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Principal Investigator

USRA

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Stephen J. Mackwell Director
Lunar and Planetary Institute
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EXECUTIVE SUMMARY

Overview
Over the past twelve months, the Lunar and Planetary Institute (LPI) has continued its focus on scientific excellence and service to NASA and the planetary science community around the world. During this performance period, the eight LPI staff scientists contributed to 39 peer-reviewed research papers and currently function as Principal- or Co-Investigator in 30 federal grants, with an addition 8 pending decision. Five of our scientists are engaged in current NASA missions, including the Mars Science Lander (Dr. Treiman), Grail (Drs. Kiefer and McGovern), Cassini (Dr. Schenk), Dawn (Drs. Kiefer and Schenk), and the Lunar Reconnaissance Orbiter (Dr. Spudis).

LPI also maintains its strong support of NASA’s research, outreach, and education programs. In conjunction with the NASA Johnson Space Center, LPI organized and convened the 43rd Lunar and Planetary Science Conference, the premier conference of the planetary research community, with a record breaking attendance of 1761. LPI also hosts the Center for Lunar Science and Exploration under the leadership of Dr. Kring, (PI). CLSE houses one of only seven research teams within the NASA Lunar Science Institute dedicated to advancing fundamental knowledge of the Moon in anticipation of future manned expeditions. NASA routinely calls on LPI scientists and postdocs to provide highly qualified expertise to their research proposal review panels; five staff scientists sit on NASA exploration and advisory groups. In addition, publishing houses across the globe frequently rely upon LPI researchers to act as editors and reviewers for their publications. Finally, through its K-16 educational outreach activities, its undergraduate internships and its post-doctoral support, LPI continues play a vital role in attracting, training, and nurturing the planetary science community of tomorrow.

Science Related Activities

Impacts of Research Excellence
Science productivity at LPI remained high; in addition to the 39 peer-reviewed publications cited above, LPI post-docs and visiting scientists produced an additional 8 with 4 others in press (Appendix I). Scientists and postdoctoral fellows were very active in professional meetings, with numerous oral and poster presentations (see Appendices II and III). Success at obtaining grants for scientific research from funding agencies remains high (Appendix IV), with over $2M in PI external science grants. The largest single grant other than the LPI CA is the Cooperative Agreement for the LPI-JSC node of the NASA Lunar Science Institute (the Center for Lunar Science and Exploration), which includes and serves researchers at the LPI, NASA-JSC, universities across the country, and the Texas teaching consortium.

Scientific service to the NASA and scientific community also remains strong, as demonstrated by the many activities included in Appendix V. Drs. Mackwell and Clifford assisted the NASA Science
Mission Directorate and the Human Exploration and Operations Directorate in organizing and convening the Workshop on Concepts and Approaches to Mars Exploration. And as previously noted several LPI scientists also served on NASA science analysis groups, including CAPTEM (Dr. Treiman), LEAG (Drs. Mackwell and Spudis), MEPAG (Dr. Clifford), OPAG (Dr. Schenk), and VEXAG (Drs. Kiefer, Mackwell, and Sharpton, with Drs. Mackwell and Sharpton sitting on the Executive Committee). LPI scientists also contributed to NASA’s grant review process, with service to the R&A Programs of: Planetary Geology and Geophysics (Drs. McGovern and Sharpton), Cosmochemistry (Drs. Spudis and Treiman), Mars Fundamental Research (Dr. Kiefer) Mars Data Analysis (Drs. Kiefer, McGovern, Sharpton, and Treiman), Origins, and Planetary Atmospheres, and Laboratory Analysis of Returned Samples (Dr. Treiman).

LPI scientists have been active in space science missions and proposals with NASA and space agencies from around the world. LPI scientist Paul Spudis continues to serve as Instrument PI for the Mini-SAR instrument on the Indian Space Research Organization’s Chandrayaan-1 Lunar Orbiter. Chandrayaan-1 completed a successful mission this summer generating significant new data that the instrument team is currently working to process and interpret. Dr. Spudis is also Deputy Principal Investigator for the mini-RF radar instrument on NASA’s Lunar Reconnaissance Orbiter (LRO), now returning data from the Moon. LPI scientists Walter Kiefer and Paul Schenk were selected as Participating Scientists for the Dawn spacecraft mission’s encounter with Vesta. Dr. Steve Clifford is Deputy Science Team Lead for the WISDOM VHF ground penetrating radar and the EISS HF ground penetrating radar for ESA’s 2013 ExoMars Mission rover and lander respectively. Dr. Allan Treiman is a co-Investigator for the CheMin instrument, and Dr. Laurel Kirkland is a co-Investigator for the ChemCam instrument on the Mars Science Laboratory. Dr. Treiman was also a co-Investigator on the SAGE mission proposal, a Venus atmosphere probe and Lander, which was in Phase A study but not down selected. Five LPI scientists were participants in proposals for Discovery class spacecraft missions (submitted in Sept. 2010); Drs. Mackwell and Sharpton were Principal Investigators on two such proposals, and are currently revising their science and mission plans in preparation for the 2015 Discover opportunity.

**Development and Training**

The Institute continues to emphasize development and training of the next generation of planetary scientists, at undergraduate, graduate, and post-graduate levels. The LPI supported and sponsored 15 postdoctoral fellows and two visiting scientists, who worked at LPI and at JSC. Six post-doctoral fellows have ‘graduated’ from the LPI this period, and all have found continuing work in their research areas, mostly in permanent positions.

In the past year, the LPI hosted and sponsored a total of 19 summer interns and students (Appendix VI). Twelve of these summer participants were in the LPI/JSC Summer Undergraduate Intern program. Six were graduate students in the Lunar Exploration Summer Interns program, created at the LPI to allow budding lunar scientist to work on science questions relevant to the Human Spaceflight Program (formerly Constellation Systems at JSC). One other undergraduate student worked at the LPI under support from various PI grants and external sources. While LPI arranged to sponsor a further 2 students from the Indian Institute of Science and Technology, as well as the annual symposium for all 6 of the Indian students and mentors, we were informed 2 weeks from the start of the program that approvals for the student travel had not been forthcoming. Despite this set-
back in 2012, IIST and LPI fully intend to continue the program in 2013 with a new student group. The LPI science staff has also mentored several undergraduate and graduate students, and young faculty members (Appendix VII).

LPI scientists participated in numerous Education and Public Outreach activities locally, nationally and internationally, as summarized in Appendices VIII & IX. Activities ranged across the full spectrum of target audiences and impact scales. At one end of the spectrum is development of the LPI Lunar Science and Engineering Portal, which aims to serve as the one-stop shop for scientific and engineering data relevant to lunar explorations. At the other end of the spectrum is Science Staff participation in local community events like Family Space Day at the LPI (targeted at elementary-age children, including home-schoolers).

This science staff of the LPI has been relatively stable the last year. Dr. Donald Bogard has continued to work at the LPI as a Heritage Fellow. Dr. Bogard is a distinguished and honored scientist, who worked for many years at JSC, first on the returned Apollo samples, and then on many aspects of solar system chronology. Dr. Virgil (Buck) Sharpton has returned to the LPI to focus on his research activities, after stepping down as Vice Chancellor at the University of Alaska. He was recently designated by President Obama to serve as acting chair of the US Arctic Research Commission.

Service
The LPI service organization is responsible for a variety of functions, including conference and workshop coordination, publications, scientist resources such as the library, the NASA Regional Planetary Image Facility (Appendix X), the LPI website (http://www.lpi.usra.edu/), and a range of electronic tools to enhance planetary science activities and effective communication within the planetary science community.

In 2012, the LPI meeting group organized 17 conferences and workshops for the planetary science community (Appendix XI). While many of these meetings were modest in size, a number of conferences had attendance exceeding 100 participants. This year marked the 43rd Lunar and Planetary Science Conference (LPSC), which was held for the fourth time at The Woodlands Waterway Marriott Hotel and Convention Center just north of Houston. More enhancements were added to the online Program Committee System tool, providing more flexibility and a more intuitive interface for the committee members to arrange the session schedule and construct the final meeting program. LPSC once again set new records for number of abstracts submitted (1943) and total participants (1761); the meeting included scientists from 31 countries and had a very high percentage of students participating (31%). In its fifth year, the LPI Career Development Awards attracted more than 200 applications for 20 travel stipends to help cover expenses for attending the Lunar and Planetary Science Conference. The meeting provides an invaluable opportunity for students, not only to present their own research, but also to hear and see firsthand the latest-breaking results from other researchers in their field. The winners were once again recruited to
work at the poster session and registration desk, reducing staffing costs while providing young scientists an opportunity to meet a large cross-section of the planetary science community.

The interactive Meeting Portal, designed to be a single point of access for LPI’s meeting-related services, was expanded to allow users more opportunities to access meeting information, submit abstracts, register for conferences and workshops, and participate on program committees. A tool was also added to allow meeting participants to construct a personal program schedule for larger conferences with multiple parallel technical sessions.

During this reporting period, Renée Dotson of the Meeting and Publication Services group began prepress services for the production of *Comparative Climatology on Terrestrial Planets (CCTP)*, which will be the next volume in the prestigious Space Science Series of the University of Arizona Press. *CCTP* is expected to be released in the fall of 2013. The collaborative agreement between the University of Arizona Press and the LPI serves to keep the price of these invaluable volumes affordable to graduate students and other researchers.

LPI staff completed four issues of the *Lunar and Planetary Information Bulletin*, a quarterly newsletter that provides updates to the planetary science community, educators, and the general public about the latest news from missions; resources for researchers; internship opportunities for students; scientific awards; education and public outreach events; new books, DVDs, games and other products available from a variety of publishers; tributes to recently deceased members of the scientific community, and a calendar of upcoming scientific workshops and conferences. The *Bulletin* is available on the LPI website at [http://www.lpi.usra.edu/publications/newsletters/lpib/](http://www.lpi.usra.edu/publications/newsletters/lpib/).

**Education and Public Outreach (E/PO)**

The LPI E/PO Department continues to engage teachers, students, and the public in exciting planetary science research and discoveries through its numerous programs. The E/PO team multiplies its impact by preparing and supporting educators – classroom teachers, librarians, museum staff, scientists, and parents - to engage their audiences. In the past year, over 550 K-16 faculty and more than 150 informal educators participated in LPI Earth and space science trainings. Collectively, these educators can make current science research accessible to over 80,000 children and students in their programs. To achieve broader impact and dissemination for its programs and products, the LPI E/PO Department partners with SMD missions and programs such as ARES, NAI, and NLSI, other space science organizations including SwRI, APL, PSI, and SSI, and institutions including libraries and museums. LPI also serves the Planetary Science E/PO Community by helping to coordinate and support community efforts to achieve deeper impact. Only a small portion of the education activities undertaken by the LPI E/PO team are funded by the Cooperative Agreement; the majority are funded by mission E/PO partnerships, individual EPOESS grants, other Cooperative Agreements, and grants from other federal agencies. More details of LPI’s Education and public outreach efforts are included in Appendix XII.
APPENDIX I: Peer-reviewed Publications

PUBLISHED


11. Green, R., Pieters, C., Mouroulis, P., Eastwood, M., Boardman, J., Glavich, T., Isaacson, P.,


**In Press**


**Submitted**


15. Öhman T. and Preeden U., 2012. Shock metamorphic features of quartz in Saarijärvi and


APPENDIX II: Scientific Staff - Conference Attendance and Abstracts Presented

**Bogard**


**Clifford**


Hecht, M.H., Aharonson, A., Byrne, S., Calvin, W., Clifford, S.M., Herkenhoff, K., and Titus, T., Next Steps in Mars Polar Science: In Situ Subsurface Exploration of the North Polar Layered Deposits, Workshop on Concepts and Approaches to Mars Exploration, [#4330].


Max, M.D. and Clifford, S.M., Mars Methane: An In-Situ Resource in Support of Human Exploration, Concepts and Approaches to Mars Exploration, [#4385].


**Hoogenboom**


Kiefer


*Kiefer, W.S., A Planetary Geophysicist Does EPO: Lessons Learned Along the Way, Fall AGU (abstract ED31C-08), December 2011.


**Kramer**


McGovern, P.J., Powell, K., Kramer, G.Y., and Litherland, M., Stress-enhanced magma ascent at the margins of large impact basins in the solar system. AGU Fall Meeting, December 5-9, 2011.


**McGovern**


Öhman:


Potter:


**Schenk**


Schenk, P., Two oral presentations on Ring-satellite interactions, Cassini PSG Meeting, Cagliari, Italy, June, 2012.


Schenk, P., and 21 others, The South Polar Structure on Vesta from Dawn: Using Geologic, Topographic and Compositional Mapping and Planetary Analogs to Test Origin Models, American Geophysical Union, Fall Meeting 2011, abstract #U21B-03.


**Sharpton**

Sharpton, V.L., Beyond Magellan: Why better SAR imaging of Venus is needed, International Venus Workshop, August 31-September 1, 2011.


**Spudis**


**Treiman**


**Usui**


White

White, O., Schenk, P., Mapping Io’s Surface Topography Using Voyager and Galileo Stereo Images and Photoclinometry. American Geophysical Union, Fall Meeting 2011, abstract #P41F-10

APPENDIX III: Invited Presentations

Clifford

1) Visiting Professor, Institut Pierre-Simon Laplace (IPSL) (2 months -- June/July and September/October, 2012), Orsay, France. A collaborative study of (1) planetary radar investigations of Mars analog environments and (2) the effects of climate change on the stability of ice-rich permafrost on the Earth and Mars involving three of IPSL’s member labs: Interactions et Dynamique des Environnements de Surface (IDES), Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS) and Laboratoire des Sciences du Climat et de l'Environnement (LSCE).

Kiefer


2) Kiefer, W.S., A Planetary Geophysicist Does EPO: Lessons Learned Along the Way, Fall AGU (abstract ED31C-08), December 2011 (Invited conference talk).


4) Kiefer, W.S., Using Gravity Observations to Explore the Structure of Volcanic Fields on the Moon, Southwest Louisiana Geophysical Society, Lafayette LA, April 2012 (Invited seminar).


Kramer


Kring

1) David A. Kring: “The Chicxulub Impact Event and the Evolutionary Calamity it Produced at the K-T Boundary,” Southern Methodist University, Dallas, TX, November 18th, 2011


**Niihara**


**Schenk**

1) “Solar System Exploration at 50 Years,” Isle of Man (UK) High School system, Douglas, UK (June 29, 2012 morning)

2) “Solar System Exploration at 50 Years,” Isle of Man Astronomical Society, Douglas, UK (June 29, 2012 evening)

3) “From Cassini (Giovanni) to Cassini (Orbiter): Surprises among the Ringed Planet’s Icy Moons after 31 Years of Exploration”, invited presentation at GSA Special Session on 30th anniversary of Planetary Division, Minneapolis, MN, October, 2011.

**Spudis**

1) Invited presentation: Cislunar development using lunar resources, Director’s Colloquium, NASA Ames Research Center, Moffett Field CA, October, 2011.

3) Invited presentation: Cislunar development using lunar resources, Director’s Colloquium, NASA Marshall Space Flight Center, Huntsville, AL, April, 2011.


**Treiman**


**Usui**


APPENDIX IV: Funding

ACTIVE

S. M. Clifford
Principal Investigator
NASA Mars Data Analysis Program
Proposal for organization of the 5th Mars Polar Science Conference and 3rd Early Mars Conference

S. M. Clifford
Co-Investigator, (PI is Essam Heggy)
NASA Planetary Geology & Geophysics Program
Electromagnetic Characterization of Dusty-Ice and Hydrate-Rich Materials in Planetary Environments NNH07ZDA001N-PGG

S. M. Clifford
Co-Investigator
NASA Education & Public Outreach for Earth & Space Science (EPOESS) Program
STEP: Creating a Sustainable Trainer Engagement Program for Earth and Space Science

T. Hoogenboom
Co-Investigator, (PI is P. McGovern)
NASA Outer Planet Research Program
Copious volcanism on a compression-dominated planet? Insights into magma ascent and mountain building on Io from advanced numerical modeling and data analysis

W. S. Kiefer
Co-Investigator
NASA Mars Fundamental Research Program
Improved Models of Magma Production and the Thermal Evolution of Mars

W. S. Kiefer
Principal Investigator
EPO supplement to Mars Fundamental Research Program grant
Preparing Librarians to Engage Children in NASA Mars Science through Astrobiology

W. S. Kiefer
Principal Investigator
NASA GRAIL Guest Scientist Program
Density Models for the Lunar Crust and Implications for the Moon’s Early Volcanic History

W. S. Kiefer
Co-investigator (PI is David Kring, LPI)
NASA Lunar Science Institute Program
Impact Processes in the Origin and Evolution of the Moon: New Sample-driven Perspectives

W. S. Kiefer
Co-investigator (PI is Gary Hunter, NASA Glenn Research Center)
NASA Planetary Instrument Definition and Development Program
High Temperature Seismometer for Venus Applications

**W.S. Kiefer**
Co-investigator (PI is Dan Britt, Univ. Central Florida)
NASA Lunar Advanced Science and Exploration Research Program

Density and Porosity of Lunar Materials

**W.S. Kiefer**
Co-investigator (PI is David Mittlefehldt, NASA Johnson Space Center)
NASA Dawn at Vesta Participating Scientist Program

Crustal Structure of 4 Vesta

**W.S. Kiefer**
Co-investigator (PI is Dan Britt, Univ. Central Florida)
NASA Mars Fundamental Research Program

Density and Porosity of Martian Crustal Materials

**W.S. Kiefer**
Co-investigator (PI is Dave Draper, NASA Johnson Space Center)
NASA Cosmochemistry program

Experimental and Theoretical Studies of Geochemical Evolution and Thermal Structure of the Martian Mantle: Test for the Martian Magma Ocean Hypothesis

**W.S. Kiefer**
Co-investigator (PI is Seiichi Nagihara, Texas Tech University)
NASA Lunar Advanced Science and Exploration Research Program

Complete Restoration of the ALSEP Data, April through June 1975, and the Associated Metadata

**W.S. Kiefer**
Collaborator (PI is Mark Zimmerman, Univ. Minnesota)
NASA Mars Fundamental Research Program

Effect of Grain Size and Water Fugacity on the Viscosity of Iron-rich Olivine with Application to Convection in the Mantle of Mars

**G. Kramer**
Co-Investigator
NASA LASER program

Study of the origin of the high surface albedo at lunar magnetic anomalies.

**G. Kramer**
Co-Investigator
NASA GRAIL Guest Scientist Program

Volcanic and Thermal Evolution of the Moon: Constraints from Integrated Analysis of GRAIL Gravity and Other Remotely Sensed.

**D.A. Kring**
Principal Investigator
NASA Mars Fundamental Research Program

Modeling of the Thermal Evolution of Impact-Generated Hydrothermal Systems on Mars
D.A. Kring
Co-Investigator
Opportunities in Science Mission Directorate Education and Public Outreach
*MyMoon: The Public’s Portal to Lunar Science Exploration through New Media*

D.A. Kring
Principal Investigator
NASA Lunar Science Institute Program
*Impact Processes in the Origin and Evolution of the Moon: New Sample-driven Perspectives*

P.J. McGovern
Principal Investigator
NASA Planetary Geology and Geophysics Program
*Mechanical controls on magma ascent, storage, and eruption at large volcanic edifices on Venus*

P. J. McGovern
Co-Investigator (D. Kring of LPI is PI)
NLSI Institute Proposal from LPI/USRA.
*Impact Processes in the Origin Evolution of the Moon: New Sample-driven Perspectives*

P. J. McGovern
Principal Investigator
NASA Mars Data Analysis Program.
*Structural Characterization and Evolution of Large Volcanoes on Mars with Insights from Numerical Simulations*

P. J. McGovern
Principal Investigator
NASA Planetary Geology and Geophysics Program
*Growth and Evolution of Large Volcanoes on Venus: Insights from Advanced Numerical Modeling of Lithospheric Response to Volcanic Loading*

P. J. McGovern
Co-Investigator (E. Grosfils of Pomona College is PI)
NASA Planetary Geology and Geophysics Program
*Three-dimensional Analysis of Ring-Fault Initiation and Caldera Formation on the Terrestrial Planets*

P. J. McGovern
Principal Investigator
NASA Outer Planets Research Program
*Copious Volcanism on a Compression-dominated Planet? Insights into Magma Ascent and Mountain Building on Io from Advanced Numerical Modeling*

P. J. McGovern
Principal Investigator
NASA GRAIL Guest Investigator Program
Volcanic and Thermal Evolution of the Moon: Constraints from Integrated Analysis of GRAIL gravity and other remotely sensed datasets

P. M. Schenk
(Principal-Investigator)
Cassini Data Analysis and Participating Scientist Program
The Snowpack of Enceladus – the Creep of Craters: Mapping Thermal Histories and Plume Deposition on Saturn’s Mid-Size Icy Satellites.

P. M. Schenk
(Principal-Investigator)
Dawn at Vesta Participating Scientist
Impact crater morphologies on Vesta: Insights into interiors and cratering process

P. M. Schenk
(Principal-Investigator)
Planetary Geology and Geophysics
Small Comets and Projectiles in the Solar System: The Issue of Secondaries on Large Icy Satellites,
NNH10ZDA001N-PGG

P.D. Spudis
Co-Investigator
NASA Lunar Science Institute Program
Lunar Polar Processes Team, Applied Physics Laboratory, Laurel MD, B. Bussey PI

P.D. Spudis
Co-Investigator (D. Kring PI)
NASA Lunar Science Institute Program

P.D.Spudis
Deputy PI (B. Bussey PI)
Lunar Reconnaissance Orbiter Extended Mission
Mini-RF experiment

A. H. Treiman
Co-Investigator
NLSI Institute
Impact Processes in the Origin and Evolution of the Moon: New Sample-driven Perspectives

A. H. Treiman
Principal Investigator
NASA Cosmochemistry
"Volatiles in the Moon's Highlands Crust: Apatite, Nominally Volatile-Free Minerals, and Cordierite"

A. H. Treiman
Principal Investigator
NASA Mars Fundamental Research Program
Acid Fog on Mars II: Experimental and Analytical Studies Of Sulfur and Halogens in Martian Basalts and their Fluids.

A. H. Treiman
Co-Investigator
NASA/Ames node of NASA Astrobiology Institute (NAI)
Early Habitable Environments and the Evolution of Complexity.

A. H. Treiman
Co-Investigator
CheMin: An X-ray Diffraction/X-ray Fluorescence (XRD/XRF) instrument for definitive mineralogical analysis in the Analytical Laboratory of MSL.

T. Usui
Principal Investigator
NASA Mars Fundamental Research Program
Olivine-hosted melt inclusions in Martian Meteorites: the search for primordial volatile abundances and lead isotopic source components of Martian magmas

T. Usui
Principal Investigator
NASA Cosmochemistry Program
Experimental and theoretical studies of geochemical evolution and thermal structure of the Martian mantle: Test for the Magma ocean hypothesis

O. White
Co-Investigator: PI is P. Schenk
Cassini Data Analysis and participating Scientists.
The Snowpack of Enceladus – the Creep of Craters: Mapping Thermal Histories and Plume Deposition on Saturn’s Mid-Size Icy Satellites

O. White
Co-Investigator: PI is P. McGovern
NASA Outer Planets Research Program
Copious Volcanism on a Compression-dominated Planet? Insights into Magma Ascent and Mountain Building on Io from Advanced Numerical Modeling

PENDING

T. Hoogenboom
Co-Investigator
Cassini Data Analysis and Participating Scientists
Geologic and Thermal History of a Nearly Active Icy Moon: An Integrated Mapping Strategy for Dione
Submitted May 2012

W. S. Kiefer
Co-Investigator (PI is Dan Britt, Univ. Central Florida)
NASA Lunar Advanced Science and Exploration Research Program

Density and Porosity of Lunar Materials

G. Kramer
Principle Investigator
NASA LASER program (2013-2016)
The Fate of Surficial Hydroxyl and Water on the Lunar Surface Over Time.

G. Kramer
Co-Investigator
NASA LASER program (2013-2016)
Analysis of Pyroclastic Deposits on the Moon: Characterization of Major and Minor Constituents.

G. Kramer
Co-Investigator
NASA LASER program (2013-2016)
Investigating peak ring formation and Lunar crustal excavation using LRO and comparative planetology.

G. Kramer
Co-Investigator
NASA LASER program (2013-2016)

P.M. Schenk
Co-Investigator, (R. Beyer, PI)
SALMON-JUICE
Wide angle camera for JUICE, NNH12ZDA006O-JUICE

V.L. Sharpton
Principal Investigator
NASA Lunar Advanced Science and Exploration Research Program
Outcrops on Lunar Crater Walls: Exposing Ejecta Volumes, Target Deformation, and Volcanic Stratigraphy

P.D. Spudis
Principal Investigator
NASA Lunar Advanced Science and Exploration Research Program
Quantification of surface roughness of lunar impact craters

P.D. Spudis
Principal Investigator
NASA Planetary Geology and Geophysics Program
Impact Basins on Mercury and the Moon

A. H. Treiman
J. Gross is Principal Investigator; Treiman is Co-Investigator
NASA LASER

*Spinel-rich lithologies in the lunar highland crust: Linking lunar samples, crystallization experiments and remote sensing.*

**A. H. Treiman**
M. Bullock is Principal Investigator; A. Treiman Co-Investigator
NASA Cosmochemistry,

*Aqueous Alteration and Noble Gas Fractionation on Mars: Integrating noble gas data from experiments with spacecraft observations and theoretical calculations.*

**O. White**
Principal Investigator
Cassini Data Analysis and Participating Scientists

*Geologic and Thermal History of a Nearly Active Icy Moon: An Integrated Mapping Strategy for Dione*
APPENDIX V: Scientific Staff - Service to NASA and the Scientific Community

Clifford

- **Organizing Committee and Session Co-Chair**, LPI/NASA Workshop on Concepts and Approaches to Mars Exploration, June 2012.
- **Guest Editor**, 5th Mars Polar Science Special Issue of Icarus.
- **Guest Editor, Early Mars III, Special Section of JGR-Planets.**
- **Member**, Mars Exploration and Program Analysis Group (MEPAG), 2000-present.

Hoogenboom

- Regular journal paper reviewer for Journal of Geophysical Research - Planets and Geophysical Journal

Kiefer:

- Member of Science Team for Dawn Mission Encounter with Asteroid 4 Vesta (2011-2013).
- Venus High Temperature Seismometer instrument development team (2009-present).
- Member of Discovery Concept Study Report Review Panel (2012).
- Member of Scientific Organizing Committee and session chair for “The Big Pictures”, Second Lunar Highlands Crust Conference, Bozeman MT, July 2012.
- Session chair for “Structure and Dynamics of the Martian Mantle” for Mars Mantle Workshop, September 2012.
- External reviewer for Mars Fundamental Research Program Review Panel and Mars Data Analysis Program Review Panel.

Kramer:

- NASA Earth and Space Science Fellowship (external)
- NASA Planetary Geology and Geophysics Program (external)
Mackwell:
- Member of Steering Committee and Inner Planets Sub-committee for NRC Planetary Decadal Survey 2013-2022
- Member of Steering Committee and Vice-Chair of Discovery and Characterization Committee for NRC Study to Review Near-Earth Object Surveys and Hazard Mitigation Strategies, 2009-2010
- Member of Senior Review Panel of the Astrophysics Division Operating Missions, NASA
- Advisory Committee, Winchell School of Earth Sciences, University of Minnesota, Minneapolis
- Advisory Committee, Department of Physics, University of Houston - Clear Lake, Houston
- Advisory Committee, Professional Masters Degree Program in Space Studies, Rice University
- Editorial Board, Physics and Chemistry of Minerals, Springer-Verlag, Berlin
- Co-Editor, Comparative Planetary Climatology (with M. Bullock), University of Arizona Planetary Science Series (in progress)
- Gilbert Award Committee, Geological Society of America
- Executive Committee, Lunar Exploration Analysis Group, NASA
- Executive Committee, Venus Exploration Analysis Group, NASA

Öhman:
- Member of the LPI Career Development Award panel
- Reviewer for Lithosphere and Bulletin of the Geological Society of Finland

Potter:
- Session Chair: 3rd Annual Lunar Graduate Conference, July 2012
- LPI Seminar Co-organizer, July 2012 – present
- Member of the American Geophysical Union

Schenk:

Mission Participation:
- Participating Scientist, Dawn at Vesta, 2010-2013.
- Participating Scientist, Cassini at Saturn, 2010-2013.
- Co-investigator on JUICE instrument proposal, Autumn, 2012

Editorial Roles
- Scientific editor, Lunar and Planetary Information Bulletin
- Collaborator and Science presenter for “Sustainable Trainer Engagement Program” at LPI, 2011-2013
- Program Committee for the Lunar and Planetary Science Conference (March, 2012)

Sharpton:
- NASA Mars Data Analysis Program Review Panel, January 9-13, 2012
- Session Chair, NLSI Science Forum with Benjamin Greenhagen Session 8: Of the Moon: Geology, July 19, 2012.
• Executive committee, Venus Exploration Advisory Group (VEXAG)
• Manuscript reviewer: Reviews of Geophysics

Spudis:
• Scientific Coordinator, LPI Summer Intern Program
• Director, NASA Regional Planetary Image Facility, Lunar and Planetary Institute
• Scientific Coordinator, LPI Summer Intern Program
• Program Committee member, Conference on the Lunar Highlands, Bozeman MT, July 2012
• Program Committee member, ASTech Developing Space Conference, Paris, Dec. 2012
• LEAG member, founding-present
• Proposal Reviewer, External: NASA Cosmochemistry, PG&G

Mission Participation:
• Lunar Reconnaissance Orbiter, Mini-RF (Deputy PI) and LROC (Team Member) experiments

Treiman:
• VEXAG (Venus exploration analysis group) Member, 2005 – present
• CAPTEM (Curation and Analysis Planning Team for Extraterrestrial Materials), Member, 2007-2012.
• MSL-MAHLI-UV Study group: Lead. Small group to investigate what, if anything, can be done with the UV fluorescence capability on the MAHLI camera on MSL. Sept. 2010 ongoing.
• External reviews for NASA proposals to Cosmochemistry, MDAP.

Usui:
• Working group member of Mars Exploration with Lander-Orbiter Synergy (JAXA)
• Journal reviews: Geochimica et Cosmochimica Acta, Meteoritics & Planetary Science
• Program committee: The 75th Annual Meeting of the Meteoritical Society, Cairns, Australia.

White:
• Served on the 43rd LPSC Committee Panel in January 2012.
• Co-Organizer of the LPI Seminar Series between June 2011 and June 2012
APPENDIX VI: Summer Student Activities
LPI/ NASA JSC Undergraduate Summer Intern Program
June 4 - August 10, 2012

<table>
<thead>
<tr>
<th>Intern</th>
<th>University</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joshua Blumenkoph</td>
<td>Yeshiva College</td>
<td>John Shebalin</td>
</tr>
<tr>
<td>Mitali Chandnani</td>
<td>Indiana University of Technology Roorkee</td>
<td>David Kring and Georgiana Kramer</td>
</tr>
<tr>
<td>Rebecca Johnston</td>
<td>Brigham Young University</td>
<td>Oliver White and Trudi Hoogenboom</td>
</tr>
<tr>
<td>Mellissa Judson</td>
<td>SUNY-Buffalo</td>
<td>Virgil (Buck) Sharpton</td>
</tr>
<tr>
<td>Jessica Kalynn</td>
<td>University of British Columbia</td>
<td>Pat McGovern and Georgiana Kramer</td>
</tr>
<tr>
<td>Lisa Korn</td>
<td>University of Massachusetts</td>
<td>Carlton Allen</td>
</tr>
<tr>
<td>Katelyn Lehman</td>
<td>Texas Christian University</td>
<td>Walter Kiefer and Georgiana Kramer</td>
</tr>
<tr>
<td>Nicole Marin</td>
<td>Arizona State University</td>
<td>Kevin Righter and Lisa Danielson</td>
</tr>
<tr>
<td>Molly Richardson</td>
<td>Rice University</td>
<td>Julianne Moses</td>
</tr>
<tr>
<td>Matthew Smith</td>
<td>East Tennessee State University</td>
<td>Paul Spudis</td>
</tr>
<tr>
<td>Jayashree Sridhar</td>
<td>Hindustan University</td>
<td>Bonnie Cooper</td>
</tr>
<tr>
<td>Poorna Srinivasan</td>
<td>Rutgers University</td>
<td>Justin Simon</td>
</tr>
</tbody>
</table>

NLSI Lunar and Exploration Graduate Interns
May 29 – August 03, 2012

<table>
<thead>
<tr>
<th>INTERN</th>
<th>UNIVERSITY</th>
<th>ADVISOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jessica Barnes</td>
<td>Open University</td>
<td>David Kring</td>
</tr>
<tr>
<td>Renee French</td>
<td>Northwestern University</td>
<td>David Kring</td>
</tr>
<tr>
<td>Joshua Garber</td>
<td>University of California, Davis</td>
<td>David Kring</td>
</tr>
<tr>
<td>William Poole</td>
<td>University College London</td>
<td>David Kring</td>
</tr>
<tr>
<td>Phillippa Holly Smith</td>
<td>Open University</td>
<td>David Kring</td>
</tr>
<tr>
<td>Yunsheng Tian</td>
<td>University of Toronto</td>
<td>David Kring</td>
</tr>
</tbody>
</table>

No Cost Visiting Students 2012

<table>
<thead>
<tr>
<th>Intern</th>
<th>University</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maria Arias de Saavedra</td>
<td>Duke University</td>
<td>Paul Spudis</td>
</tr>
</tbody>
</table>
APPENDIX VII: Mentoring

Clifford:

- **Donald Barker**, *Department of Geosciences, University of Houston*, Houston, TX. PhD candidate. Research focus: Mars exploration geophysics and the application of sequence stratigraphy to investigations of the Martian hemispheric dichotomy. Have worked with him on various research projects associated with his 3 previous MS degrees. Currently I serve as his co-adviser and as a member of his PhD committee.

- **Yolanda Cedillo-Flores** *Universidad Nacional Autónoma de México (UNAM)*, Mexico. PhD student. Project: Investigation of the role of gas fluidization on the formation of gullied terrain on Mars. Primary advisor: Allan Treiman. Worked with Yolanda on modeling the thermal evolution of the Martian regolith and the formation and stability of seasonal CO₂ deposits. Also co-authored (w/Allan Treiman and Jeremie Lasue) Yolanda’s peer-reviewed paper on the same topic. This publication was the last requirement for Yolanda to receive her doctorate from UNAM.

**LPI Summer Intern Activities:**

- LPI Summer Intern brown bag seminar: “Climatic and Hydrologic Evolution of Mars”, LPI, Houston, TX, 8/1/2012.

Hoogenboom:

- Co-Advisor: Rebecca Johnston, Brigham Young University, 2012 LPI/JSC Summer Intern Program

Kiefer:

- Post-doc adviser for Dr. Constantin Sandu (LPI), Improved Models of Magma Production and the Thermal Evolution of Mars, July 2010-March 2012.
- Post-doc adviser for Dr. James Solano (NASA Johnson Space Center), Crustal Structure of Asteroid 4 Vesta, July 2011-February 2012. (co-adviser with Dr. Duck Mittlefehldt of NASA JSC).
- Post-doc adviser for Dr. Ross Potter (LPI), working on numerical simulations of lunar impact basin formation, February 2012-present. (co-adviser with Dr. David Kring and Dr. Pat McGovern).
- Co-adviser for Erica Jawin’s undergraduate senior thesis at Mt. Holyoke College on the relationship between topographic roughness and radar scattering at lunar volcanic structures, August 2011-May 2012. This was a continuation of her work with me as an LPI undergraduate summer intern during summer 2011. (co-adviser with Dr. Caleb Fassett and Dr. Darby Dyar).
- Co-adviser for LPI Graduate Intern Katelyn Lehman’s study of the composition of the Moon’s Marius Hills volcanic field using near-infrared and thermal infrared spectroscopy, June-August 2012. (co-adviser with Dr. George Kramer).
- Co-adviser for LPI-JSC Lunar Exploration Interns Jessica Barnes, Renee French, Joshua Garber, Wil Poole, Phillipa Smith, and Bob Tian on a study of lunar landing sites for geophysical exploration of the Moon, June-August 2012 (co-adviser with Dr. David Kring).

Kramer:

**Lunar High School Research Program:**

- Kickapoo High School, Springfield, MO; Stratified Ejecta Boulders as Indicators of Layered Plutons on the Lunar Nearside
- St. Mary’s School, OR, Comparing the Geology and Petrology of the Apollo 17 Landing Site with
\textbf{M\textsuperscript{3} Spectroscopy}

\textbf{McGovern:}
- Summer Intern Advisor: Kathryn Powell of Rice University from the 2011 LPI Summer Intern Program. Kathryn presented her work on the origin and transport of olivines around the Crisium basin on the Moon at \textit{LPSC XLIII} in March 2012.
- Summer Intern Advisor: Jessica Kalyon of the University of British Columbia in the 2012 LPI Summer Intern Program. Jessica presented her work on olivine and spinel deposits at the Moscoviense and Imbrium basins on the Moon to the 2012 LPI/JSC Summer Intern Program.
- Post-doc Advisor: Gerald Galgana of LPI, working on the links between lithospheric stress state, magma ascent, and volcano growth at large edifices on Venus (supported by my PG\&G grant).
- Graduate student Advisor: Matthew Weller, Rice University. Matt is working with me and Juli Morgan of Rice to analyze the structure of the eastern Olympus Mons basal scarp, using topographic data from HRSC stereo imaging. Matt is applying limit equilibrium analysis to evaluate possible configurations of flank failure surfaces (supported by my MDAP grant).
- Post-doc Advisor: Thomas Fournier, Rice University. Tom is working with Juli Morgan, Matt Weller, and me on studies of the flank structure of Olympus Mons on Mars, and on models of surface deformation induced by intrusions (in part supported by my MDAP grant).

\textbf{Schenk:}
- Edger Rivera-Valentin, August – October, 2010, visiting graduate student
- Oliver White, LPI post-doctoral scientist
- Trudi Hoogenboom, LPI postdoctoral scientist

\textbf{Sharpton:}
- LPI Summer Intern Program: Mentored Melissa Judson, SUNY Buffalo, "Regional Slope Characteristics of Small Lunar Craters" using LROC data, ISIS, and ArcGIS software.

\textbf{Spudis:}
- LPI Summer Intern Program – Scientific Coordinator and Advisor
- 2012 Summer Intern Matthew Smith
- 2012 Summer Undergraduate Fellow Maria Benitez

\textbf{Treiman:}
- Post-Doc Advisor: Dr. Yann Sonzogni . LPI.

\textbf{Usui:}

\textbf{White}
- Trudi Hoogenboom, LPI Post Doc, Aspects of ISIS dealing with stereo and photoclinometry digital elevation model generation and topography measurement
APPENDIX VIII: Scientific Staff - Education/Public Outreach Activities

Clifford:

Guest Lecture:
--Gave a guest lecture on "Planetary Radar" to a University of Paris system graduate class on Planetary Remote Sensing (instructor: Dr. Valerie Ciarletti), Universite de Versailles Saint-Quentin-en-Yvelines, Versailles, France. 2/14/2012.

Seminars:
--LPI Cosmic Explorations Public Lecture Series "Mars: Discoveries and Insights from 50 Years of Robotic Exploration", LPI, Houston, TX, 6/7/2012.
--Geology Department Seminar: "Scientific and Ethical Considerations in the Search for Life in Planetary Environments", University of Paris Sud, Orsay, France.

Press Interviews:
--Interviewed on the KPRC TV (Houston, TX) morning show about the landing of the Curiosity Rover on Mars. 8/6/2012.
--Interviewed (by Eric Hand) for a Nature news piece entitled "Dreams of water on Mars evaporate: Climate models reveal the Red Planet was mostly cold and dry." 4/11/2012
--Interviewed (by Christoph Seidler of Spiegel) for a story about the WISDOM radar team's participation in Dachstein, Austria field test in April ('Austrian Cave Sets Stage for Red Planet Voyage') 5/2/2012
--Interviewed (by Sarah Everts, Chemical & Engineering News) for a story about the WISDOM radar team's participation in Dachstein, Austria field test in April ('Space Suit In A Cave Austrian Alps provide a proxy for martian caves that could hold life'). 5/4/2012

Seminars:
--LPI Summer Intern brown bag seminar: "Climatic and Hydrologic Evolution of Mars", LPI, Houston, TX, 8/1/2012.
--LPI Cosmic Explorations Public Lecture Series "Mars: Discoveries and Insights from 50 Years of Robotic Exploration", LPI, Houston, TX, 6/7/2012.
--Geology Department Seminar: "Scientific and Ethical Considerations in the Search for Life in Planetary Environments", University of Paris Sud, Orsay, France.

Kiefer:
--Content adviser and science reviewer for LPI's “Explore: Life on Mars?” informal education (library based) program.
--Member of the Project Advisory Board for the PBS LearningMedia/WGBH Education Foundation's “Year of the Solar System: Digital Media for K-12 Planetary Sciences”.
--"Exploring Mars with the Opportunity and Curiosity Rovers", featured speaker for the Mars Rover Celebration at University of Houston, January 28, 2012. (talk given to approximately 400 middle school students, plus teachers and parents).
--"What Turned off the Martian Magnetic Field?" for the Red Planet Report website (redplanet.asu.edu), February 2012 (web article based on a paper in Geophysical Research Letters).

Kramer:
--International Observe the Moon Night, October, 2011.
--9th grade classroom visit & presentation, Corte Madera, CA, December, 2011.
--Space Day at K. E. Little Elementary School, Bacliff, TX, May 4, 2012.
--LPI's Space Fest: Mars Science Laboratory Curiosity Rover Landing, August 5, 2012.
--LPI's Venus Transit, June 5, 2012.
--Organizer, Houston/LPI Planetary Exploration Car Wash and Bake Sale, June 9, 2012.
--International Observe the Moon Night, September, 2012.

Press Interviews:
--“Focus: Magnetic Fields Explain Lunar Surface Features”, by Katie Mack, Physics 5, 92, August 20, 2012. DOI: 10.1103/Physics.5.92.

McGovern:
--LPI Summer Intern Program, presented seminar on “Geophysics and Volcanology of Mars”, 2012.
--Rice University Dept. of Earth Science Seminar Class ESci 529 The Moon: Origin and Evolution of Earth’s Companion. (Spring Semester 2012). I envisioned, designed, and recruited speakers for a seminar that exposed the Rice University student community to prominent lunar scientists at the Lunar and Planetary Institute and Johnson Space Center (with Rice Earth Science Department Professor Cin-Ty Lee). A wide range of topics was considered, from early solar system dynamics and bombardment history to magmatic and thermal models for the lunar interior, to lunar seismicity, to regolith and dust. This course enrolled 9 students, at both undergraduate and graduate levels, and appears to have been popular with the students.
Öhman:
--Along with G. Kramer and Landprint.com to create 3D models of Tycho and Schrödinger craters
--Interview about asteroid impact hazard in Finnish e-magazine *Maggo*

Potter:
--Judge for the LPI high school lunar science research competition (April 2012)
--Volunteer at the LPI Skyfest activity evenings (2012)

Schenk:
--Collaborator and Science presenter for “Sustainable Trainer Engagement Program” at LPI, 2011-2013
--Presenter at “Space Day” at Little Elementary School, Dickinson, Texas, May 2012.
--Maintains blog on research activities and space history at [http://stereomoons.blogspot.com/](http://stereomoons.blogspot.com/)

Press Interviews:
--Press conference presentation on Dawn results at Vesta at GSA, October, 2012.
--Interview with BBC at GSA, October, 2012, discussing Vesta results.
--Phone interviews with at least 4 reporters concerning publication of first dawn Science articles.
--Phone interviews with several reporters concerning first Dawn presentations at GSA and AGU.
--Phone interviews with several reports concerning Schmidt Europa results

Spudis:
--Guest Speaker engagements: LPI Summer High School teachers workshop, various others
--Write column for Smithsonian Air and Space magazine, “The Once and Future Moon” (2011-2012 30 columns)

Articles for the Popular Press:

Treiman:
--Dwornik award judging. LPSC 2012.

Presentations:
--'Cosmic Visions' talk on "Climate Change on Mars,' November, 2011.
--'The Solar System,' five presentation to 4th-grade students at K.E. Little Elementary School, Dickinson ISD, May 6, 2011.
Public Interviews:

--Phone interview, Sep. 20 2010, with Michael Schirber of Astrobiology Magazine (astrobio.net) about ALH 84001.
--Email interview with Wired magazine, mid-March 2011.

Usui:

White:
--Volunteered and presented at five Sky Fest events since October 2011.
--Presented on Io to special needs high school students at Redwood High School, Larkspur, CA in December 2011
--Presented on planetary ices to elementary school students for a Space Day at K.E. Little Elementary School, Baycliff, TX, in May 2012.
### APPENDIX IX: Seminar Speakers

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Topic</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean-Philippe Combe</td>
<td>Bear Fight Institute</td>
<td>Saga in the quest for characterization of water on the Moon: A hot and rough challenge in the near-infrared</td>
<td>October 17, 2011</td>
</tr>
<tr>
<td>Mikki M. Osterloo</td>
<td>Laboratory for Atmospheric and Space Physics at the University of Colorado-Boulder</td>
<td>Mars chloride-bearing materials: Signatures of aqueous environments</td>
<td>October 28, 2011</td>
</tr>
<tr>
<td>Ashley Gerard Davies</td>
<td>Jet Propulsion Laboratory, California Institute of Technology</td>
<td>Active Lava Lakes As Windows Into Io’s Interior</td>
<td>November 11, 2011</td>
</tr>
<tr>
<td>Silvio Mollo</td>
<td>Istituto Nazionale di Geofisica e Vulcanologia</td>
<td>Influence of Cooling Rate on Textural and Chemical Features of Terrestrial and Extraterrestrial Basaltic Rocks</td>
<td>November 17, 2011</td>
</tr>
<tr>
<td>Neyda Abreu</td>
<td></td>
<td>Opaque Assemblages in CR chondrites – A history of Impact-Driven Aqueous Alteration</td>
<td>November 18, 2011</td>
</tr>
<tr>
<td>Yann Sonzogni</td>
<td>UCLA, Department of Earth and Space Sciences</td>
<td>Melt inclusions: from crystal growth kinetics to planetary-bodies formation</td>
<td>November 30, 2011</td>
</tr>
<tr>
<td>Devin McKeegan</td>
<td></td>
<td>The oxygen isotopic composition of the Sun: Implications for nebula chemistry</td>
<td>December 2, 2011</td>
</tr>
<tr>
<td>Debra Hurqitz</td>
<td>Brown University</td>
<td>Lava erosion on the terrestrial planets: Using analytical models to distinguish between mechanical and thermal erosion</td>
<td>February 6, 2012</td>
</tr>
<tr>
<td>Name</td>
<td>Affiliation</td>
<td>Title</td>
<td>Date</td>
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<tr>
<td>Ryan Mills</td>
<td>University of North Carolina</td>
<td>Re-evaluating pluton/volcano connections and igneous textures in light of incremental magma explacement</td>
<td>March 2, 2012</td>
</tr>
<tr>
<td>Kerri Donalson Hanna</td>
<td>Brown University</td>
<td></td>
<td>March 11, 2012</td>
</tr>
<tr>
<td>Kaveh Pahlevan</td>
<td>Yale University</td>
<td>When the Moon was a Cloud: Testing the Lunar Creation Myth</td>
<td>March 30, 2012</td>
</tr>
<tr>
<td>Adriene Dove</td>
<td></td>
<td>Experimental investigations of lunar plasma and dust dynamics</td>
<td>April 3, 2012</td>
</tr>
<tr>
<td>Jerry Harder</td>
<td>LASP</td>
<td>The Solar Radiation and Climate Experiment (SORCE): Measuring the Sun’s influence on climate from space</td>
<td>April 27, 2012</td>
</tr>
<tr>
<td>Kerri Donaldson Hanna</td>
<td>Brown University</td>
<td>Compositional Diversity of the Moon’s Primary Crust from Integrated Diviner and M$^2$ Analysis</td>
<td>May 11, 2012</td>
</tr>
<tr>
<td>Christian Klimczak</td>
<td>Carnegie Institute of Washington</td>
<td>Faults and Folds on Mercury</td>
<td>May 18, 2012</td>
</tr>
<tr>
<td>Arln Crotts</td>
<td>Columbia University</td>
<td>Lunar Volatiles: Sources and Resources</td>
<td>June 1, 2012</td>
</tr>
<tr>
<td>Dave Blewett</td>
<td>Johns Hopkins University, Applied Physics Laboratory</td>
<td>Mercury Hollows</td>
<td>June 8, 2012</td>
</tr>
<tr>
<td>Name</td>
<td>Institution</td>
<td>Title</td>
<td>Date</td>
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<tr>
<td>Marc Biren</td>
<td>University of New Brunswick</td>
<td>Central uplift formation in crystalline target rocks: Evidence from the Manicouagan impact structure, Quebec</td>
<td>June 11, 2012</td>
</tr>
<tr>
<td>Timothy J. Peters</td>
<td>Vanderbilt University</td>
<td>The response of zircon to hydrothermal fluid interaction and deep crustal metamorphism associated with Mountain building processes</td>
<td>June 29, 2012</td>
</tr>
<tr>
<td>Timothy Glotch</td>
<td>Stony Brook University</td>
<td>Evidence for magma-carbonate interaction beneath Syrtis Major, Mars</td>
<td>July 6, 2012</td>
</tr>
<tr>
<td>Lon Hood</td>
<td>University of Arizona</td>
<td>Lunar Magnetism: Core Dynamo and Origin of the Strong Anomalies</td>
<td>August 17, 2012</td>
</tr>
<tr>
<td>Jasper Halekas</td>
<td>University of California, Berkley</td>
<td>First Results from the ARTEMIS Mission: The Moon’s Sphere of Influence</td>
<td>August 24, 2012</td>
</tr>
<tr>
<td>Andy Rivkin</td>
<td>Johns Hopkins University, Applied Physics Laboratory</td>
<td>Water, Hydroxyl, and Ice in the Asteroid Belt</td>
<td>September 7, 2012</td>
</tr>
<tr>
<td>Sam Lawrence</td>
<td>Arizona State University</td>
<td>New Insights Into Lunar Geology from the Lunar Reconnaissance Orbiter Camera</td>
<td>September 21, 2012</td>
</tr>
</tbody>
</table>
APPENDIX X: NASA Regional Planetary Image Facility and Library

The NASA Regional Planetary Image Facility (RPIF) at the Lunar and Planetary Institute, one of the first established, is led by Dr. Paul Spudis. As RPIF Director, Dr. Spudis provides overall direction of the facility, interfaces with NASA program management, and serves on the RPIF Board of Directors. The RPIF Director and Manager participated in the RPIF annual review held in Flagstaff, Arizona in October 2011. One of the meeting action items was a request to develop social media presence for the RPIF network via Facebook. An assessment and report of this project will be presented at the next review meeting.

As a RPIF, LPI maintains an open-access policy for users and is available to the public during normal business hours. To reach interested users Beyond the Walls of building, the RPIF / Library as made efforts to utilize tools such as website development, social media, and Wikipedia to provide access to the rich resources within the facility. We have scanned and prepared key parts of the collection including the extensive map collection, books, documents, and imagery. The Map Collection has expanded with the addition of 45 Venus maps and the Lunar Sample Atlas has been expanded with additional images.

In effort to expand our reach to the amateur science community and general public, we now have over 1300 images on the LPI Flickr site with a total of 149,000 views to date. As an interactive site, viewers can leave comments or tag an image with their keywords for easy retrieval. The tagging allows individual researchers, educators, or the curious to stumble upon planetary images in a new way. We have also worked with other social media sites such as Facebook, Twitter, and Pinterest. Our presence on all these social media sites focuses on planetary science in general and LPI meetings and activities specifically. Although most of the interest is from the United States, there is also significant interested followers and fans from India, Spain, Italy, Brazil and Indonesia.

Work has continued with Wikipedia. According to Alexa.Com, Wikipedia, an online free encyclopedia, is the 6th most popular site in the United States. Using the resources of the Library and its staff, we have made efforts to update articles, add references, and enhance biographies of planetary science investigators. To raise awareness within the planetary science community of this effort, LPI hosted a booth again at LPSC to encourage student and scientist involvement in updating and developing good solid planetary science articles and biographies. By encouraging expertise in the field, we have increased the accuracy of Wikipedia planetary science articles, which often is a primary information source for students, educators, and the public.

A new library catalog system, EOS International, was selected and implemented during the first quarter of CY2012 without any interruption of library service. The new system gives increased flexibility such as individual accounts, online renewals, and ability to comment and rate books by registered library users both distant and onsite. It will also provide growth and options as our online resources expand.

The RPIF/Library facility will continue to serve a broad range of patrons, including funded scientists, educators, students, and the public. The collection, which contains over 60,000 items, is refreshed on a regular basis with the addition of books, journals, and data within the scope of the CAN. We are a member of OCLC, an international network of libraries, museums, and institutions, and AMIGOS, a regional network of libraries. These networks provide access to LPI library collections worldwide.
APPENDIX XI: Meeting and Publication Services - Conferences and Workshops

Annual Meeting of the Lunar Exploration Analysis Group; November 7–9, 2011; Houston, Texas; Attendance: 113; Charles Shearer (University of New Mexico), Clive Neal (University of Notre Dame), and Stephen Mackwell (Lunar and Planetary Institute).

Workshop on Formation of the First Solids in the Solar System; November 7–9, 2011; Kauai, Hawaii; Attendance: 182; Alexander N. Krot, Edward R. D. Scott, Gary R. Huss (HIGP/SOEST, University of Hawaii), Jonathan Williams (IfA, University of Hawai'i), Martin Bizzarro (Natural History Museum, Denmark), and Yuri Amelin (Australian National University).

Workshop on the Early Solar System Impact Bombardment II; February 1–3, 2012; Houston, Texas; Attendance: 72; David Kring (Lunar and Planetary Institute) and William Bottke (Southwest Research Institute).

Conference on Life Detection in Extraterrestrial Samples; February 13–15, 2012; San Diego, California; Attendance: 94; Dave Beaty (NASA Mars Program Office), Cassie Conley (NASA Planetary Protection), Gerhard Kminek (ESA Planetary Protection), Mary Voytek (NASA Astrobiology), Jorge Vago (ESA Mars Program), Michael Meyer (NASA Mars Exploration Program), and Dave Des Marais (Chair, Mars Exploration Program Analysis Group).

43rd Lunar and Planetary Science Conference; March 19–23, 2012; The Woodlands, Texas; Attendance: 1761; Stephen Mackwell (Lunar and Planetary Institute), Eileen Stansbery (NASA Johnson Space Center), and David Draper (NASA Johnson Space Center).

Nuclear and Emerging Technologies for Space; March 21–23, 2012; The Woodlands, Texas; Attendance: 118; Len Dudzinski (NASA Headquarters), Wade Carroll (Department of Energy Headquarters), and George Schmidt (NASA Goddard Spaceflight Center).

Spring Meeting of the Meteorite Working Group (MWG); March 23–24, 2012; The Woodlands, Texas; Attendance: 21; Conel Alexander (Carnegie Institution).

Spring Meeting of the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM); March 24–25, 2012; Houston, Texas; Attendance: 24; Meenakshi Wadhwa (Arizona State University).

Asteroids, Comets, Meteors 2012; May 16–20, 2012; Niigata, Japan; Attendance: 403; Sho Sasaki (National Astronomical Observatory of Japan), Wing-Huen Ip (National Central University, Taiwan), William Bottke (Southwest Research Institute), Andy Cheng (Johns Hopkins University), Guy Consolmagno (Vatican Observatory), Karen Meech (University of Hawaii), Rita Schulz (ESA/ESTEC), Pavel Spurny (Astronomical Institute of the Czech Republic), Giovanni Valsecchi (IASF Sezione di Roma, INAF), Junichi Watanabe (National Astronomical Observatory, Japan) and Mike Zolensky (NASA Johnson Space Center).
Third International Conference on Early Mars: Geologic and Hydrologic Evolution, Physical and Chemical Environments, and the Implications for Life; May 21–25, 2012; Lake Tahoe, Nevada; Attendance: 85; Stephen Clifford (Lunar and Planetary Institute), David Beaty (NASA Mars Program Office), Jean-Pierre Bibring (Université Paris-Sud), Robert Craddock (Smithsonian Institution), Jack Farmer (Arizona State University), Robert Haberle (NASA Ames Research Center), and Horton Newsom (University of New Mexico).


Comparative Climatology of Terrestrial Planets; June 25–28, 2012; Boulder, Colorado; Attendance: 129; Mark Bullock (Southwest Research Institute), Waleed Abdalati (NASA Headquarters), Richard Eckman (NASA Headquarters), Lori Glaze (NASA Goddard Spaceflight Center), Jim Green (NASA Headquarters), David Grinspoon (Denver Museum of Nature and Science), Madhulika Guhathakurta (NASA Headquarters), James Hansen (NASA Goddard Institute for Space Studies), Sanjay Limaye (University of Wisconsin), Stephen Mackwell (Lunar and Planetary Institute), Adriana Ocampo (NASA Headquarters), Mario Perez (NASA Headquarters), and Suzanne Smrekar (Jet Propulsion Laboratory).

Second Conference on the Lunar Highlands Crust; July 13–15, 2012; Bozeman, Montana; Attendance: 41; Allan Treiman (Lunar and Planetary Institute), Charles Shearer (University of New Mexico), and Meenakshi Wadhwa (Arizona State University).

75th Annual Meeting of the Meteoritical Society; August 12–17, 2012; Cairns, Australia; Attendance: 370; Trevor Ireland, Marc Norman, Yuri Amelin, Hugh O-Neill, Charley Lineweaver, and Raquel Salmeron (Australian National University).

The Mantle of Mars: Insights from Theory, Geophysics, High-Pressure Studies, and Meteorites; September 10–12, 2012; Houston, Texas; Attendance: 62; Jim Papike (University of New Mexico), Charles Shearer (University of New Mexico), and Dave Beaty (Jet Propulsion Laboratory).

Fall Meeting of the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM); September 27–28, 2012; Houston, Texas; Attendance: 23; Meenakshi Wadhwa (Arizona State University).
APPENDIX XII: Department of Education and Public Outreach  
October 1 2011 to September 30, 2012

The Lunar and Planetary Institute (LPI) Department of Education and Public Outreach (E/PO) focuses on preparing and supporting formal and informal educators, through materials development and training, to infuse Earth and planetary science into their programmatic efforts.

Personnel
The Department is led by Dr. Stephanie Shipp, with Education Specialists Ms. Heather Dalton, Ms. Brooke Hsu (located at Goddard Space Flight Center), Ms. Andrea Jones (located at Goddard Space Flight Center), Ms. Eve Halligan, Ms. Katie Hessen (located at Goddard Space Flight Center), Ms. Keliann LaConte, Mr. Andrew Shaner, Ms. Christine Shupla, Education Assistant Yolanda Ballard-Zimmerman, Multimedia Specialist Mr. John Blackwell, Special Programs Coordinator Dr. Jancy McPhee, and NLSI Coordinator Ms. Julie Tygielski.

Formal Education Programs
The LPI E/PO team conducts numerous day- and week-long teacher trainings during the year, locally and nationally, often in collaboration with partners. Shupla is the Formal Education Lead. Training is designed based on audience need, ties to both the National Science Education Standards and Standards for Professional Development of Teachers of Science, and best practices as identified in educational research. All formal education efforts are evaluated, either by an external evaluator, or through staff-administered pre- and post- content tests and training perceptions surveys. In general, LPI’s trainings are rated as highly successful by participants. In 2012, 557 educators were trained in 20 professional development sessions. Collectively, these teachers are estimated to reach almost 70,000 students per year. Overviews of 2012 program activity are presented below.

LPI Educator Training – The LPI E/PO team continues to provide training to classroom science teachers in the Houston and Texas area, often in partnership with Harris County Department of Education (HCDE) and Johnson Space Center Astromaterials Research Exploration Science Education Team. Through the trainings participants experience standards-based, inquiry oriented classroom activities, and learned about available resources aligned with their teaching needs. In FY12 seven trainings were conducted, reaching 147 K-12 educators.

http://www.lpi.usra.edu/education/workshops/workshops.shtml

Sustainable Trainer Engagement Program for Earth and Space Science (STEP) - A recent grant from NASA allows LPI, the Harris County Department of Education, four Texas Regional Science Collaboratives, six Houston-based school districts, and ten Earth and space scientists, to concentrate on deeply increasing the capacity of local Houston area science specialists during a three year effort. Through STEP, led by Shupla, 60 6-8th grade science specialists and lead teachers are being provided in-depth Earth and space science content. The program integrates NASA activities and resources with modeled pedagogy tied to the Earth and Space Science Standards for which Texas educators are responsible. Over the extended project, face-to-face and online learning experiences with LPI E/PO staff and scientists from LPI and Johnson Space Center will result a sustainable Community of Practice. Ultimately the participants will be better prepared to provide training and continued support in Earth and space science for approximately 800 additional middle school science teachers, who, in turn, will be able to share NASA activities and resources with up to 100,000 students. In addition to preparing and supporting the science specialists, the
project will evaluate the efficacy of the Train-the-Trainer model, a model often used to multiply the impact of E/PO efforts. However, in spite of the frequency of its use, there is little educational research regarding the overall validity of the model. The results of the evaluation effort will be published to inform NASA and other E/PO programs employing the Train-the-Trainer model of the findings.

Lunar Reconnaissance Orbiter (LRO) Mission Formal Education Programs– The LRO Formal Education program, led by Jones, featured the Lunar Workshops for Educators (LWE) professional development series, teacher kits, and the Lunar Student Imaging Program (LSIP). Seventy-two grade 6–12 science teachers from across the country learned about lunar science and exploration with the help of LRO scientists and data in 4 separate week-long LWE teacher trainings. Support was also provided for the NLSI-sponsored Unknown Moon Institute held in Houston, Texas. Teacher kits, which contain non-consumable topically-organized educational materials created by the LRO E/PO team, were produced and will be available for loan from LRO E/PO team member institutions. The LSIP program was developed as a pilot student program that involves students in authentic lunar exploration. In FY13–14 LRO formal education programs will focus on district-level partnerships that serve middle school teachers local to LRO E/PO team member institutions. LSIP will be conducted via distance learning technologies and will be featured in LRO teacher trainings, and quarterly follow-up sessions will keep LWE participants engaged in lunar science throughout the year.

Participants in an LRO Lunar Workshops for Educators in Mississippi mark the position and phase of the Moon in the daytime sky.

NASA Lunar Science Institute (NLSI) Dynamic Response of the Environment At the Moon (DREAM) E/PO – LPI has contributed to the DREAM E/PO program by incorporating elements of the team’s research - interactions of the solar wind with the near surface lunar environment - into existing lunar EPO activities. Elements of DREAM science were incorporated into the LRO LWEs. DREAM science was also incorporated into International Observe the Moon Night efforts.
High School Educator Lunar Training – As part of the Johns Hopkins Applied Physics Laboratory NASA Lunar Science Institute Team E/PO Efforts, LPI, led by Shupla, helped to design and implement a week-long educator training. Twenty high school teachers spent a week at LPI, learning about current lunar science and exploration, including an in-depth examination of the environment of the lunar poles. Participants interacted with NLSI scientists, visited the Johnson Space Center’s Astromaterials Curation Lab, undertook hands-on activities, and planned for implementation of lunar investigations in their classrooms. Evaluations extremely positive; 100% reported the institute, activities, and presentations were very good to excellent. http://www.lpi.usra.edu/education/workshops/unknownMoon/agenda.html

High-school educators participating in the Unknown Moon training got a tour of the Johnson Space Center’s Astromaterials Curation Lab.

Sample Analysis at Mars (SAM) / Mars Science Laboratory Mission Educator Resources – The LPI-based SAM E/PO team, led by Jones, shares SAM, Curiosity, and Mars science through a variety of products and programs. The team designed a landing site activity to simulate the landing site selection process for middle school students, assists SAM scientists with obtaining interns, and supports professional development trainings for formal and informal educators hosted by the Mars Public Engagement Team and the NASA Goddard Space Flight Center (GSFC) Office of Education. In addition to formal education activities, the team hosts and supports outreach events, represents SAM in national conferences, provides Curiosity exhibit materials to the Goddard Visitor Center, and helps design and maintain a public SAM website (http://ssed.gsfc.nasa.gov/sam/). The SAM E/PO team is also working with interpreters to incorporate Curiosity and Mars science into National Park programs. These efforts will continue in FY13.

ChemCam / Mars Science Laboratory Mission Educator Training- Twenty-two high school teachers participated in Mars Revealed: Evolving Technology, Advancing Science, a professional development training at LPI that is part of the ChemCam instrument EPO program led by Shaner. Using the history of Mars exploration as a framework, participants built their understanding of the Martian environment (surface evolution, atmospheric properties, habitability) while exploring how advances in technology contributed to scientists’ changing understanding of Mars. The participants
conducted standards-aligned classroom activities addressing each topic. To end the week, attendees learned about the engineering and scientific challenges of preparing for possible future human exploration of Mars, and they visited Johnson Space Center where they spoke with engineers and scientists designing and building the Space Exploration Vehicle and Habitat Demonstration Unit. The training will be repeated annually through 2015. Shaner also led activities at the Mars Public Engagement Program educator trainings held during the Mars Science Lab launch (November 2011 at Kennedy Space Flight Center) and landing (August 2012 at the Jet Propulsion Laboratory). In addition to these formal education activities, LPI also oversees the educational aspects of the ChemCam website (http://www.msl-chemcam.com/) and will implement training programs for librarians and other informal educators in 2012 and 2013.

Faculty Institutes for NASA Earth and Space Science Education (FINESSE) – LPI leads a collaboration of scientists and science education specialists, in partnership with the Association for Science Teacher Education (ASTE) and the National Association of Community College Teacher Education Programs (NACCTEP), to provide faculty involved in teacher preparation with access to NASA Earth and space science content, data, and educational resources through two-day Institutes. In its final year, activity, led by Shupla, included:

- A training for 26 participants at the ASTE Annual Conference in Clearwater, Florida (January 3-4, 2012). Participants explored best science education practices for teacher preparation, learned about curricular support resources for teacher educators that leverage NASA SMD content and data, and became part of a network of teacher education faculty.
- Seven posters at ASTE Annual Conference in which past FINESSE participants shared how they implemented FINESSE in their programs with pre-service teachers
- Formative and summative evaluation of the program
- Hosting of the Southwest ASTE (SW-ASTE) mini-conference at LPI for 26 SW-ASTE members, where members presented their current research findings and networked.

All materials are available online. http://www.lpi.usra.edu/education/facultyInstitutes/.

Center for Lunar Science and Exploration / LPI and ARES High School Student Lunar Mentoring and Research Program – In addition to education faculty training, LPI also hosts the High School Lunar Mentoring and Research Program for high school students, as part of its NLSI team effort. In 2012 90 students and 15 teachers participated as fifteen teams in the eight-month project. The students and their teachers represented 13 high schools from across the nation, many of which serve underserved / underrepresented populations, including rural communities. The High School Lunar Mentoring and Research Program, led by Shaner, is designed to expose high-school students to science and science careers, with an emphasis on lunar science and exploration. Each student team conducted an authentic lunar research project under the guidance of an online lunar scientist mentor and presented their research to a panel of lunar scientists. The team from Kickapoo High School, Springfield, Missouri, won for the second year in a row. The team presented their lunar research poster - Stratified Ejecta Boulders as Indicators of Layered Plutons on the Lunar Nearside - at the NLSI Forum at NASA Ames Research Center in July 2012. The Kickapoo team won 3rd place at the Forum for their poster in a competition with undergraduate and graduate students. The FY13 program is underway, with 10 teams participating. http://www.lpi.usra.edu/nlsi/education/hsResearch/
Informal Education Programs
The LPI E/PO team, with LaConte as the Informal Education Lead, strives to prepare and support informal educators in engaging and educating their audiences about Earth and planetary science. These educators can be librarians, museum, science center and planetarium staff, and national park personnel. Resources and training are designed to meet audience needs and reflect best practices as identified in educational research. All informal education efforts are evaluated, either by an external evaluator, or through staff-administered pre- and post-content tests and training perceptions surveys. LPI’s informal trainings typically are rated as highly successful; one evaluator notes that LPI’s programs rate significantly above similar trainings. In 2012, 168 informal educators were trained in 7 professional development sessions. Overviews of 2012 program activity are presented below.

Explore! Program – Since 1998, the Explore Program has provided materials and training for children’s and youth librarians and other informal educators to support them in making Earth and space science accessible and engaging to their communities. To date, more than 780 librarians have been trained in 34 states, reaching over 45,000 children annually; many of these libraries and communities are in the Nation’s rural regions. Participants are invited to join a listserv and discussion boards for further interaction and support. http://www.lpi.usra.edu/education/explore/

FY12 activity included:

Delivery of Countdown to Curiosity, a five day experience for 36 librarians and park personnel, at Kennedy Space Center (KSC). The experience, led by Halligan and Shaner, was requested by NASA’s Planetary Science Division in support of the MSL Launch in November 2012. The week included a two-day training sharing Explore Mars activities, featuring Mars science content and presentations by MSL scientists. The training effort partnered with the Mars Public Engagement team, and introduced the Imagine Mars community activity to the participants. Attendees also participated in a behind-the-scenes tour of KSC and on-site viewing of the launch. All participants
were expected to give a minimum of three children’s or family programs at their library/park, including hosting a landing event. Two webinar sessions were held subsequent to the training to provide mission updates and support the participants in implementing their programs. It is estimated that 100 events were held in the months leading up to the landing, engaging thousands of children and family members. In addition, LPI worked with the American Library Association (ALA) to electronically distribute information about the landing – and ways libraries could bring Mars and the MSL landing into their programs – with 10,000 members of ALA.

A recent Explore effort, funded by a supplemental E/PO grant to two LPI scientists and led by Halligan, brings the science of astrobiology and Mars to libraries with a focus on engaging girls. Explore: Life on Mars? partnered with the NASA Astrobiology Institute and the National Girls Collaborative Project (NGCP) to create a module of activities featuring female astrobiologists that specifically appeals to learning preferences of girls. The first librarian training was conducted for 24 librarians in April, 2012, at the University of Wisconsin-Madison in collaboration with the Wisconsin Astrobiology Research Consortium and the Wisconsin State Library. Evaluation data indicate the participants are excited and prepared to implement the program in their communities. Further trainings and continued evaluation are planned, and the materials are being prepared for NASA product review and online access.

Librarians from Wisconsin participate in hands-on activities that can be used to engage their patrons in determining what signatures past or present life might present on Mars.

LPI supports the Juno Mission E/PO through Explore trainings for children’s and youth librarians. LPI previously developed a module of activities to engage children and families in the library setting; the materials have been through NASA product review and are available online. In FY12 two Jupiter’s Family Secrets trainings were offered: 26 library, museum staff and park interpreters attended a training at State College, Pennsylvania on May 21-22, 2012; and 21 librarians participated in a training in Morgantown, West Virginia on September 20-21, 2012. The training model for Juno has LPI returning to the mid-East coast region for a total of five trainings. The intent is to build a sustainable network in the region that will continue after trainings are completed. To augment the network, LPI is working with librarian “mentors,” a subset of the participants who learn the content
and activities at a deeper level and will be able to support other librarians in the region in implementing their programs.

LPI works with Southwest Research Institute’s Center for Lunar Origin and Evolution, one of the NLSI teams, to prepare librarians to engage children and families in lunar science through the use of the LPI-developed Marvel Moon module of hands-on activities. Through the program, focusing on librarians serving underserved and underrepresented audiences, one face-to-face training and a two-part webinar are offered each year. Fifteen librarians and informal science educators attended the two-day professional development training at Butte-Silverbow Public Library in Butte, Montana, on September 6-7, 2012 to explore the formation and evolution of the Moon, and its influence on Earth and humans. Training included live and virtual presentations by SwRI NLSI scientists, as well as implementation of the module activities and exploration of how the participants will integrate the content and materials into their own programs. A two-part webinar exploring the content and hands-on activities, presented in August and September 2012, was attended by 30 informal educators. The module of materials is being prepared for NASA product review. All materials are available online. http://www.lpi.usra.edu/education/explore/marvelMoon/

Through an NSF grant to the Space Science Institute (SSI), the LPI is partnering with SSI, ALA, and NGCP to prepare library staff to engage patrons in traveling exhibits. LPI has created modules of activities to accompany the Discover Earth and Discover Tech exhibits, currently on tour to 10 and 8 rural libraries, respectively. LaConte completed the Discover Tech module in the spring of 2012. The module currently is being field tested. LPI helped to design and implement the two-day training for Discover Tech host librarians with the Discover Tech team in November, 2012 at the Louisville Public Library.

Traveling Library Exhibit Program - Six traveling exhibits, designed to engage the general public in lunar science and exploration, and to share NLSI research, are available for loan to libraries, science centers, planetariums and other informal learning institutions serving primarily underserved and under-represented audiences. The exhibits include how the Moon formed, the scientific relevance of lunar exploration, and lunar craters. Three more exhibits currently are in development. As of September 2012, the exhibits have visited 24 unique locations and been viewed by 100,000 visitors. Two additional exhibits are ready for fabrication and two are in development. http://www.lpi.usra.edu/nlsi/education/exhibits/

LRO Mission Informal Education Programs – The LRO Mission E/PO team has developed materials appropriate for use in informal educational settings. These materials include visualizations, docent programs for Science On a Sphere, and the International Observe the Moon Night outreach program. The LPI team has conducted professional development for informal educators on these materials, and all materials developed under the program have been compiled and will be posted on the LRO website (http://lro.gsfc.nasa.gov). In FY13, LRO Informal education will focus its efforts on modifying existing formal educational products for informal audiences, and conducting professional development on those products with afterschool providers.

MAVEN Mission to Mars Informal E/PO Programs – The LPI team is leading the development of a program about the MAVEN Mission for Science On a Sphere (SOS) audiences. Science On a Sphere is a system that is used to project planetary and Earth data on a three-meter sphere. There are currently over 70 installations around the United States and the world. The MAVEN SOS program will discuss the importance of solar wind and atmospheric interactions, and the role the Sun may have played in changing the climate of Mars over time. The program, intended for use by museum educators, is targeted at middle school audiences, will run approximately 20 minutes, and
include interactive, hands-on components. LPI will be leading professional development on the program for SOS educators in FY13.

OSIRIS REx Asteroid Sample Return Mission Informal E/PO Program – Members of the LPI education team are part of the OSIRIS-REx EPO team, and although the work will not begin until FY15, LPI will lead a major portion of the OSIRIS-REx informal education program. LPI will adapt materials developed by OSIRIS-REx formal educational partners using the Explore library model and conduct professional development training for librarians and other informal education providers over the course of the mission lifetime, which ends in 2024.

Community Engagement
The LPI E/PO team works to engage the local – and extended - community in lunar and planetary science and exploration.

SkyFest - Several times a year, LPI partners with the Johnson Space Center Astronomical Society to engage families in SkyFest, a celebration of celestial events or NASA milestones. Each event includes presentations by LPI staff scientists and post-docs, hands-on explorations, story time reading, and telescope viewing. The events are thematically based, with all activities tied to central learning themes and messages; parents are provided resources to continue exploration at home. Preliminary evaluation data indicate families enjoy the events, learn new information, and are more likely to pursue other science activities as a result of participating. In 2012, five SkyFest events were held, including Exploring Icy Worlds in our Solar System, Winter Wanderers Planetary Viewing, the Transit of Venus, the Mars Science Laboratory Curiosity Rover Landing, and the International Observe the Moon Night. Each event was attended by an average of 210 children and family members.

Young SkyFest explorers make observations about the characteristics of ice.
International Observe the Moon Night (InOMN) - LPI partnered with several organizations, including the NASA Lunar Science Institute, to design, implement, and host two InOMN events in FY12, led by Hsu. LPI oversaw the InOMN website. The first event was October 8, 2011. Over 625 sites registered events internationally, with 115,000 attendees recorded in more than 50 countries. Events were hosted locally at Goddard (600 attendees) and by LPI in collaboration with the Johnson Space Center Astronomical Society and Astronomy Day efforts at the George Observatory in Houston, Texas (350 direct participants). LPI E/PO team members interacted with the public, displayed Moon rocks, and conducted hands-on activities to help engage and educate visitors about lunar science and exploration. The 2012 InOMN event was held on September 22. The event was dedicated to Neil Armstrong, and visitors were encouraged the public to 'wink at the Moon.' Over 575 events were held internationally in 46 states and 49 countries. Events were hosted by LPI staff at Goddard (approximately 400 participants) and LPI (300 participants). http://observethemoonnight.org/.

![Visitors at the 2012 Goddard InOMN event take a telescopic lunar tour.](image)

Cosmic Explorations Lecture Series - LPI offers an annual lecture series, led by Shaner, designed to engage inquisitive adult members of the general public in current relevant topics in space science. The FY12 series celebrated the Year of the Solar System and the new worlds and new discoveries that are fundamentally changing our relationship with and understanding of our solar system. On average, 150 inquisitive adults attend each lecture. The FY13 series presents: A User's Guide to the Universe: You Live Here, Here's What You Need to Know. http://www.lpi.usra.edu/education/lectures/

MyMoon - LPI is collaborating with lunar scientists, educators, artists, and the public to engage a population of new lunar enthusiasts between 18 and 25 through an online educational new-media portal. The target audience is invited to interact with lunar content that informs them about NASA's lunar science research and missions, and engages them in future plans for lunar exploration through online webcasts, exhibits, events, contests, and opportunities for involvement. A distributed "street team" of five to ten members of the target audience has been created to encourage participation. The street team is using social media to engage the target audience in the conversation about Moon in culture, science and exploration. Efforts over the next year will continue to focus on community development and developing a long-term strategy for MyMoon using the formative and summative evaluation results. http://www.lpi.usra.edu/mymoon/

Service to the NASA Science Mission Directorate E/PO Community

Programs Planetary Science E/PO Forum – LPI, in collaboration with NASA's Jet Propulsion
Laboratory, Emily A. CoBabe and Associates, Sustainability Schools Consulting, LLC, and the Midcontinent Research for Education and Learning (McREL), supports the NASA Science Mission Directorate (SMD) in the coordination of the Planetary Science Division E/PO community efforts to increase the overall coherence of the SMD E/PO program leading to more effective, sustainable, and efficient utilization of SMD science discoveries and learning experiences. The community includes approximately 150 education specialists and scientists. LPI coordinates communications from NASA Headquarters and SMD, provides orientation and resources for new members, facilitates collaboration and leveraging of resources and efforts among community members, offers professional development based on community needs, and coordinates cross-community thematic efforts. FY12 activities included hosting monthly community tag-ups, leading the annual community meeting in collaboration with the Heliophysics E/PO Community, organizing data calls for the SMD E/PO portfolio, managing the use and revision of the SMD E/PO community online workspace (http://smdepo.org), overseeing the Year of the Solar System (YSS) resource dissemination, offering face-to-face online professional development training, coordinating conference participation, engaging scientists through the development of new tools and resources, engaging higher education planetary science faculty through EarthSpace (http://www.lpi.usra.edu/earthspace/), supporting SMD E/PO portfolio analysis and one-stop-shop design and development, and participating in audience-based working groups. Presentations and posters about these efforts were presented at various conferences, including the American Geophysical Union Conference in San Francisco and the Lunar and Planetary Science Conference in Houston.

Earth Forum – LPI holds two positions on the NASA SMD Earth Science E/PO Forum (ESEPOF) leadership team: the Informal Education Lead and the Lead for Scientist Engagement. Both Leads help coordinate community efforts and communication within the ESEPOF, with other NASA Science Mission Directorate E/PO Forums, and with NASA Headquarters. Responsibilities also include representing the ESEPOF in several of the cross-Forum Working Groups, representing the ESEPOF at annual conferences, leading content specific focus groups, co-leading the Reflecting on Practice (RoP) professional development program with the LPI E/PO team, serving on the cross-Forum Reporting Implementation Team, and collecting data on all NASA-funded Earth Science E/PO programs and activities for the annual Earth Forum Data Call. All of these efforts will continue in FY13, with plans to expand RoP to bring it to the larger NASA E/PO community.