Back to the Moon: "The Next Leap"

By DEEPANJALI KAKATI

Four decades after Neil Armstrong stepped on the moon, NASA has returned to Earth's nearest celestial neighbor with what it calls the "next leap in lunar exploration." The project involves flying two radar instruments to the moon to map the lunar poles, search for water ice and demonstrate new communication technologies.

The instruments are orbiting the moon on two platforms: the Indian Space Research Organisation's Chandrayaan-1, launched on October 22, 2008, and NASA's Lunar Reconnaissance Orbiter (LRO), launched on June 18, 2009.

During the first imaging season aboard Chandrayaan-1, from February to April 2009, NASA's Miniature Synthetic Aperture Radar (Mini-SAR) collected several strips of data each day from both lunar poles. These have been combined to form mosaics that cover an area of more than 250,000 square kilometers.

This data "has revealed interesting features in the lunar polar areas, including craters which could contain water ice," says Stewart Nozette, principal investigator for the radar instrument on the Lunar Reconnaissance Orbiter and co-investigator for Mini-SAR on Chandrayaan-1. The instrument has also shown volcanic deposits and other "interesting geological features on other parts of the moon," he says. The data must be calibrated and reviewed by scientists before final conclusions can be made on what it all means.

The instruments on the Indian and American orbiters will work in tandem, in a way. Once the Mini-SAR on Chandrayaan-1 spots suspected ice deposits as it whizzes over the lunar surface, NASA's orbiter will focus in to make more targeted observations. The next mapping season begins later this summer. Nozette says scientists are working to see if the instruments aboard both orbiters can make joint observations during this period. "The opportunity for joint Chandrayaan-LRO observations is unique and will not occur again," he says.

These joint observations are called bistatic radar. It means Chandrayaan transmits data and the NASA lunar orbiter receives it. "Ice produces a unique signature in this mode," says Nozette.

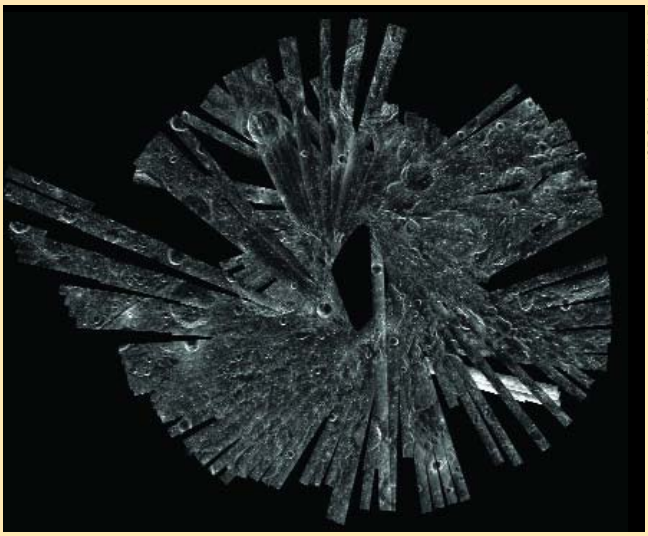
NASA's Mini-SAR is one of the 11 instruments on Chandrayaan-1, which will map the lunar surface for two years. The other NASA instrument on the unmanned Indian spacecraft is the Moon Mineralogy Mapper. The data gathered from these instruments will contribute to NASA's increased understanding of the lunar environment as the agency implements America's space exploration plan. The vision is for robotic and human missions to the moon.

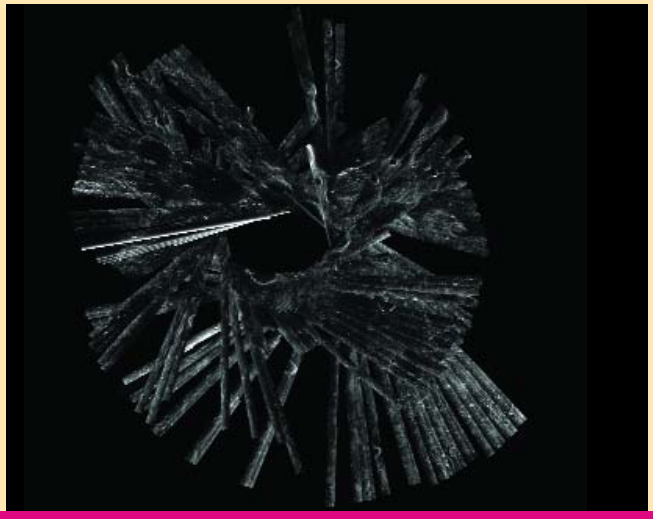
The moon mapper is the first instrument to provide highly uniform imaging of the moon's surface. Besides length and width, it analyzes a third dimension—color. "The Moon Mineralogy Mapper provides us with compositional information across the moon that we have never had access to before," Carlé Pieters, the moon mapper's principal investigator, says in a statement on the NASA Web site. "Our ability to now identify and map the composition of the surface in geologic context provides a new level of detail needed to explore and understand Earth's nearest neighbor."

At the Lunar and Planetary Science Conference held in Texas in March, the mapper team reported that their instrument had found additional evidence of possible past magma activity on the moon. It detected a massive deposit of layer upon layer of anorthosite. On Earth, this rock is produced in magma, deep below the surface of the ground, and is exuded in volcanic eruptions or in other types of magma flow.

The finding is significant because it finally validates the "lunar magma ocean" hypothesis, 40 years after Apollo 11 brought back the first samples of lunar soil. "There have been competing theories of the origin of the moon and the very early history of the lunar surface. The dominant theory was that the Earth was struck by another large body during the early formation of the Solar System, and as a result of this collision the moon formed, initially with a surface of liquid rock (known as magma)," says Thomas Glavich, project manager for the moon mapper until it was delivered to Chandrayaan-1 in 2008.

Glavich, still an adviser on the project, explains that an important part of the proof of this theory would be the discovery of massive amounts of anorthosite in a large, continuous layer. "Anorthosite is feldspar (a mineral containing aluminum, silica, oxygen and usually either sodium or calcium) and is a relatively light rock. The feldspar crystallized and rose to the top of the magma ocean in a massive layer," he says. The moon mapper on Chandrayaan-1 found and mapped this layer.





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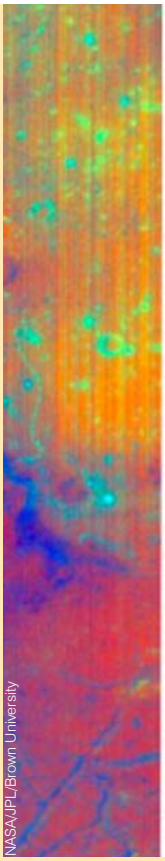

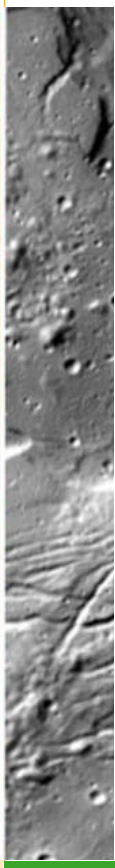

NASA/JPL/Brown University

Top right corner: Different wavelengths of light provide new information about the Orientale Basin region of the moon in a composite image taken by the Moon Mineralogy Mapper. Right: Coverage maps of the Mini-SAR as of March 2009. It has mapped about 80 percent of the moon's north (above) and south poles.