

# 2015 LEAG Meeting Findings

The attendees of the 2015 LEAG Meeting endorse the following findings:

## Lunar Reconnaissance Orbiter (LRO) [SMD-PSD, HEOMD]

**Finding.** Close collaborations and communication between PSD and HEOMD is encouraged, including exploring the funding returning Mini-RF to operation.

**Background.** LRO remains scientifically productive and is vital for the success of future lunar surface missions, such as named decadal survey science missions (South Pole-Aitken Basin Sample Return, Lunar Geophysical Network) and exploration missions (Resource Prospector). The LEAG community applauds PSDs efforts to continue to fund the LRO extended mission thus following the 2014 Senior Review and despite LRO being zeroed out in the President's budget. As shown at the 2015 LEAG meeting, the Mini-RF instrument still has much to contribute to science and exploration, especially with regard to the polar volatile story. In addition, NASA's Planetary Science Division is encouraged to endorse opportunities by targeting spacecraft that have reached end-of-life to impact the permanently shaded regions of the lunar poles in a manner similar to LCROSS, to further investigate volatile species in these areas.

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## Resource Prospector Mission [HEOMD, SMD-PSD]

**Finding 1.** The attendees of the LEAG meeting support the HEOMD Resource Prospector Mission and are excited by the progress made since the 2014 LEAG meeting. Given the international interest in getting to the Moon, continued HEOMD support is encouraged for this vital mission.

**Finding 2.** NASA's Planetary Science Mission Division (PSD) is encouraged to evaluate how the Resource Prospector Mission could address decadal survey goals, and explore avenues for lunar science community participation in this mission.

**Background.** Resource Prospector is well equipped to provide some ground truth needed to test hypotheses stemming from orbital data, but additional physical/mineral characterization instruments are recommended and further similar missions will be required to other locations.

# 2015 LEAG Meeting Findings

## Lunar Polar Volatiles [SMD-PSD, HEOMD-AES]

**Finding 1.** The LEAG community supports the selection of cubesat missions that can start to address the higher spatial resolution issue of lunar polar volatiles that will inform future rover missions to the lunar surface.

**Finding 2.** A broad understanding of the type, distribution, and distribution of lunar polar volatiles can only come from the synthesis of multiple data sets, including new observations. This synthesis should be considered in Senior Review decisions regarding LRO mission extensions, and will be significant in the formulation of future surface missions to the lunar poles.

**Background.** Recent progress has been made in understanding of the amounts, distribution, and form of volatiles in lunar polar regions. However, higher spatial resolution and ground truth are still needed in order to assess lunar polar volatiles as a resource. Cubesats have a strong potential for providing individual measurements of great value for furthering the understanding of lunar polar volatiles both for science and exploration.

# 2015 LEAG Meeting Findings

## Lunar Polar Volatiles and Their Use [SMD-PSD, HEOMD].

**Finding.** A long term and integrated approach to understanding the significance and scientific implications of polar volatiles and their potential as a strategic resource is the logical next step.

**Background.** With the potential for lunar polar volatiles to increase our understanding of volatile cycling on airless bodies and dramatically reduce the launch mass from Earth, understanding the distribution, form, composition, extractability, and use is now required. Given the important science and exploration implications polar volatiles hold, an integrated SMD/HEOMD approach is suggested. At the initiation of such an integrated approach inclusion of all stakeholders (international, government, private sector) would be essential. NASA is encouraged to formulate such an approach and the LEAG community stands ready to help in this endeavor.

# 2015 LEAG Meeting Findings

## Simulant Program [HEOMD, STMD, SMD-PSD]

**Finding.** Lunar and other extra-terrestrial materials simulants are important for both science and engineering studies and it is critical that an appropriate simulant be used (i.e., simulants are specialized and are designed only appropriate for certain studies), which has not been the case. We propose that a coordination activity be initiated that will establish an “**Extra-Terrestrial Materials Simulant Program**” that will identify and define the necessary analogs and standards for the Moon, small bodies, and Mars. This program should improve coordination between HEOMD, STMD, and SMD with regard to simulant manufacture and use. Those simulants must be appropriate for use in the various aspects of space exploration and note that, by definition, such work must include the necessary scientific and engineering expertise to define them.

**Background:** Since its beginning in 2004, the Lunar Simulant Program at MSFC has attempted to carry out its mission of over-seeing and control of the manufacture of lunar simulants. However, there has been a lack of funding and a perceived lack of efficiency and validity of the operation of this program, specifically with regards to scientific/engineering input from the planetary community. Historically all planetary materials have been stored, curated, and dispersed at Johnson Space Center, this would seem to be the logical locale for the proposed program.

# 2015 LEAG Meeting Findings

## Lunar Capabilities Roadmap (LCR) [SMD-PSD, HEOMD-AES]

**Finding.** The participants of the 2015 LEAG meeting endorse the construction of a Lunar Capabilities Roadmap by LEAG, deduced from the Lunar Exploration Roadmap, that would highlight instrumentation and technologies critical for science and exploration of the Moon and potentially beyond.

**Background.** The LCR will be a strategic and living document that could:

- Facilitate design reference mission(s) concept(s) studies;
- Identify critical capabilities for early flight testing of unproven yet critical instruments and technologies;
- Leverage from existing national and international technology roadmaps;
- Leverage innovative business models as identified in the recently released NASA-funded Evolved Lunar Architecture study;
- Identify capabilities of benefit to SMD, HEOMD, and STMD that would benefit from collaborative development.

# 2015 LEAG Meeting: CAB\* Findings

## Public-Private Partnerships [HEOMD]

**Finding.** LEAG's CAB is in unanimous agreement in its finding that the NASA Lunar CATALYST program and future public-private partnerships of its kind are worthy of support and advocacy. Such support, strategically communicated to NASA and political leaders, could open new pathways for more frequent and affordable lunar science and exploration mission opportunities. In turn, these public-private partnerships demonstrate the U.S. government's leadership and support for commercial space exploration bolstering investment potential and broadening customer base. Lunar CATALYST, in particular, builds on the progress of NASA's partnerships with the U.S. commercial space industry and has been instrumental in providing commercial partners access to key support and resources to help achieve their lunar goals.

\*CAB = LEAG Commercial Advisory Board

# 2015 LEAG Meeting CAB Findings

## Public-Private Partnerships (cont.)

**Background:** Public-private partnerships such as the Innovative Lunar Data Demonstration (ILDD) and NASA Lunar Cargo Transportation and Landing bY Soft Touchdown (Lunar CATALYST) are beneficial to the exploration of the Moon. These programs were established to accelerate development of commercial robotic landers to deliver cargo to the lunar surface. Delivery capability of this kind will address emerging demand by government and private sector customers who wish to conduct activities on the Moon. It will enable new science and exploration missions of interest to the national and international scientific and academic communities. In turn, these public-private partnerships demonstrate the U.S. government's support for commercial space exploration bolstering investment potential and broadening customer base.

# 2015 LEAG Meeting: CAB Findings

## Regulatory Risk [HEOMD]

**Finding.** LEAG's CAB is unanimous in its finding that commercial players can be enablers of science and exploration missions of interest to the global lunar science community; and that LEAG support and advocacy of enabling regulatory provisions for commercial lunar missions are in alignment with its charter and interests.

**Background.** Regulatory risk is second only to financial risk for the private space sector, and is a common denominator concern to commercial lunar companies. In particular, compliance to Article VI of the 1967 Outer Space Treaty is an important enabler to commercial lunar activity and an early determination of how the governments will comply with Article VI will accelerate imminent progress. To this end, there is need to establish regulatory frameworks that enable commercial space activity beyond Earth orbit, place minimal burden of process and oversight on companies, and remain compliant to obligations as a signatories to the 1967 Outer Space Treaty. Commercial space exploration companies are currently engaged in discussions with federal agencies in the establishment of regulatory/policy regimes that would allow the governments to license private players to conduct commercial activities beyond Earth orbit, on the Moon and on other celestial bodies.