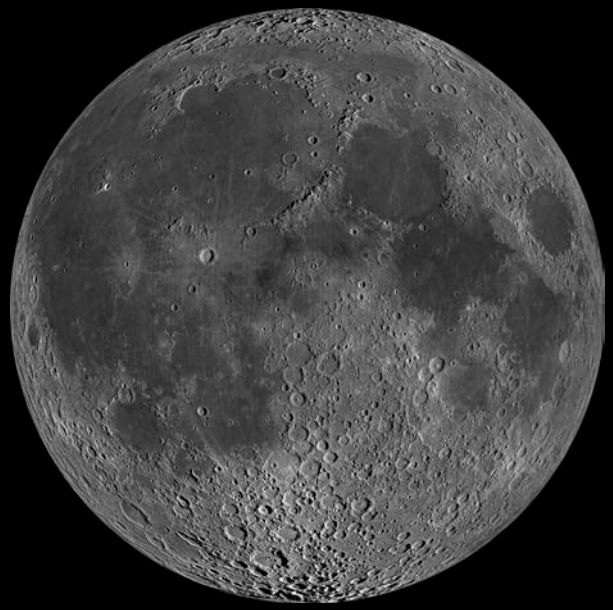
LRO

Science Results

and Ways to Get Involved in NASA Lunar Science



Andrea Jones

Planetary Science Institute, at

NASA's Goddard Space Flight Center

Prelude to the Lunar Reconnaissance Orbiter (LRO): **Why go to the Moon?**

LRO Mission Motivations

Originally:

The first step in a program to extend human presence in the Solar System, beginning with a return to the Moon.

Since expanded:

From exploration to science.

Instruments

What kind of information would you want to collect?

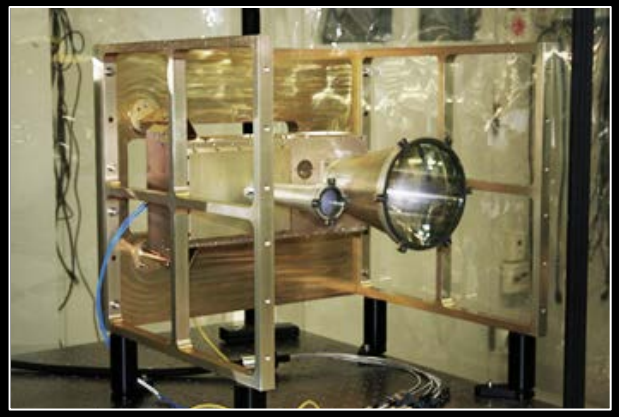
NASA's Choices:

- Detailed characterization of the lunar surface
- Characterize the lunar radiation environment
- Identify resources, such as ice deposits and sunlight
- Identify landing hazards, such as rough terrain or rocks

LRO's Instruments:

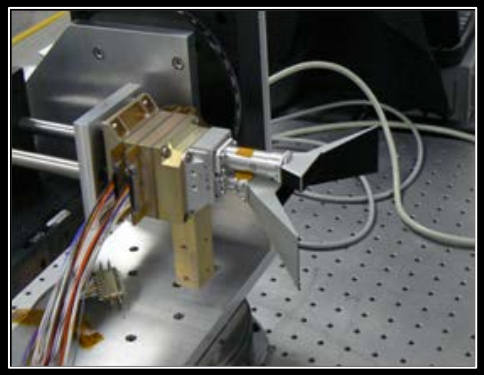
LOLA: Lunar Orbiter Laser Altimeter

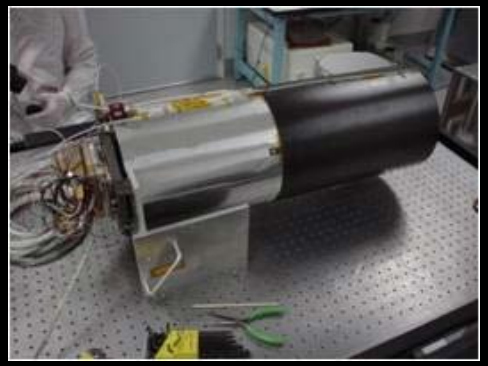
- Uses laser pulses to characterize topography, slope, and surface reflectance
- Can identify areas of permanent sunlight and shadow through analysis of surface elevations



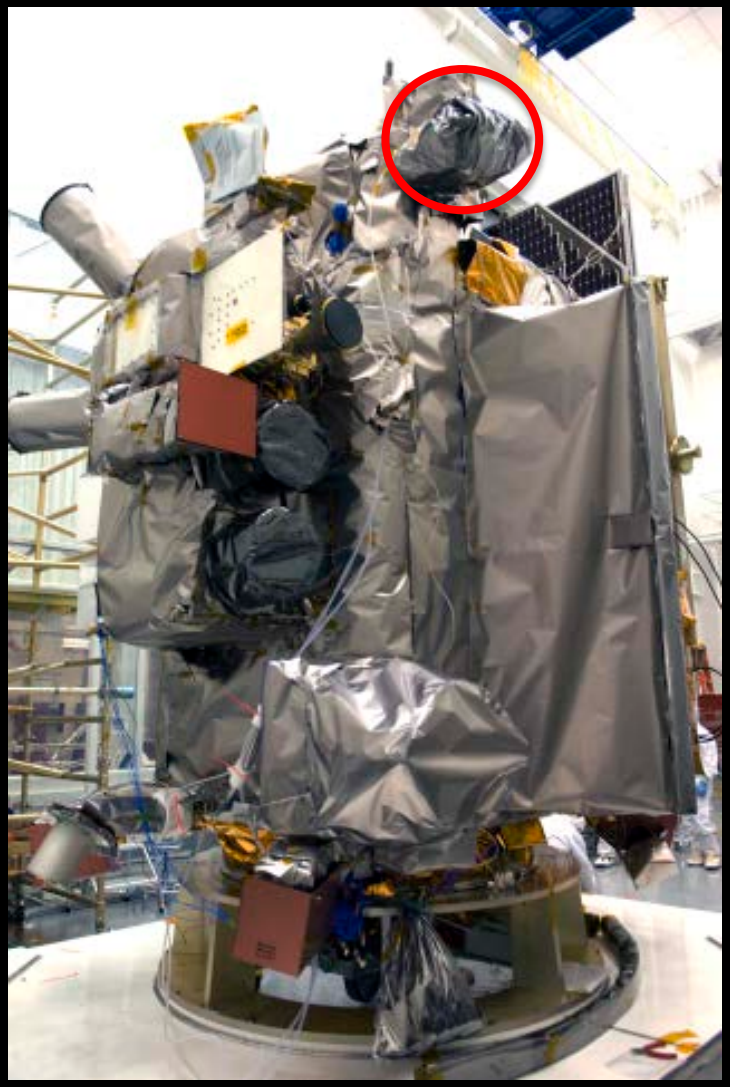
LROC: Lunar Reconnaissance Orbiter Camera

- Visible, UV, and infrared imagery
- High resolution camera
- Images help characterize the surface, identify resources and hazards, and provide polar illumination data





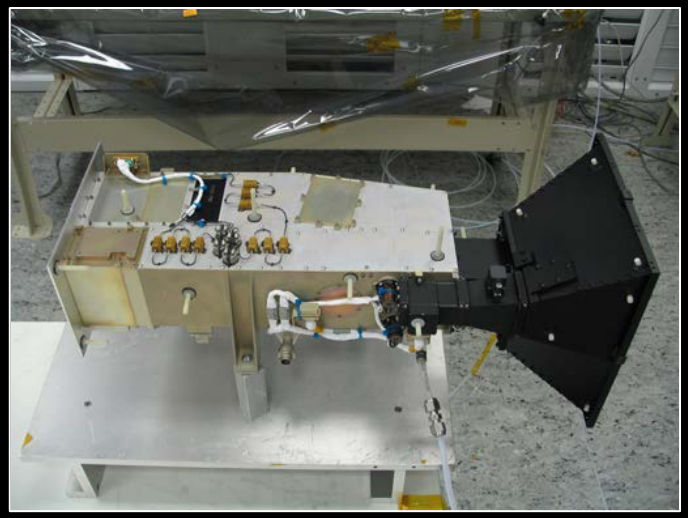
Diviner Lunar Radiometer Experiment



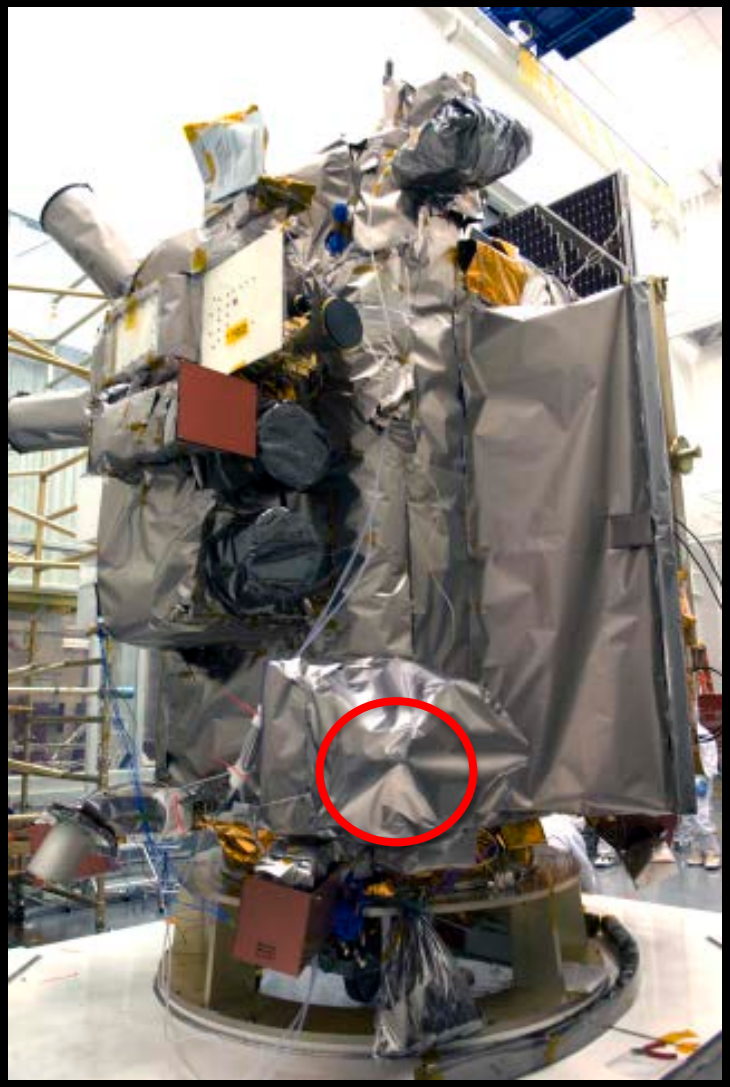
- Measures surface and subsurface temperatures
- Identifies cold traps and potential ice deposits
- Identifies landing hazards, such as rocky terrain
- Helps determine surface composition

LAMP: Lyman Alpha Mapping Project

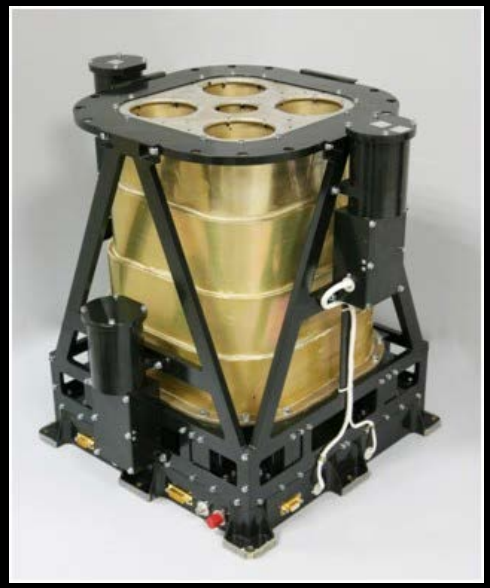
- Measures reflected UV radiation from distant stars
- “Sees inside” permanently shadowed craters



LEND: Lunar Exploration Neutron Detector

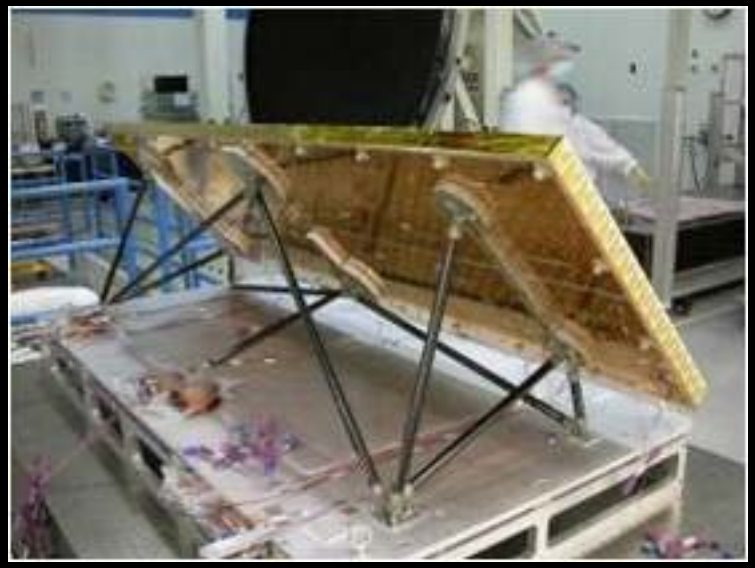


- Measures the flux of neutrons from the Moon
- Identifies potential ice deposits



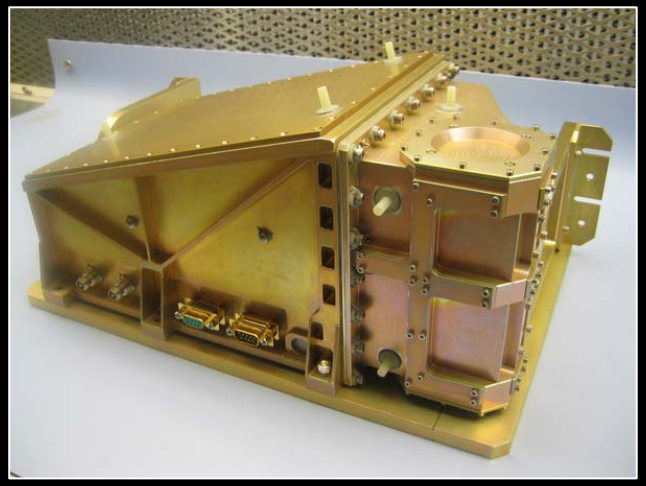
Mini-RF Technology Demonstration

- Measures reflectivity using X and S band radar
- Can identify likely ice deposits
- Can “see” beneath the surface
- Supplements visible imagery



CRaTER: Cosmic Ray Telescope for the Effects of Radiation

- Measures incoming radiation (solar, cosmic background, and reflected lunar radiation)
- Contains a human Tissue Equivalent Plastic to assess biological impacts of radiation



The Lunar Reconnaissance Orbiter (LRO)

Science Objectives

Investigate:

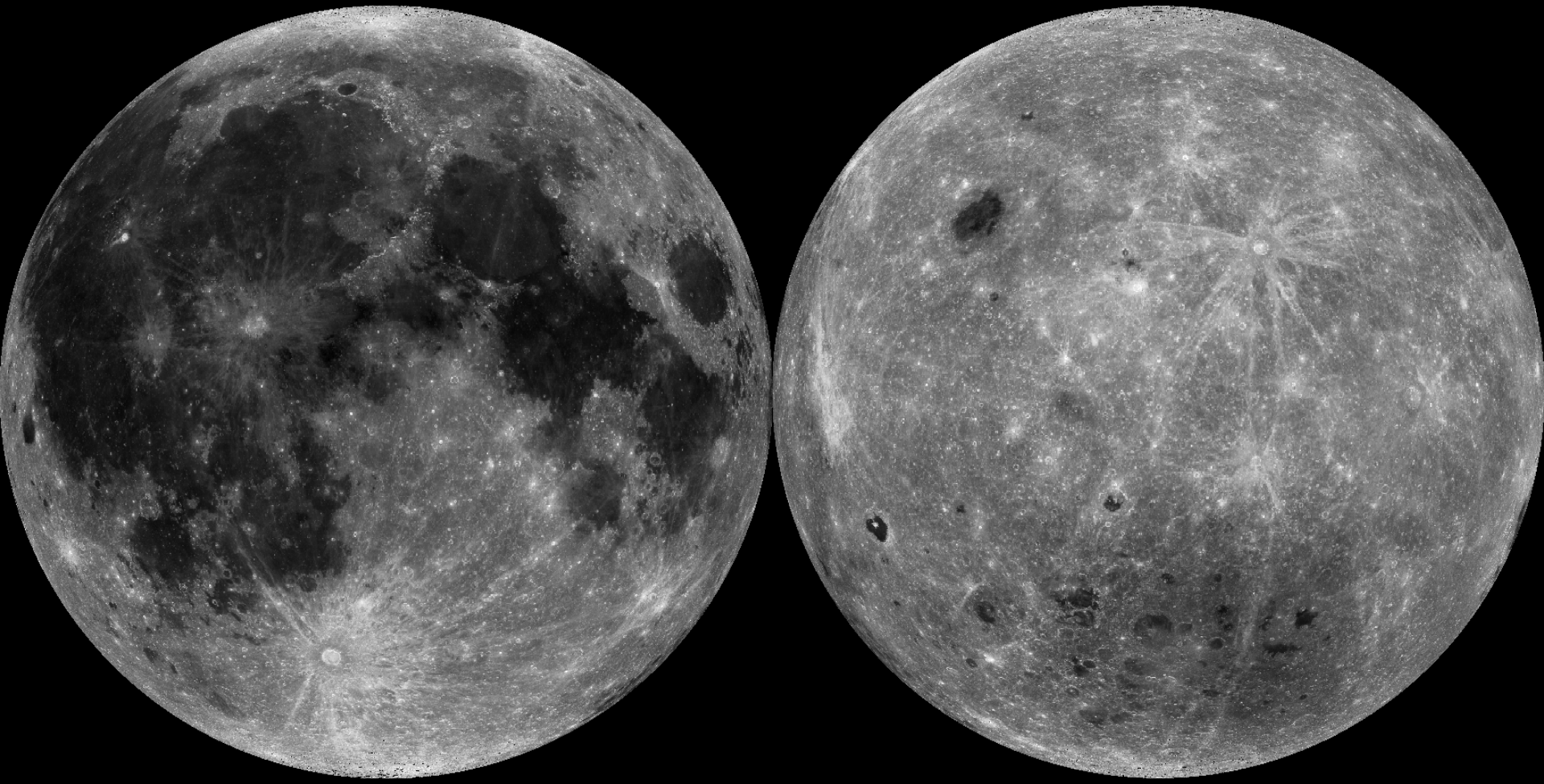
- Impact history of the Moon
- Lunar geologic processes and their role in the evolution of the lunar crust
- Formation of the lunar regolith
- Volatiles on the Moon, especially at the poles
- Lunar radiation environment

Launch!

- June 18, 2009
- Arrived at the Moon 4.5 days later
- 3 months commissioning (instrument check-out)
- Initial 50-km polar mapping orbit
- Sister spacecraft: LCROSS

Science Results

Images of the entire Moon

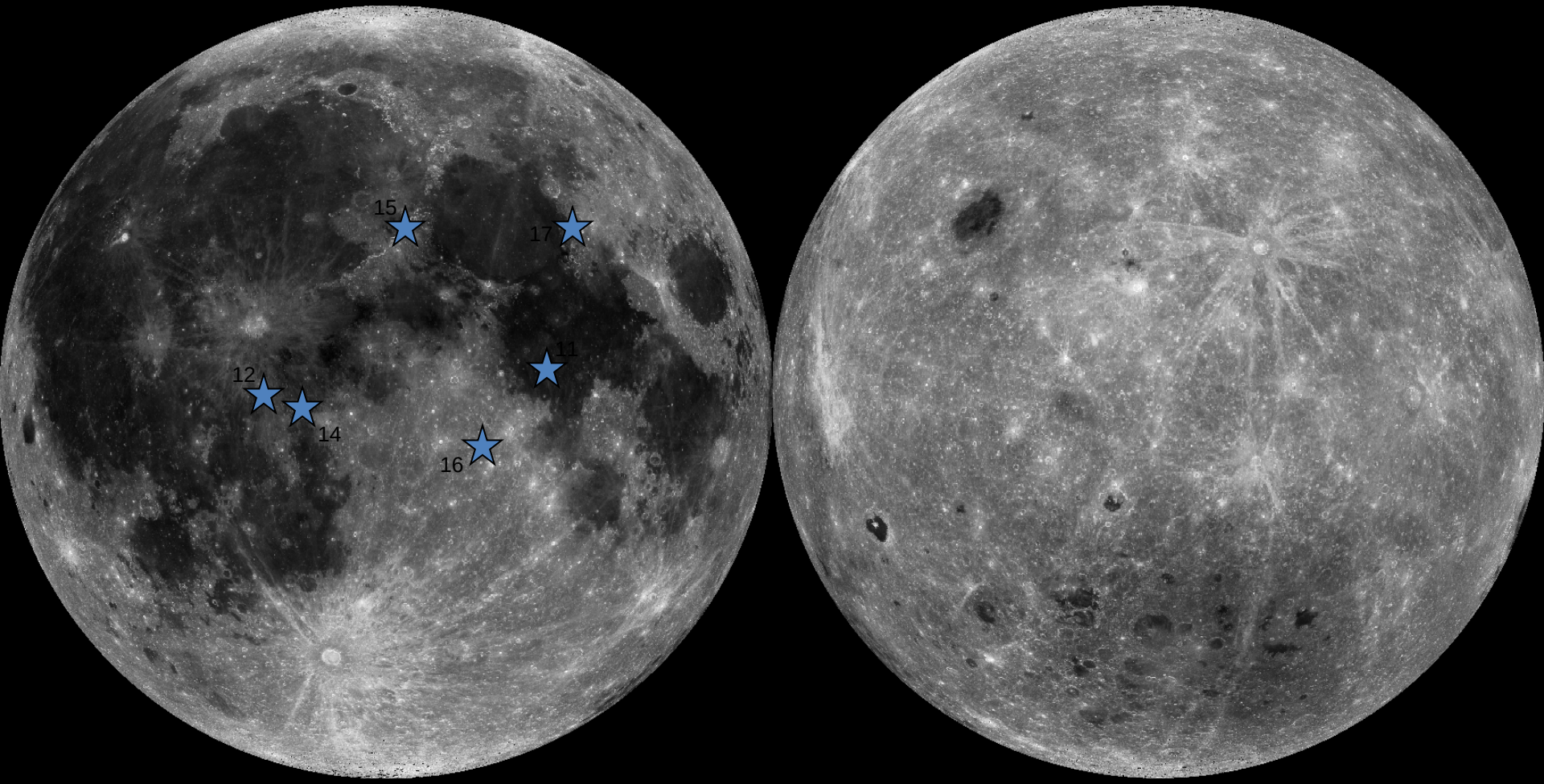


LROC image mosaic
Showing topography

LROC image mosaic
Showing surface reflectance

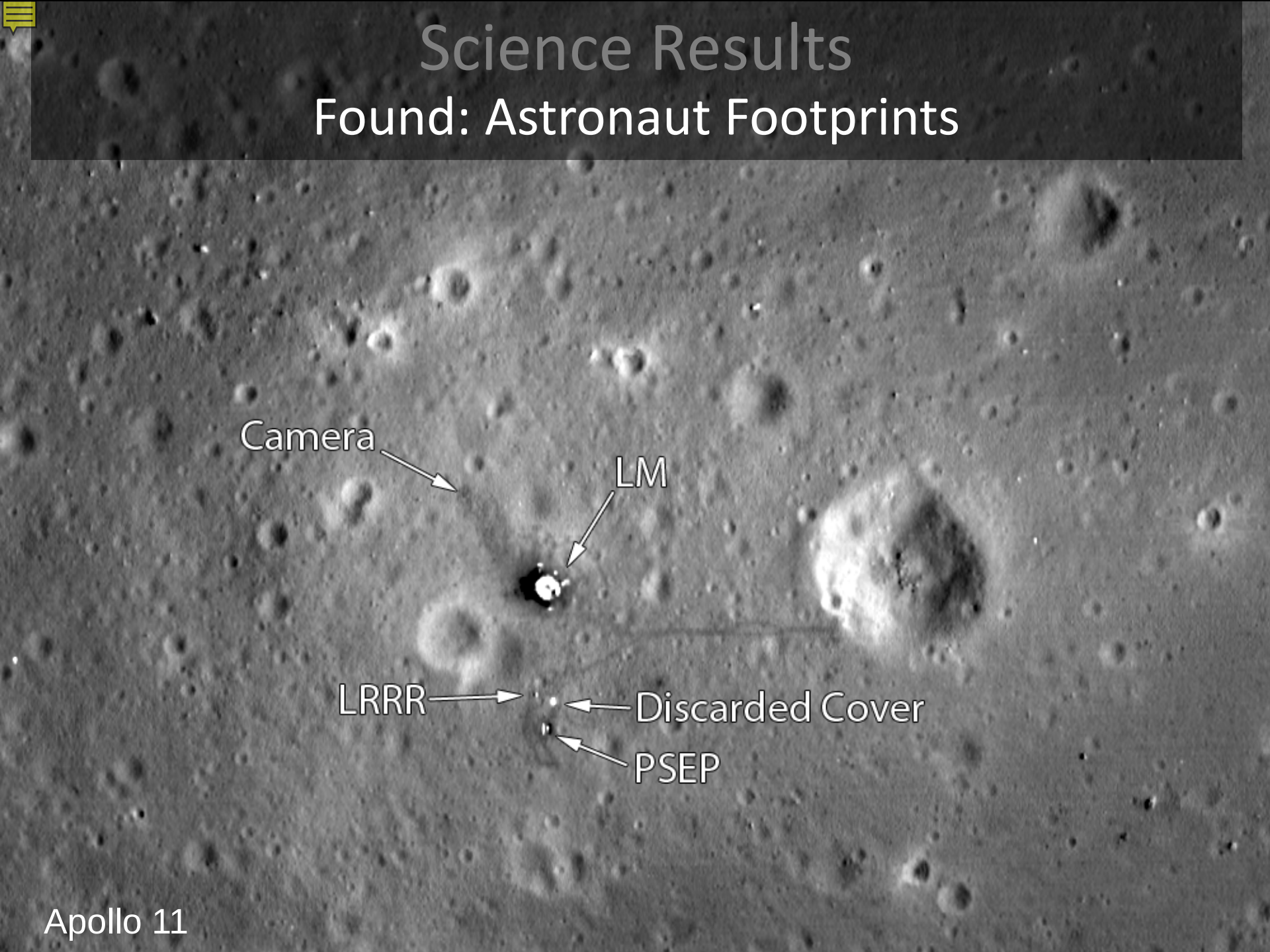
Science Results

Repeat imaging of Apollo landing sites

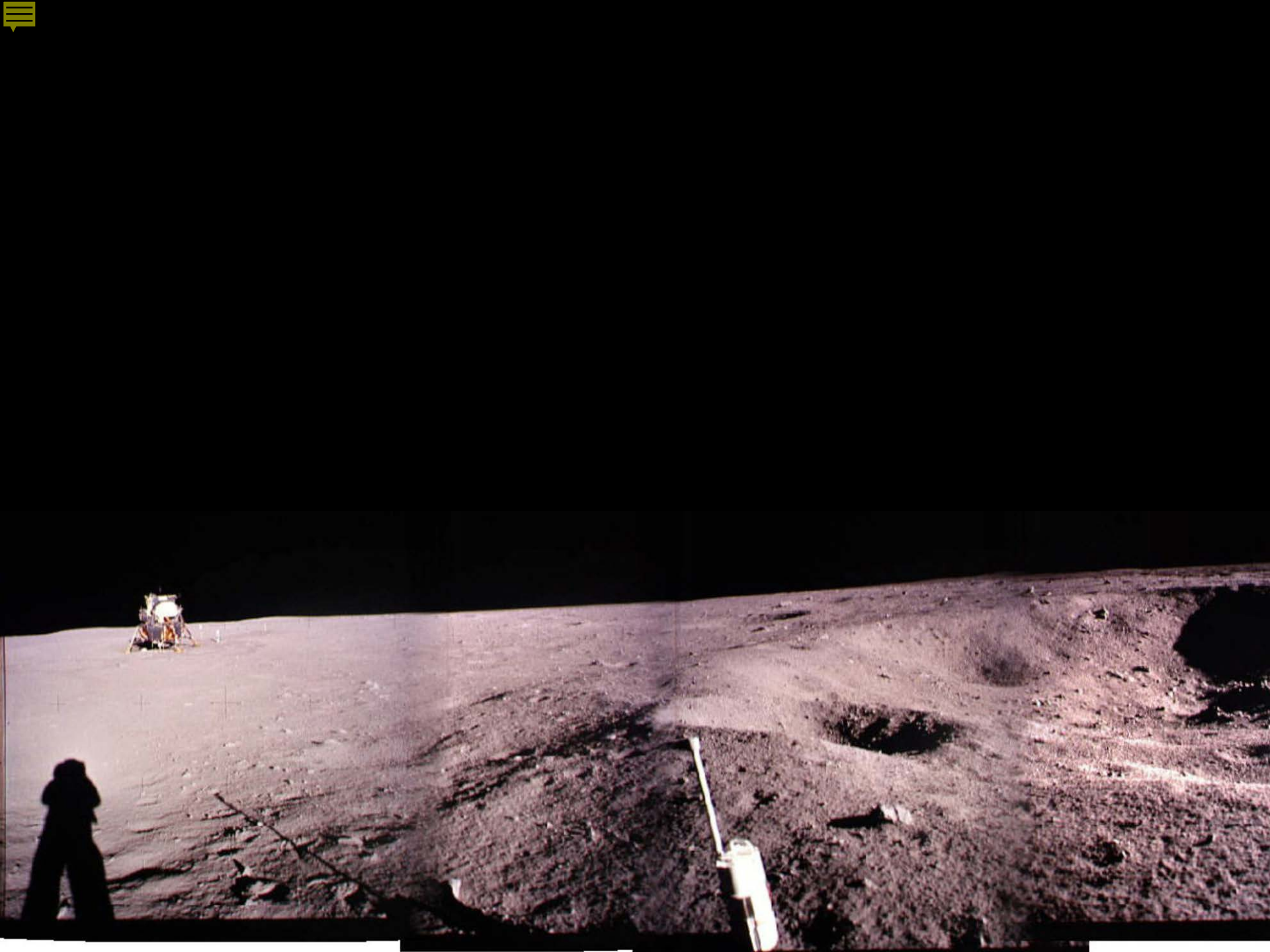


Science Results

Found: Astronaut Footprints



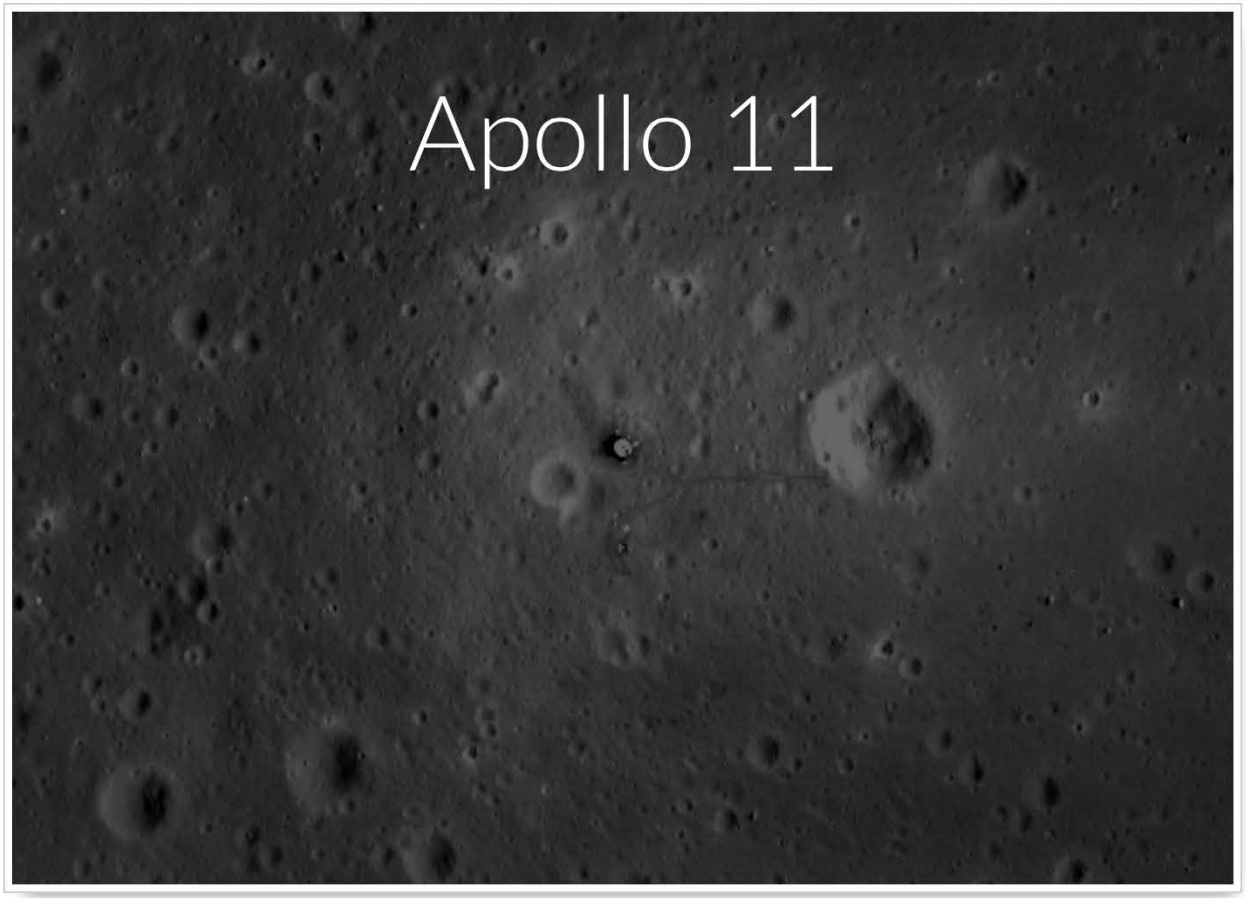
Apollo 11



LROC Featured Sites

Apollo Landing Sites

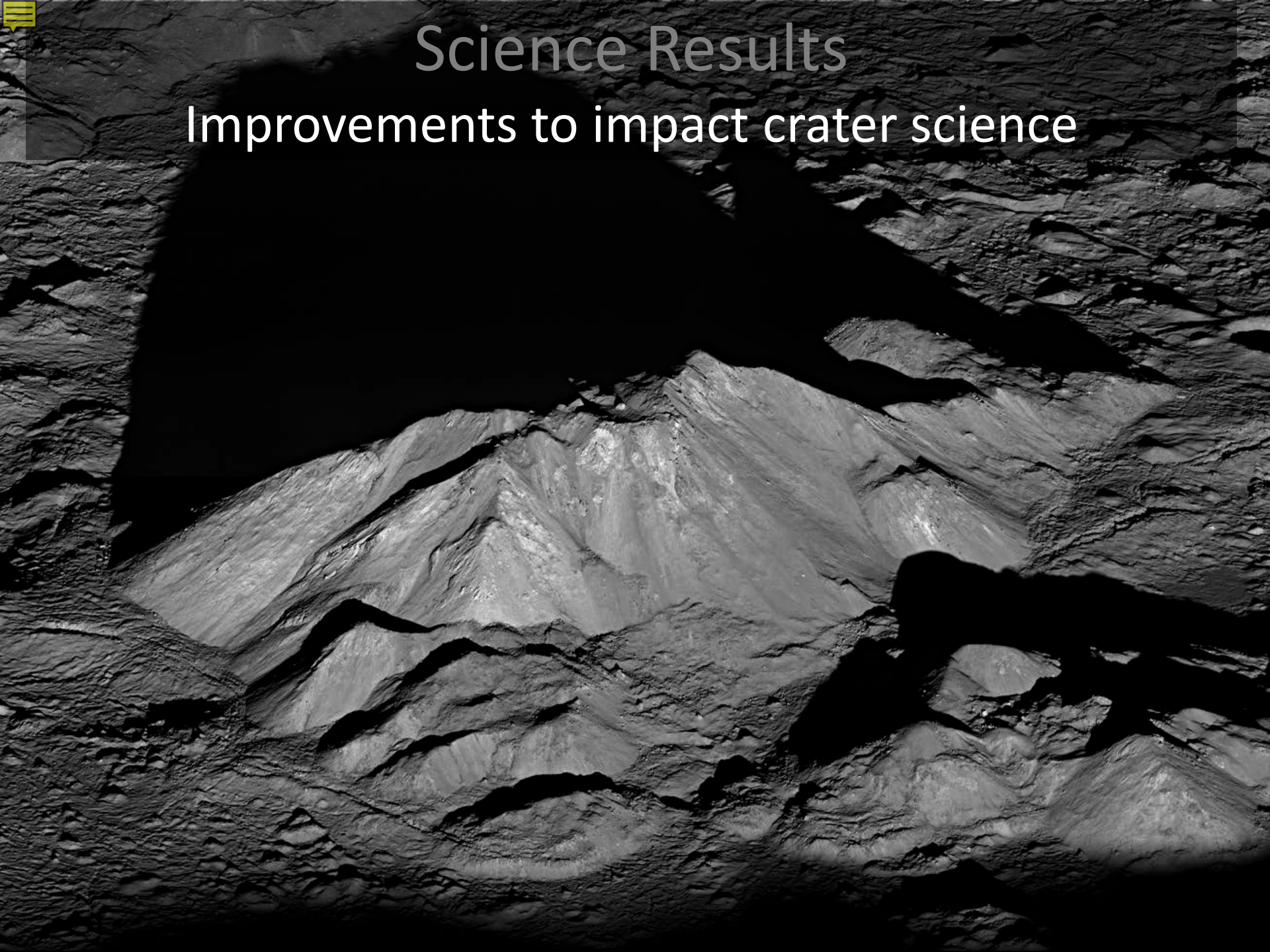
Images
Featured Sites
Quickmap
Videos
Gigapan

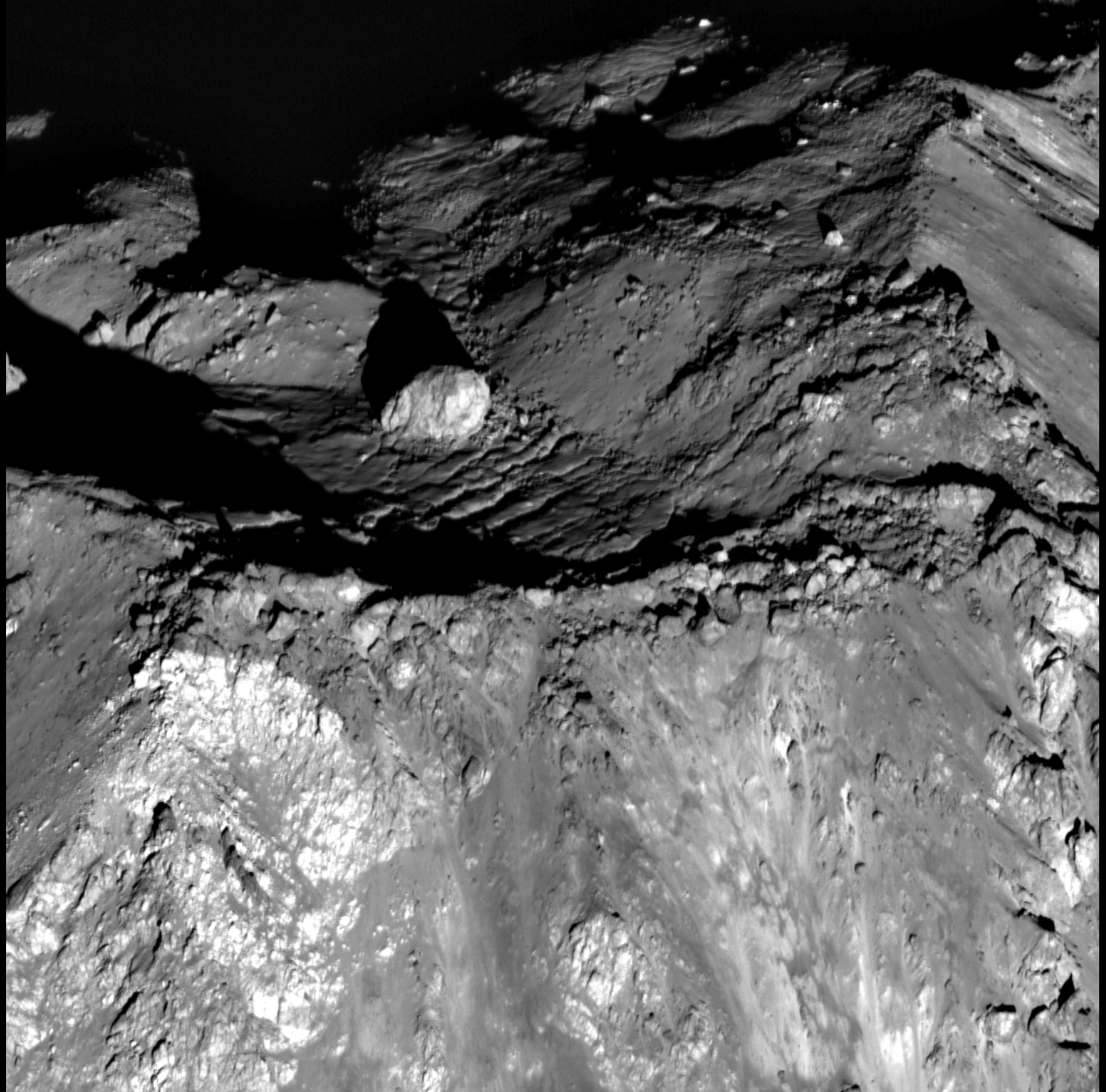


http://lroc.sese.asu.edu/featured_sites

Science Results

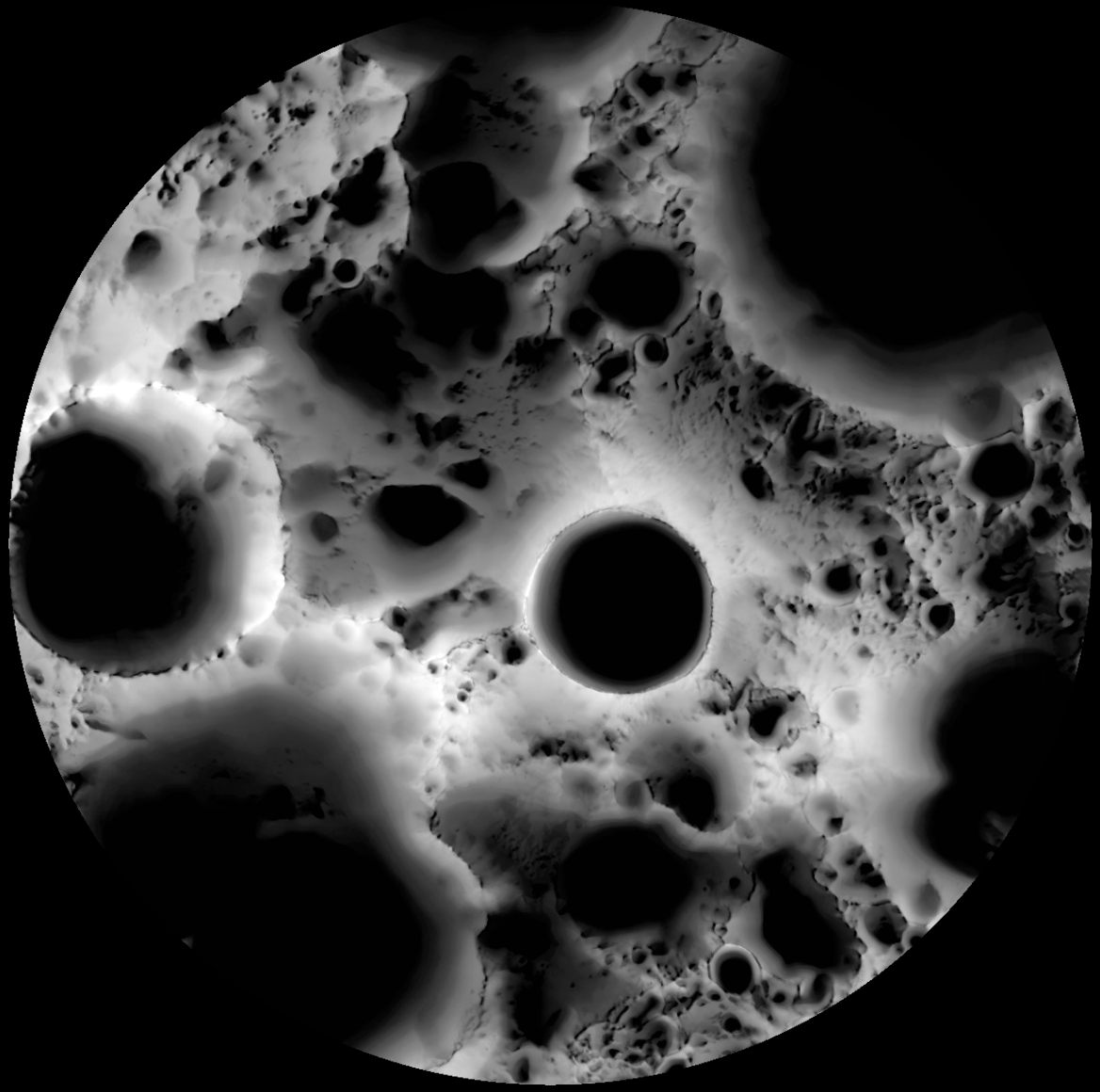
Improvements to impact crater science



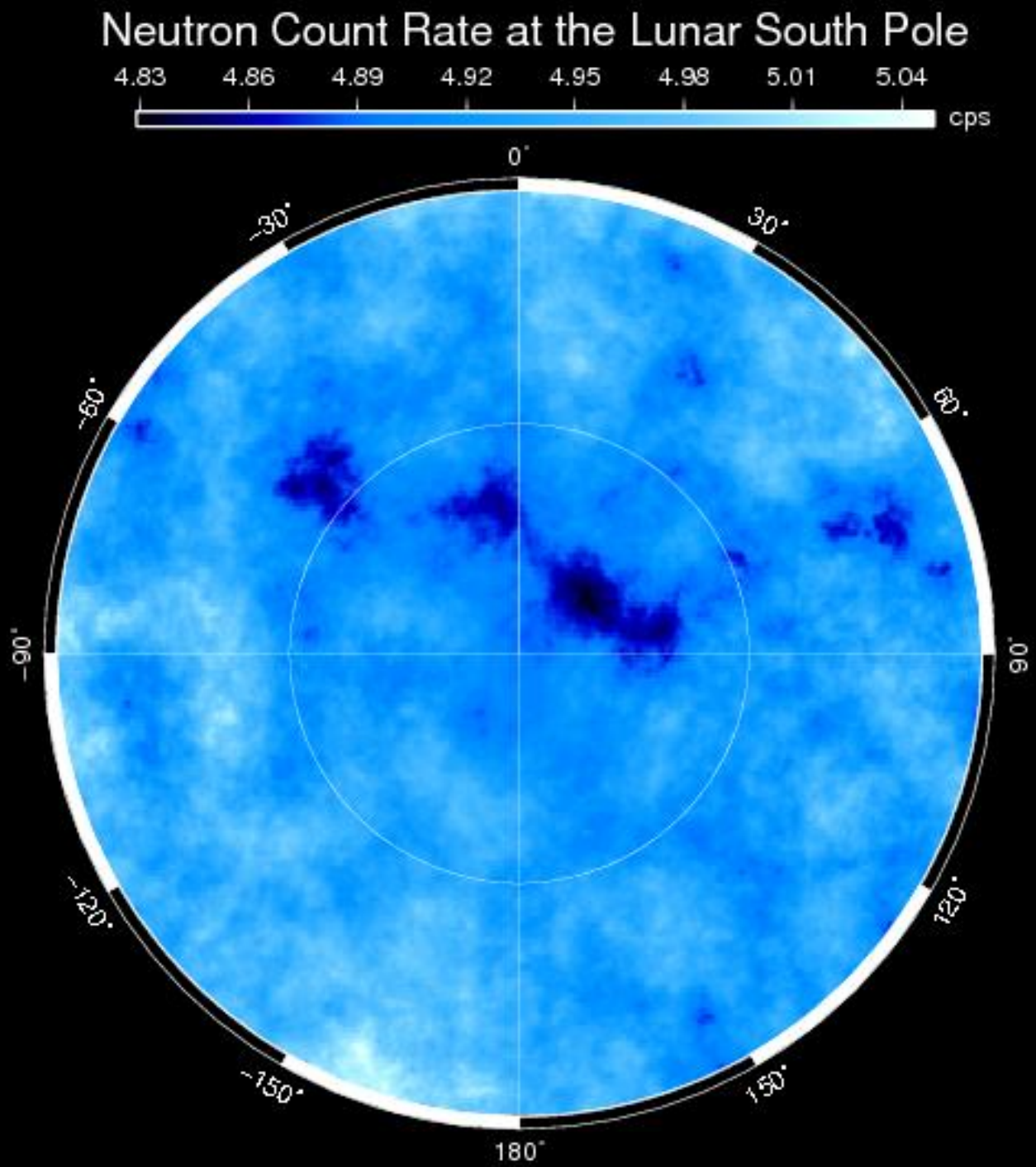


Science Results

Illumination maps



LROC illumination map of south pole (85° –90° S), created from 6 months of images



Science Results

Water found!

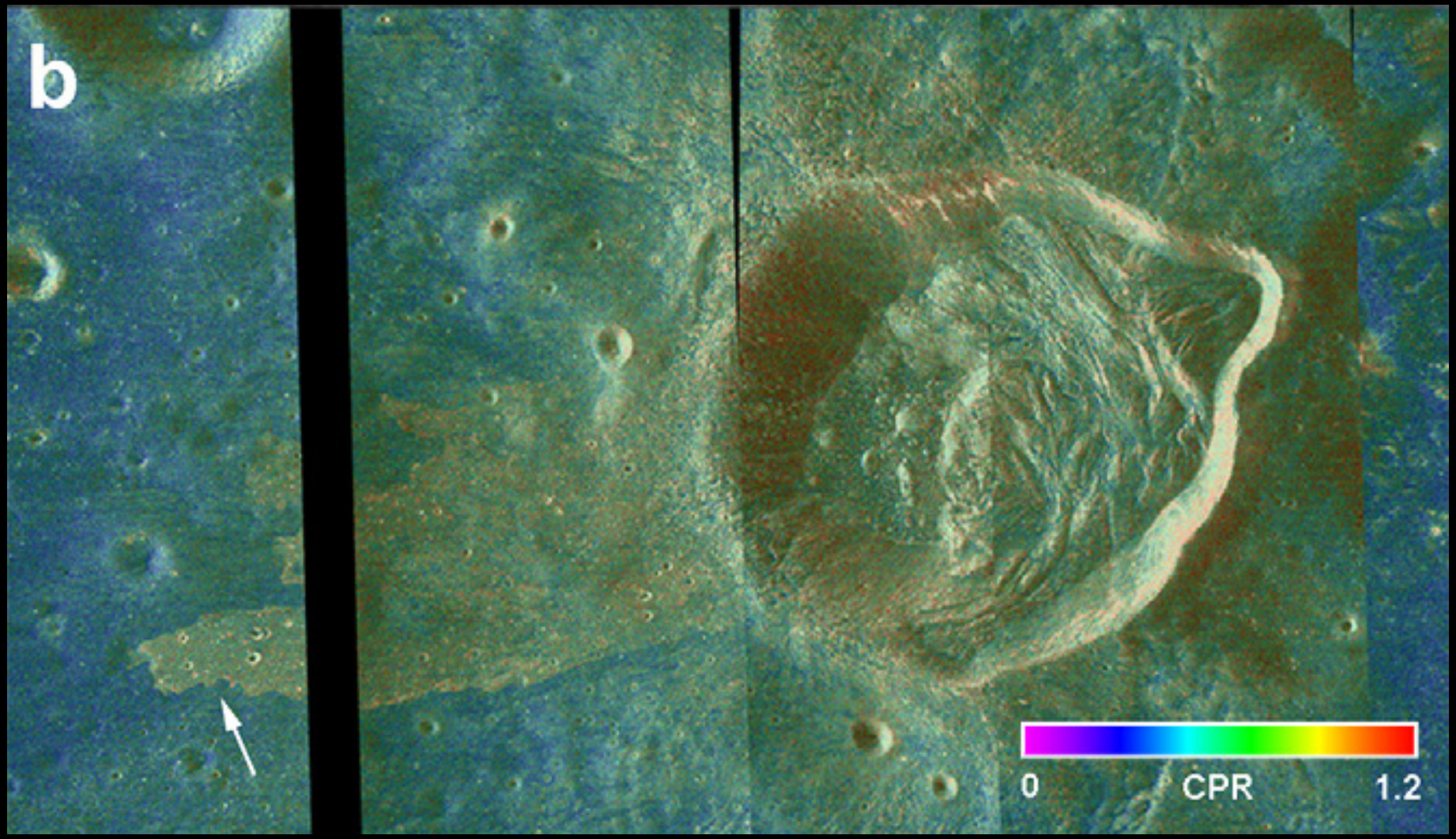
– But not where we expected…

Science Results

Seeing the invisible

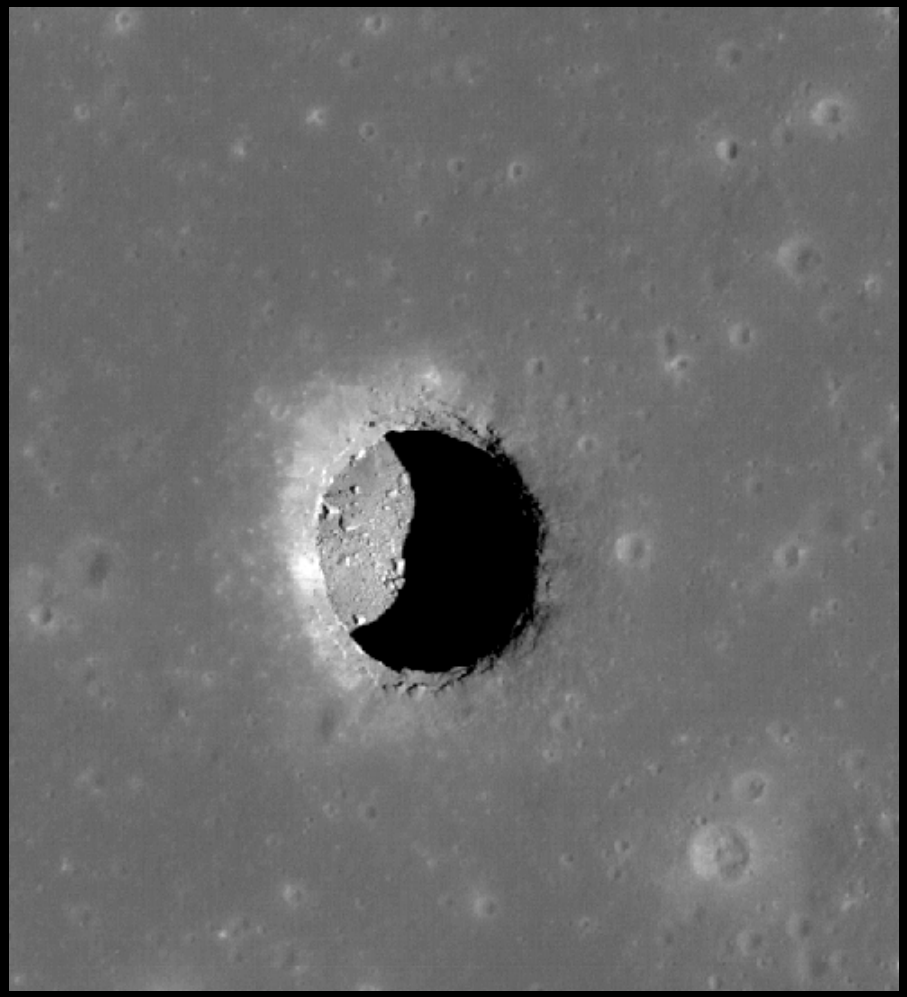
Science Results

Seeing the invisible



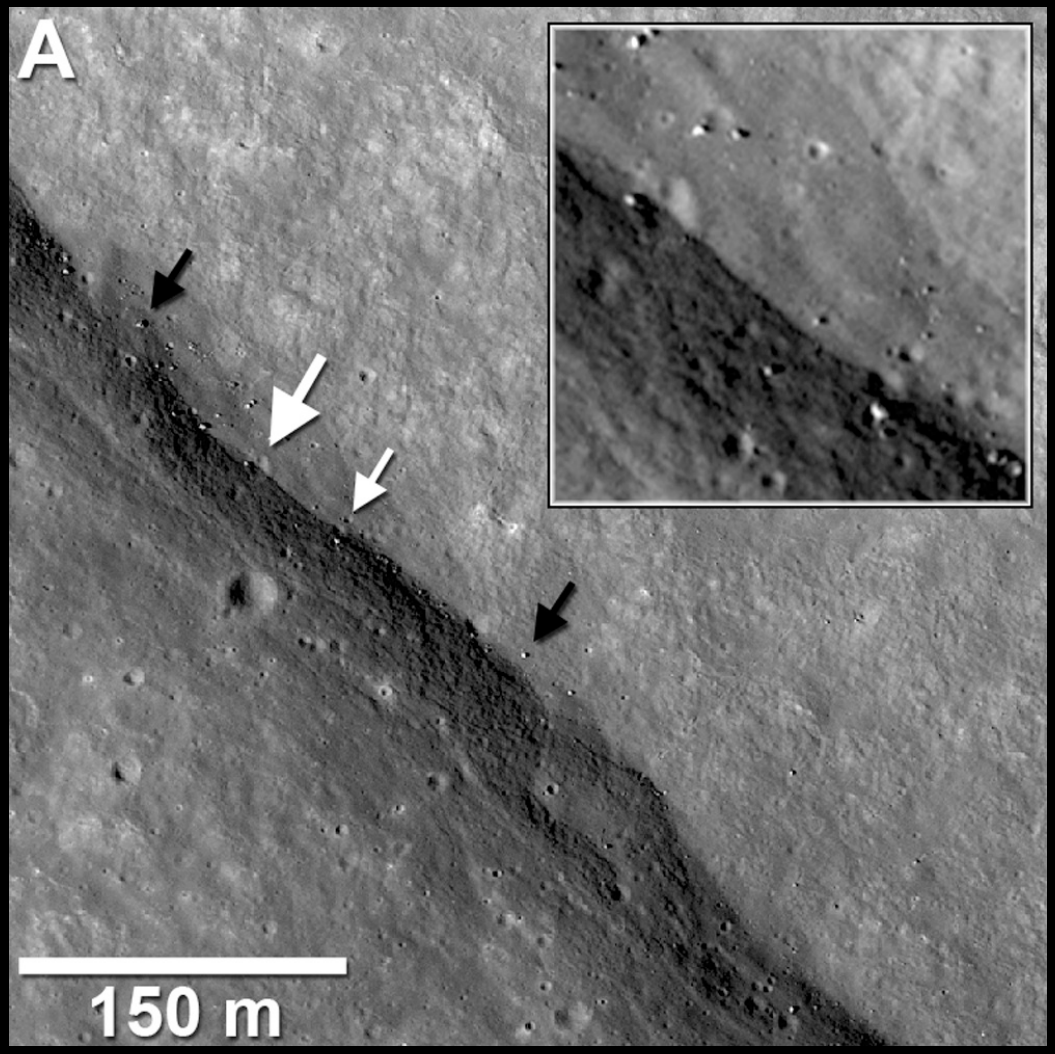
Science Results

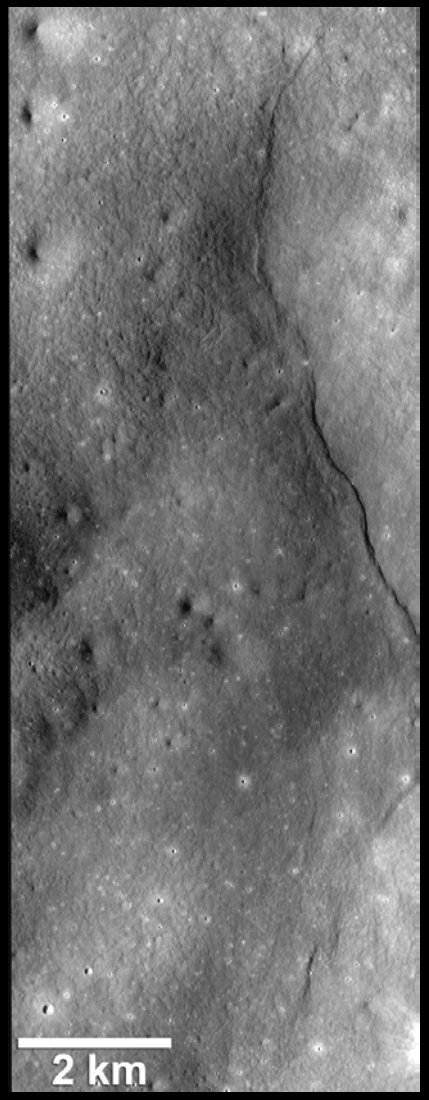
Lunar pits and bridges



Science Results

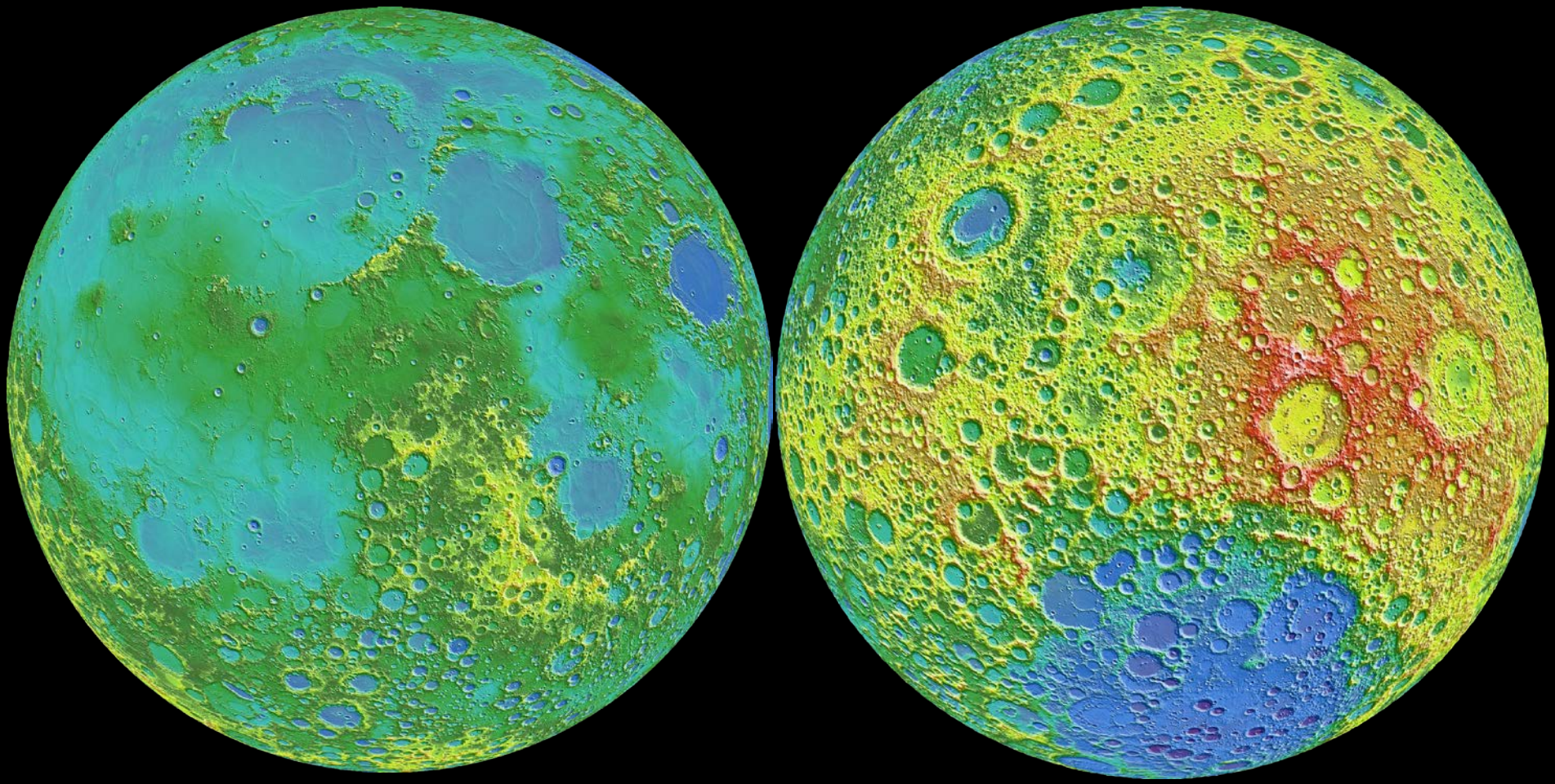
The incredible shrinking Moon!





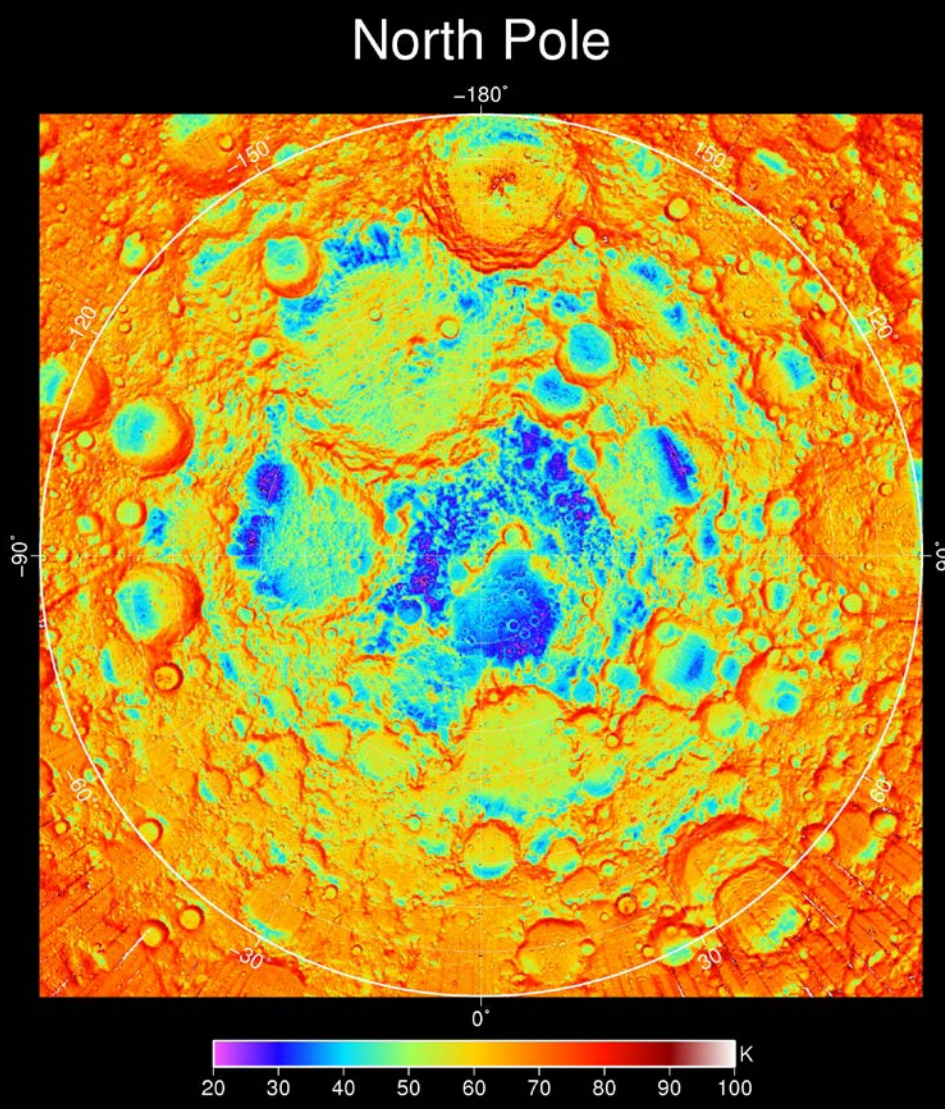
Science Results

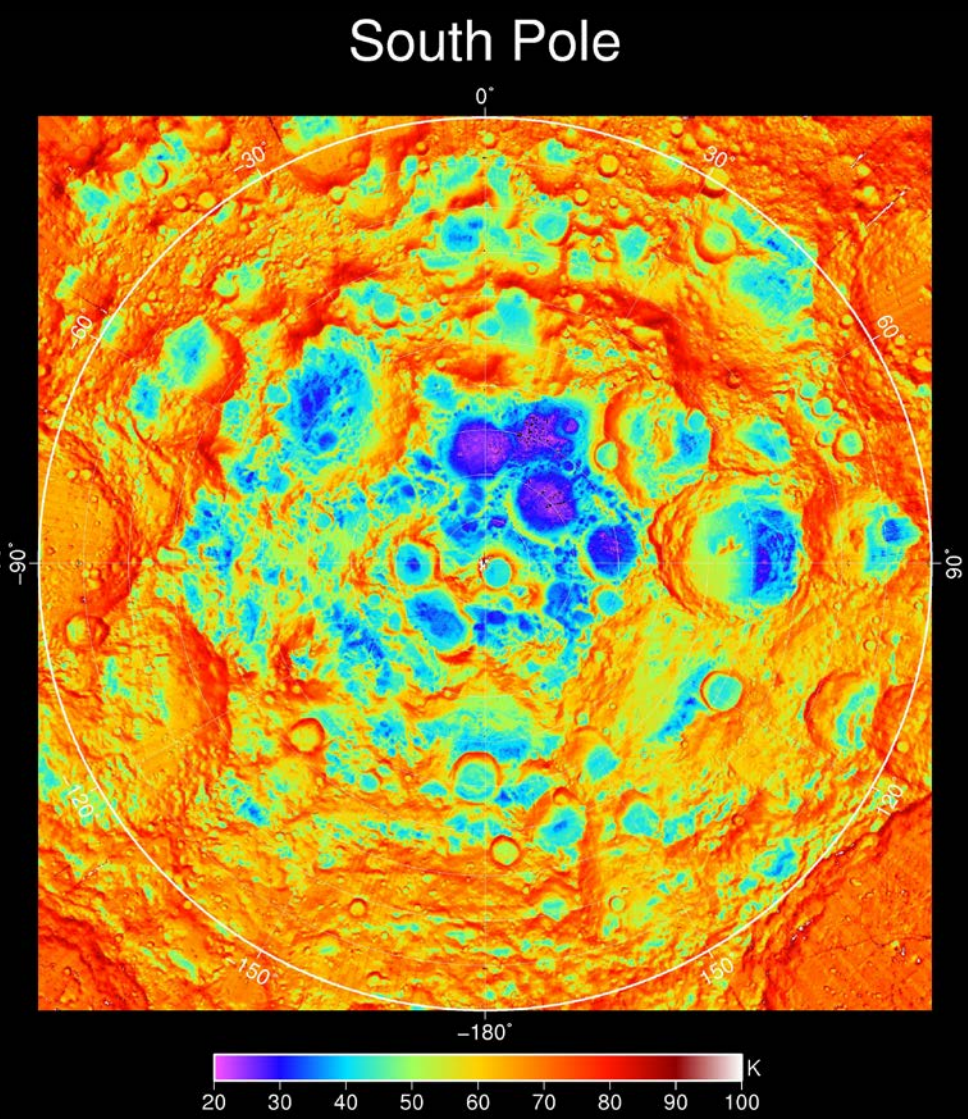
Best topography data in the Solar System



Science Results

Coldest measured place in the Solar System





Science Results

New impact craters!

Science Results

New impact craters!

Science Results

Recent lunar volcanism!

Science Results

Lunar hydrogen is more abundant on the Moon's pole-facing slopes

Some Cool Things From LRO

- The Moon is changing!
  We can watch it!
- We can identify safe landing sites for future explorers
- We better understand the Moon rocks brought back by the Apollo astronauts
- The Moon may have been geologically active **really recently**! (for a geologist…)
- There is a lot left to learn about the Moon!

Learn more!

And get involved!

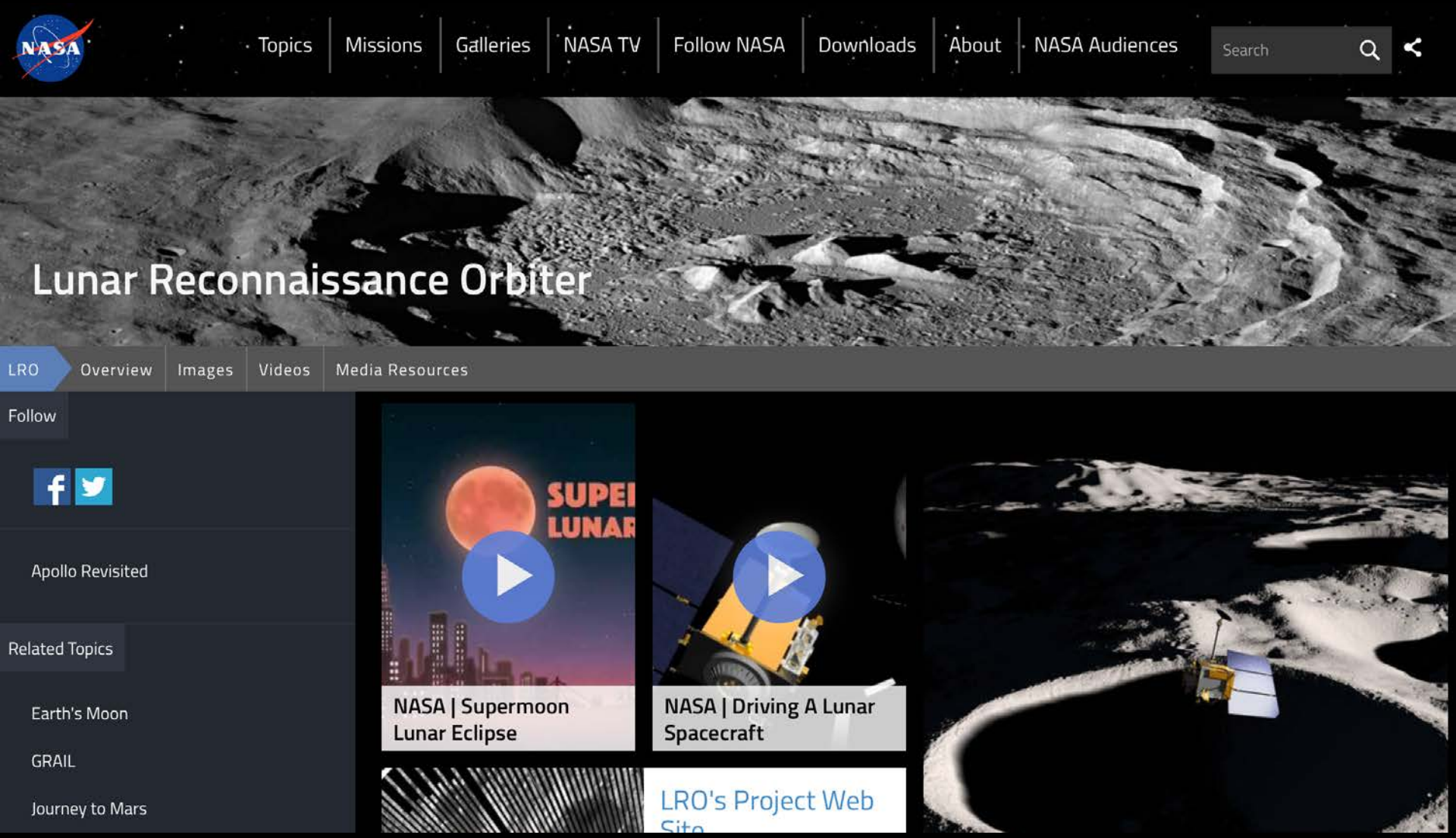
International Observe the Moon Night

International Observe the Moon Night (InOMN) is an annual worldwide celebration of lunar science and exploration. One day each year, everyone on Earth is invited to unite to observe and learn about the Moon and its connection to planetary science, and share personal and community connections we all have to the Moon.

Sponsored by:

observethemoonnight.org

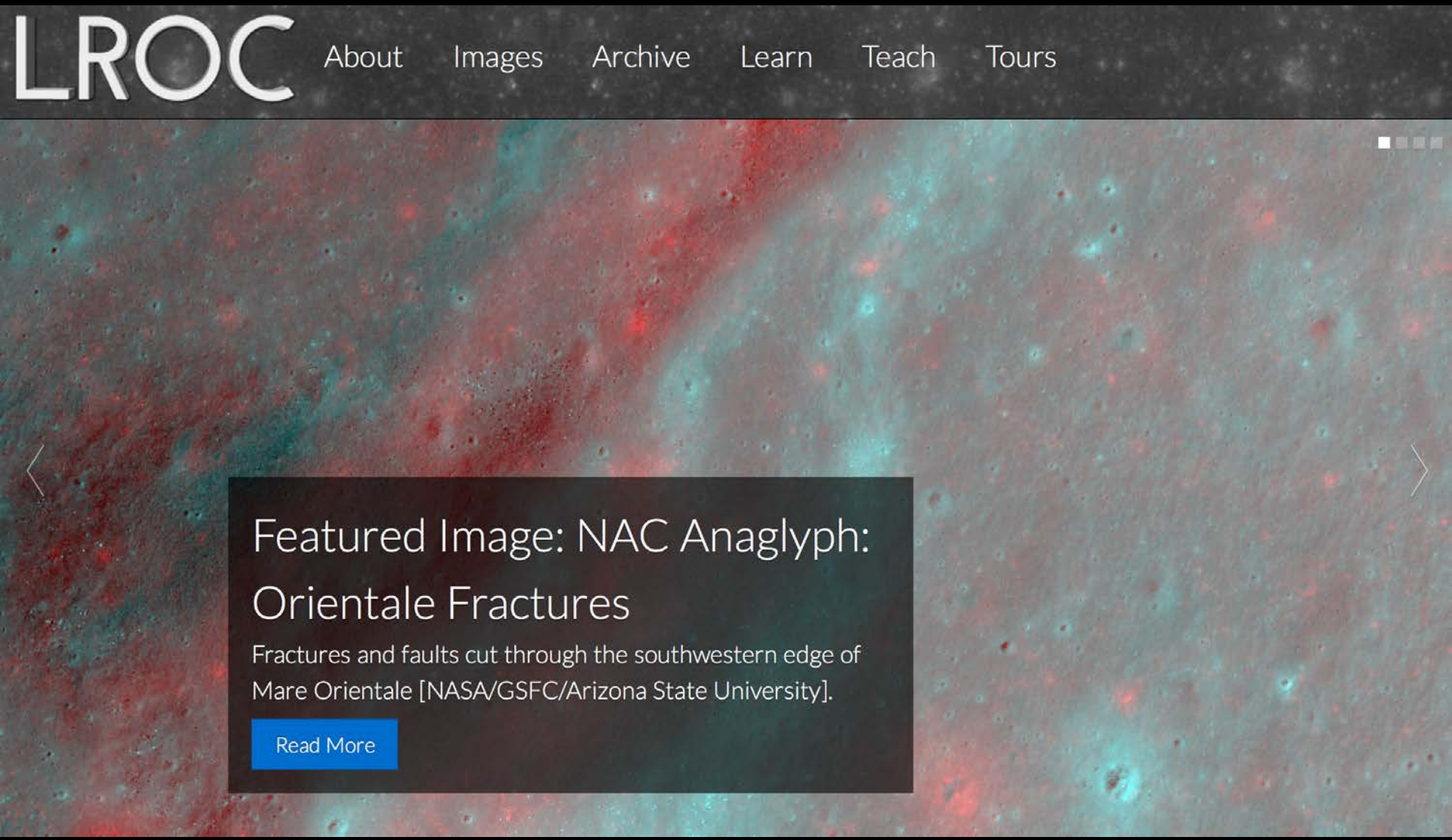
LRO on the NASA Website



http://www.nasa.gov/LRO

LROC Website:

Images, Data, Where is LRO now?, and more!



http://lroc.sese.asu.edu

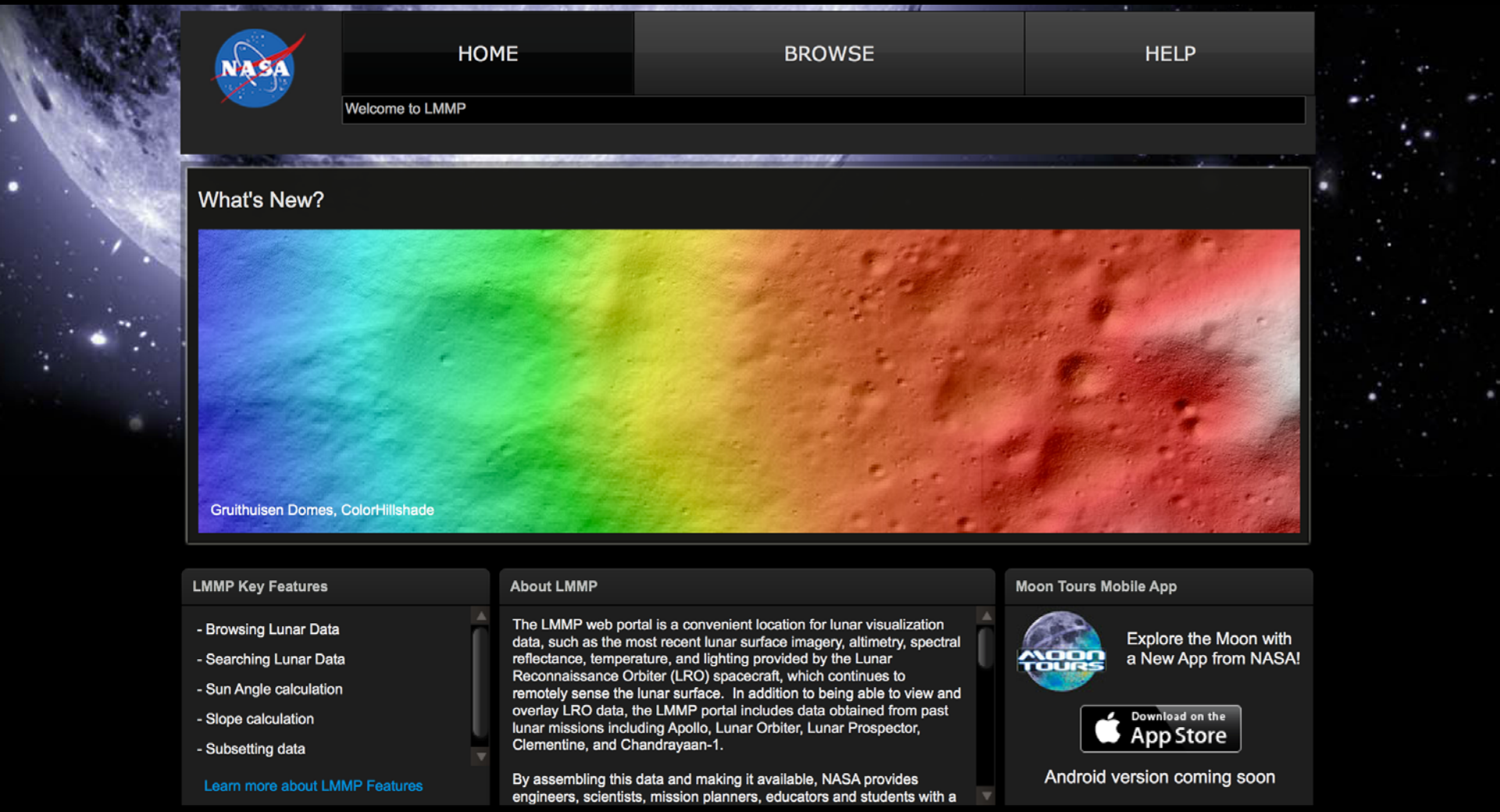
Participate in lunar science research!

Citizen Science

CosmoQuest – Moon Mappers

https://cosmoquest.org/mappers/moon

Lunar Mapping and Modeling Portal



http://lmmp.nasa.gov

NASA Wavelength

http://nasawavelength.org

LRO's Lunar Workshops for Educators

- Award-winning week-long professional development workshops designed for grade 6–9 science teachers focused on lunar science and exploration, with follow-up throughout the school year.
- Recognized as an exemplary model of teacher professional development by the NASA Office of Education and NASA Review Panels.

LRO's Lunar Workshops for Educators

- Over 300 teachers from 30 states and 3 countries have participated since 2010.
- For more information, and to apply, visit:

  http://lunar.gsfc.nasa.gov/lwe/index.html

"The workshop was an overall high quality, effective professional development experience… Participants' feelings about the workshop and presenters were overwhelmingly positive."

Resources

- LRO mission website:
  LRO.gsfc.nasa.gov
- International Observe the Moon Night:
  observethemoonnight.org
- NASA's Lunar Portal:
  Moon.nasa.gov
- NASA Solar System Exploration:
  SolarSystem.nasa.gov
- Moon, Earth, and Space Science Visualizations:
  svs.gsfc.nasa.gov
  YouTube.com/NASAexplorer

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Follow LRO!

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- Facebook: Lunar Reconnaissance Orbiter

Share pictures and highlights from your InOMN event!

- Twitter: #moonnight; @observethemoon
- Facebook: International Observe the Moon Night
- Flickr: https://www.flickr.com/groups/inomn2015/