



Lunar Exploration Analysis Group
Report to the Planetary Science Subcommittee
5 October 2015

exploration science resources commerce

LRO NAC – Orientale Basin

Reconstituted Executive Committee

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Dana Hurley – Lunar Volatiles (Johns Hopkins University Applied Physics Lab)

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Ex Officio

Ben Bussey, NASA-HEOMD

Sarah Noble – NASA-SMD

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Leslie Gertsch – Space Resources Roundtable

Mike Hawes – Lockheed Martin

Jim Keravala – Shackleton Energy

Eric Reiners – Caterpillar

Kevin Peterson – Astrobotic CTO

Bruce Pittman – NASA Ames (Space Portal)

Bob Richards – Moon Express

Kris Zacny – Honeybee Robotics

* Charter currently being drafted

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LEAG Activities 2015

- **Annual Meeting: 20-22 October, USRA HQ, Columbia, MD**
 - ~100 registrants so far, strong push to get early career researchers involved
 - Focus on Recent Lunar Activity and ISRU
- **New Views of the Moon II**
 - Chapter leads identified and being contacted;
 - Talk at EPSC last month;
 - First workshop scheduled 24-26 May 2015 @ LPI.
- **Geological Astronaut Training SAT**
 - Recently stood up;
 - Not currently part of official astronaut training – ad hoc only;
 - Dean Eppler and Jake Bleacher co-chairs.
- **Involvement in the ISECG Global Exploration Roadmap**
 - “Humans to the Lunar Surface” part of Science White paper;
 - Version 3 currently being revised by the international team;
 - The plan: Final version due end of October.

LEAG Activities 2015 (cont.)

- **ESA Topical Team response to the V-SAT Report**
 - Substantial agreement with V-SAT findings, with some differences and changes of emphasis;
 - V-SAT membership currently working with the Topical Team.
- **Presentation to National Academies Space Studies Board**
 - “The Scientific and Exploration Benefits of Human Lunar Exploration”;
 - 4 November 2015, UC Irvine.
- **Re-vamping the LEAG website:**
 - “Science nuggets” page initiated;
 - Community asked to supply nuggets;
 - On going project.

Community Concerns

- LRO Budget – Jim Green discussed in his presentation; waiting for the budget after the CR

Future Activities

- Workshop on the Nature of the Lunar Mantle
- International Lunar Workshop wrapped in to NVM II
- LEAG Townhall at LPSC 47
- NGLSE-LEAG networking “meet-and-greet” session at LPSC 47

Science Nuggets

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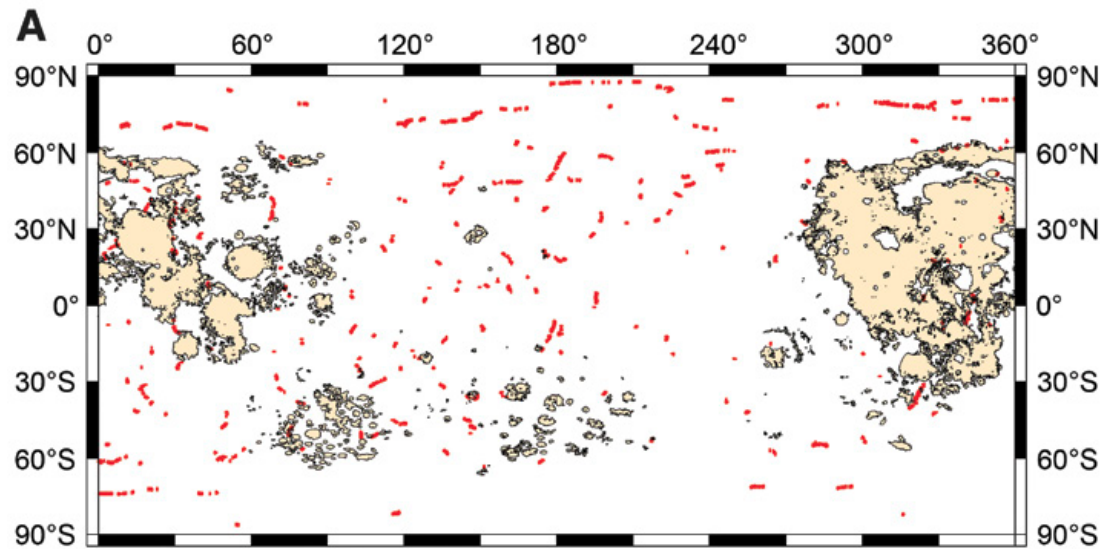
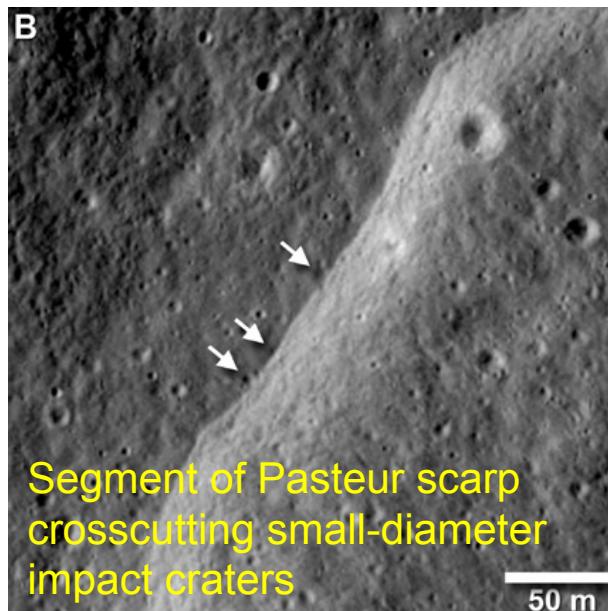
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LUNAR EXPLORATION ANALYSIS GROUP

Global thrust faulting on the Moon and the influence of tidal stresses

Thomas R. Watters, Mark S. Robinson, Geoffrey C. Collins, Maria E. Banks, Katie Daud, Nathan R. Williams, and Michelle M. Selvans (2015) *Geology* **43**, 851-854.

- LROC images – 3200 lobate thrust fault scarps on the Moon.
- Estimated to be <50 Ma and maybe actively forming today.
- Non-random distribution consistent with late-stage global contraction.
- Present-day tidal stresses potentially activate these thrust faults.
- Possibly produce the enigmatic shallow moonquakes recorded by Apollo, some of which had body wave magnitudes ≥ 5 .

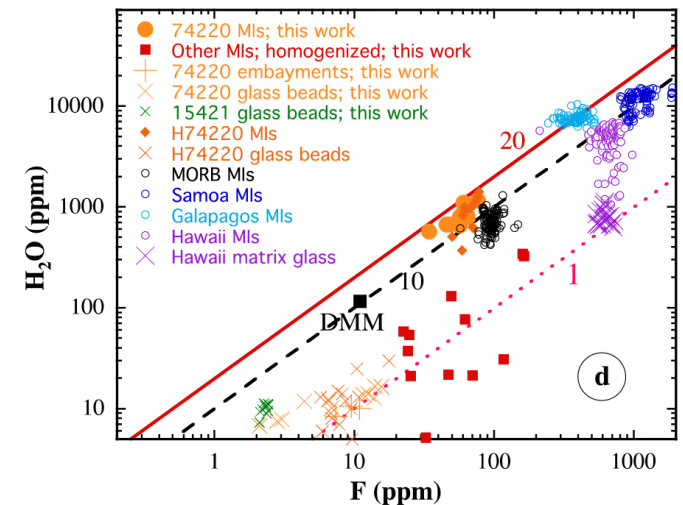
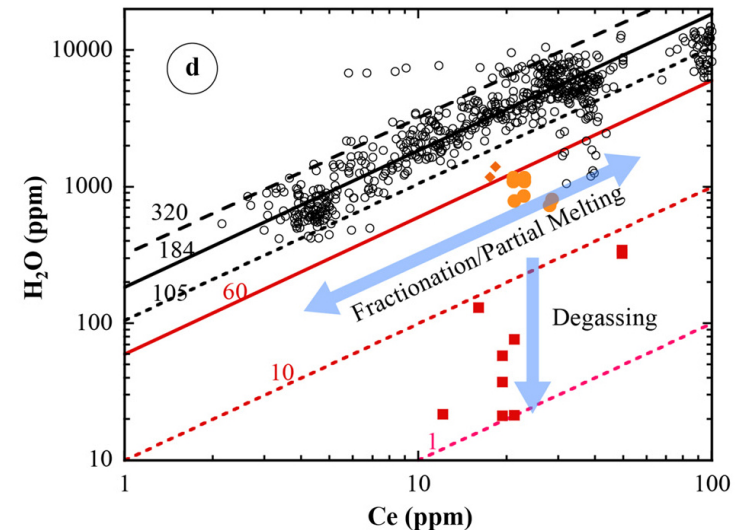


Map of digitized locations of lobate scarps on the Moon

Water, fluorine, and sulfur concentrations in the lunar mantle

Yang Chen, Youxue Zhang, Yang Liu, Yunbin Guan, John Eiler, Edward M. Stolper
(2015) *Earth & Planetary Science Letters* **427**, 37-46

- Analysis of volatiles in melt inclusions in 74220, 15421, 10020, 12008, 15016.
- Results by Hauri et al. (2011) for 74220 are not anomalous.
- Approximate constancy of volatile depletion in the Moon relative to the Earth explained by assuming that both acquired volatiles from a similar source or by a similar mechanism, but the earth was more efficient in acquiring the volatiles.
- The H₂O, F and S concentrations in the primitive lunar mantle source to be similar to or slightly lower than those in terrestrial MORB mantle.

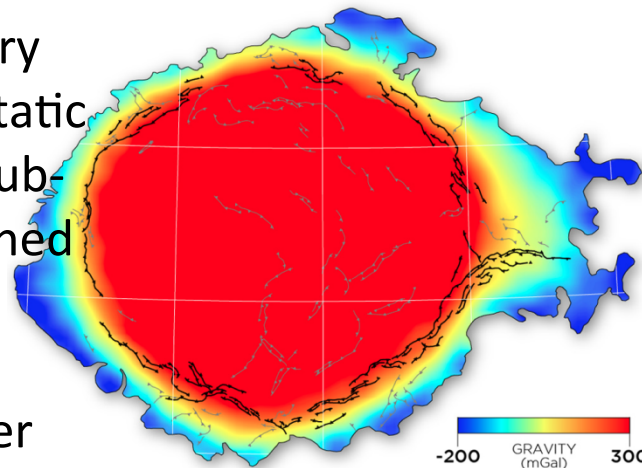


Deep-seated thrust faults bound the Mare Crisium lunar mascon

Paul K. Byrne, Christian Klimczak, Patrick J. McGovern, Erwan Mazarico, Peter B. James, Gregory A. Neumann, Maria T. Zuber, Sean C. Solomon (2015) *Earth & Planetary Science Letters* **427**, 183-190.

GRAIL data, LROC WAC DTM, and finite element modeling show that the deep-seated thrusts may have been localized by the boundary between the super-isostatic mantle material and a sub-isostatic collar of thickened crust that resulted from basin formation and modification shortly after impact. Other mascons formed in a similar manner.

GRAIL free-air gravity anomaly map (to degree and order 320) for the interior of Mare Crisium.



Tectonic landforms and physiography of Mare Crisium. (a) Structural map of the basin interior. (b) Color-coded elevation map of the mare deposits.

