Lunar CRater and Sensing Satellite

An Overview of the LCROSS Impact
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The Team

The LCROSS Science Team

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The Target

Where we went and why

Primary Criteria:
1. Ejecta Illumination
2. Association with hydrogen
3. Observable to Earth
4. “Smooth”, flat terrain

Considered available data, status of LCROSS payload, ability of LRO to observe, and limits of Earth observing for each site.

South Pole on October 9, 4:00 AM PT
Cabeus A:
- Best Earth observing (not perfect since backdrop would have been lit moon)
- Hydrogen association was questionable

Cabeus B:
- No obvious association with hydrogen

Cabeus:
- Obvious hydrogen, but worst Earth observing
The Target

LOLA dem_cyl70Sv2.grd

Centaur

Centaur
The Target

Comparison of Image analysis and Trajectory Estimates for actual impact location
• Impact error ~300 meters
The LCROSS Payload

- NIR (0.9–1.7 um) context imagery
- Monitor ejecta cloud morphology
- Determine NIR grain properties
- Water concentration maps

- NIR (6.0–13.5 um) thermal image
- Monitor the ejecta cloud morphology
- Determine MIR grain properties
- Measure thermal evolution of ejecta cloud
- Remnant crater imagery

- Three color context imagery
- Monitor ejecta cloud morphology
- Determine visible grain properties
- Measure total impact flash luminance

- Visible (425–1,000 nm) emission and reflectance spectrometry
- Sensitive to total volatile soil content, regolith depth, and target strength

- Visible (263–650 nm) emission and reflectance spectrometry
- Measure H2O ice features
- Three color context imagery
- Measure H2O ice features
- Occultation viewer to measure water vapor absorption maps

- UV/Vis Spectrometer
- NIR (1.2–2.4um) emission and reflectance spectrometry
- Visible (650–1000 nm) emission and reflectance spectrometry
- Measure grain properties
- Measure H2O ice features
- Occultation viewer to measure water vapor absorption maps

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Impact Observations

LCROSS Visible Camera Image of Ejecta Cloud

10 km
Impact Observations

LCROSS Visible Camera Image of Ejecta Cloud

Field of View of instruments making measurements of the vapor and debris composition
Impact Observations

LCROSS Observations with Model Fit

Only Water Vapor and Ice Included

Model Fit

Brightness

Wavelength (microns)

LCROSS / NASA ARC / A. Colaprete
Impact Observations

Model fit when other compounds are included
Impact Observations

Ratio of Post-to-Pre-Impact

Wavelength (nm)

OH Emission

Band Strength

Time after Impact

Time before Impact

3.0
3.0
2.5
2.0
1.5
1.0
0.5
0.5
310
300
305
310
315
320
Impact Observations

Hydroxyl (OH) Band Strength from UV/Visible Spectrometer

OH Band Strength vs. Time Relative to Impact (seconds)

- Pre-Impact
- Baseline
- Post-Impact
Impact Observations

LCROSS NIR Camera image from about 10 km above surface.
Impact Observations

LCROSS NIR Camera image from about 10 km above surface
Summary:

The impact appears to have occurred in volatile rich area:
• Water and other compounds (e.g., CH4, CO2, SO2, NH3) possibly observed

• Still translating estimates of total water from band depths and OH emission strengths to soil concentration, but amounts are significant

• The very cold temperatures sequester all sorts of materials, from multiple sources, including comets and asteroids