Mission Home
- Summary
- Fact Sheet
- Objectives
- Mission Team
- Orbit View

News

Presentations

Background Science
- Electric Spacecraft Propulsion
- Moon

Spacecraft
- 3D Model
- Instruments

Mission Operations
- Launch Vehicle
- SMART-1 Launch Campaign
- Launch Phase
- Lunar Capture
- Lunar Orbit
- Lunar Impact
- Status Reports

Mission Background

Services
- Publications
- Conferences
- Calendar
- Subscribe
- Glossary

Images and Videos

21-Jul-2009 19:38:42 UT

Print this Email this

From SMART-1 to LRO/LCROSS: precursors for lunar exploration

17 Jun 2009

On the occasion of the launch of the two NASA missions LRO and LCROSS (due on Thursday 18 June, 21:12 GMT), we have asked some questions to Bernard H. Foing (BHF), ESA project scientist for SMART-1 and Executive director for the International Lunar Exploration Working Group (ILEWG).

Q: *How did SMART-1 prepare for LRO and LCROSS?*

BHF: SMART-1 mission tested new propulsion and miniaturisation technologies. It also provided some data helping for future lunar exploration and human expeditions. The SMART-1 instruments delivered images and spectral analysis on sites of interest for scientific studies or exploration. Over more than one year, SMART-1 studied illumination daily variations at the poles, and identified peaks of quasi-eternal light that could be used for future robotic outposts and international lunar bases. In addition SMART-1 X-ray and infrared instruments gave information on lunar elemental and mineral resources. Finally the SMART-1 impact observation campaign could be used as "dry run" for the LCROSS water detection observation campaign. SMART-1 has been a precursor for the Robotic Village and the International Lunar Base that have been advocated by the International Lunar Exploration Working Group (ILEWG).
LRO will extend this at much higher spatial resolution with an extensive set of cameras, instruments and techniques to deliver the data needed for preparing safely future human expeditions.

Q: *Do you believe there is water ice at the poles? If so, do you believe it is uniformly spread, or secluded in small pockets?*

BHF: I would expect the water ice could come in thin layers separated by layers of covering protective dust layers. The ice thickness would vary with the history of bombardment of comets and water rich asteroids, but also could come in patches on the surface.

Q: *How could it have stayed frozen inside shadowed craters, without sublimating into the lunar exosphere?*

BHF: Layers at temperatures colder than 80 Kelvin (about -190 °C) would take billion of years to sublimate, if protected early enough from sputtering by meteorites or from energetic solar wind particles.

Q: *What have the Lunar Prospector, Chandrayaan-1 and Kaguya missions found that supports or casts doubt on the theory of lunar ice?*

BHF: The theoretical prediction for lunar ice comes from studies by Watson (1961) and Arnold (1979). Lunar orbiter IV showed already areas of permanent shadow, later imaged by Clementine

RELATED LINKS
- SMART-1 Mission Review
- SMART-1 Impact Flash and Debris: Crash Scene Investigation
- SMART-1 south pole maps
- Help to define a lunar lander (ESA request for information)
- International Lunar Exploration Working Group (ILEWG)
- LRO NASA website
- LCROSS NASA website

and SMART-1. Clementine found anomalous bistatic radar reflection that may be interpreted as surface ice or surface roughness. Lunar Prospector detected an enhancement of H content in polar areas that could be due to trapping of comet ice (up to 1% mixed with soil) or solar wind Hydrogen. Kaguya did not find extensive surface deposits in the bottom of Shackleton crater that seems to be too warm to host extensive surface ice.

***Q*:** *How will LRO and LCROSS further inform us on the possibility of lunar ice?*

BHF: The LRO camera will provide 1m resolution pictures enabling to characterize future sites. The LRO altimeter, diviner and Lyman alpha mapper will be able to see beyond the visible into permanently shadowed areas and to search for ice deposits. The Chandrayaan-1 and LRO radars will search for near-subsurface water ice. Therefore the open question on lunar ice could be sorted soon. The LCROSS impact will be a key to search and characterise the ice even buried under the dust.
The next challenge for future missions will be to land in the permanently shadowed bottom of a polar crater and extract a few metres core of soil, possibly sampling at once hundred layers of comets (or water rich asteroids) that impacted the Moon in the past 3 billion years!

***Q*:** *What is Europe doing about lunar exploration and future landers?*

BHF: After the SMART-1 development, operations and data analysis, ESA has been involved in Chang'E1, a Chinese lunar mission, and contributed 3 instruments to the Indian Chandrayaan-1 lunar orbiter, still delivering new data. ESA studied a lunar polar lander with objectives to search and characterise polar regions. ESA released a call for ideas for techniques, instruments techniques and experiments that could be accommodated on a lunar cargo lander launched with an Ariane 5 and deploying 1 ton of equipment in support of future human lunar exploration. In April 2009, ESA received 194 proposals to this call showing a large interest from the community.

Contact info
Bernard Foing
ESA SMART-1 project scientist, Bernard.Foing@esa.int
ILEWG executive director

Last Update: 18 Jun 2009