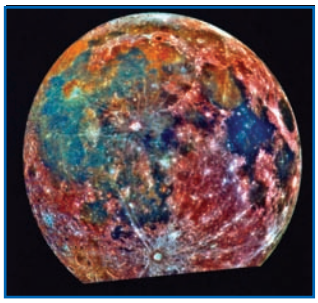
National Aeronautics and Space Administration

Moon Mineralogy Mapper

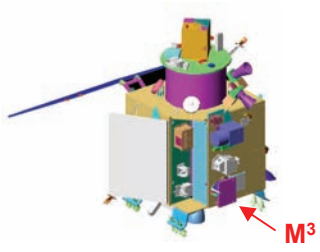
Unlocking the Mysteries of the Moon

A view of our Moon from Apollo 17.



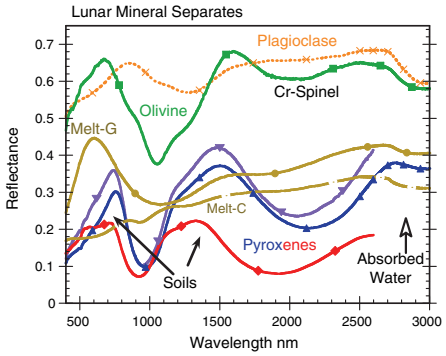
A different view of the Moon from Galileo spacecraft generated by 3 exposures through different filters at 425,000 km distance (1994). Colors denote different compositions, or mineralogy, of the surface materials.
Dark Blue = titanium-rich material(s)
Red = iron and titanium-poor highlands
Orange = iron-rich, low-titanium basalt
Purple = pyroclastic (volcanic)

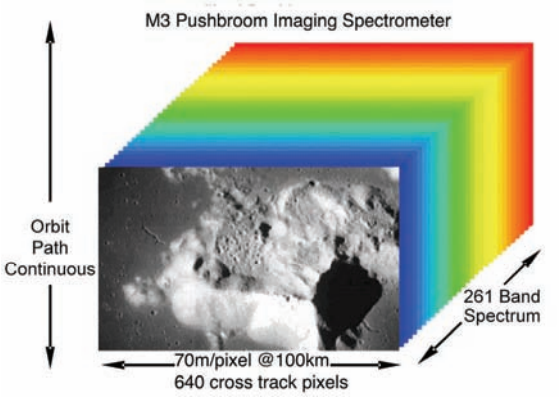
M³/Chandrayaan-1 (below) will provide much greater details with high resolution spectra!



A NASA DISCOVERY MISSION OF OPPORTUNITY

Moon Mineralogy Mapper (M³) is a state-of-the-art, high-spectral-resolution imaging spectrometer that will characterize and map the mineral composition of the Moon. The M³ instrument will be flown on Chandrayaan-1, the Indian Space Research Organization (ISRO) mission to be launched in March 2008. The Moon is a cornerstone to understanding early solar system processes. M³ high-resolution compositional maps will dramatically improve our understanding about the early evolution of the terrestrial planets and will provide an assessment of lunar resources at high-spatial resolution.





M³ Science Overview

- Characterize and map the lunar surface composition in the context of its geologic evolution.
  - ♦ Evaluate primary crustal components and their distribution across the highlands.
  - ♦ Characterize the diversity and extent of different types of basaltic volcanism.
  - ♦ Identify and assess deposits containing volatiles including water.
  - ♦ Map fresh craters as probes to the interior.
  - ♦ Identify and evaluate concentrations of unusual/unexpected minerals.
- Assess the Moon mineral resources at high spatial resolution.

M³ Mission Overview

- Launch: March 2008
- Launch Vehicle: Polar Satellite Launch Vehicle, India
- Spacecraft: Chandrayaan-1, provided by India
  - ♦ Launch Site: SDSC, India
  - ♦ Cruise Time: 5.5 days
  - ♦ Mission Duration: 2 years
- Final Orbit: 100 km, polar
- Field of View: 40 km
  - ♦ Imaging modes:
    - Global (140 m/pixel res)
    - Targeted (70 m/pixel res)
- Ground Station: Bangalore, India
- Science Data: ISRO to JPL to Science Team

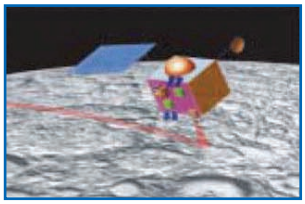
Questions M³ will help address

What is the composition of the Moon's crust and how does it vary?

How do the volcanic and crater deposits on the lunar surface vary?

What clues do the fresh lunar craters provide about the interior of the Moon?

What mineral resources exist on the Moon?



M³ Instrument Overview

- Single detector with spectral range 430 to 3,000 nmi
- 600 spatial elements
- 260 spectral channels
- High signal-to-noise ratio
- Push broom grating spectrometer
  - ♦ Highly uniform
  - ♦ Compact
- All aluminum optics
- Mass < 8 kg, power < 13 W
- Passive thermal control
- Designed to be compatible with Chandrayaan-1
- Robust, high heritage

Principal Investigator Carlé Pieters with model of instrument.

M³ Education and Public Outreach (E/PO)

M³ provides a unique opportunity to inform, engage, and excite educators and the public about the Moon and the science, technology, engineering, and mathematics (STEM) involved in exploring it further. Three thematic strands provide continuity between M³'s formal, informal, and outreach activities in support of the national education standards:

- Geology of the Earth-Moon System
- Properties of Lunar Materials
- Lunar Resources

M³ E/PO partners will produce accessible inquiry-based activities and programs for audiences of all ages and work with ISRO's E/PO program to share the excitement of the mission. Examples include:

College of Charleston	E/PO Coordination, Lunar Toolkit development, Professional development workshops and Web content, Coordination with ISRO E/PO
Lunar and Planetary Institute	Hand-held spectrometer and associated curricular activities, Storytelling, Posters
U.S. Space and Rocket Center	Formal and informal educator training, exhibit development
Montana State University	Lunar outpost on-line resources, WebCT online course for educators
Program Evaluation Research Group (PERG)	Program Evaluation

Experienced Science Team

Carlé Pieters, PI	Brown University
Rob Green	Jet Propulsion Lab
Bonnie Buratti	Jet Propulsion Lab
Cassandra Runyon	College of Charleston
James Head	Brown University
Jack Mustard	Brown University
Jessica Sunshine	Univ. of Maryland
Joseph Boardman	AIG
Larry Taylor	Univ. Tennessee
Matt Staid	PSI
Roger Clark	US Geological Survey
Stefanie Tompkins	SAIC
Tom McCord	Univ. of Hawai'i

M³ Contact Information

Science:
Dr. Carlé Pieters, Brown University
Carle_Pieters@brown.edu

Engineering/Technology:
Mr. Tom Glavich, Jet Propulsion Laboratory
Thomas.Glavich@jpl.nasa.gov

Education/Public Outreach:
Dr. Cassandra Runyon, College of Charleston
runyonc@cofc.edu

For more information:
http://discovery.nasa.gov/M3.html

M³ Quick Facts

- ♦ A high-resolution spectrometer to map the mineral composition of the Moon
- ♦ Launch: March, 2008
- ♦ Flying on Chandrayaan-1
- ♦ Two-year mission

Pub 8-40651
FL-2006-09-142-MSFC