic missions to Mars and other destinations.
- Pursue scientific activities to address fundamental questions about the solar system, the universe, and our place in them.
- Extend sustained human presence to the Moon to enable eventual settlement.

Lunar Exploration Strategy Themes

Why are we going to the Moon?

Crosscutting Themes:

- Expand Earth's economic sphere to encompass the Moon, and pursue lunar activities with direct benefits to life on Earth.
- Strengthen existing and create new global partnerships.
- Engage, inspire, and educate the public.

Lunar Exploration Strategy *Objectives*

Basic Science (Astronomy and Astrophysics; Heliophysics; Earth Observation; Lunar Geology; Environmental Characterization)

Applied Science (Lunar Resource ISRU; Materials Science)

Human Health and Biology (Human Health; Life Support and Habitation; Operations Environment Monitoring; Environmental Hazard Mitigation)

Infrastructure (Power; Communication; Guidance, Navigation and Control; Surface Mobility; Transportation; General Infrastructure; Crew Activity Support; Operations Test & Verification)

Commerce (Development of Lunar Commerce; Commercial Opportunities)

Other (Historic Preservation; Global Partnerships; Public Engagement; Program Execution)

LEAG now

- New Chair: Clive Neal
- Charter under development
- Executive Committee with broad disciplinary representation

www.lpi.usra.edu/leag

Some Near-Term Needs for Lunar Science

- Basic and applied science data analysis program for lunar missions
 - Lunar Reconnaissance Orbiter
 - Chandryaan-1
 - Selene
 - Subsequent Lunar Precursor Robotic Missions
- Supporting research and technology program for exploration and science. For example:
 - Resource utilization experiments and equipment development to flight readiness
 - Telerobotics and role of humans and robots
 - Biomedicine
 - Exploration equipment and instrument development

Additional slides

LEAG Themes and Objectives Phasing SAT

Charge:

Review themes and objectives developed by synthesis of products of Exploration Strategy Workshop, Request for Information, and other sources

- Is the list complete?
- Are there redundancies?
- Are the objectives state clearly?
- Are any themes or objectives overstated or unachievable?

LEAG HAB-SAT

- Purpose: To assess the relative importance and time phasing of objectives in relation to the theme of Human Habitation of the Moon. This will involve:
 - ranking the objectives relative to each other in connection to the human habitation theme
 - identifying the essential capabilities and requirements needed to satisfy each objective
 - identifying which objectives are best done or need to be done on robotic missions
 - identifying which objectives ought to be done on human sortie missions
 - identifying the order in which objectives should be done at a permanent outpost site in order to sustain presence and advance exploration goals