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Moon mission tackles water question

NASA orbiter will hunt for water ice that could be used as a resource by future astronauts.

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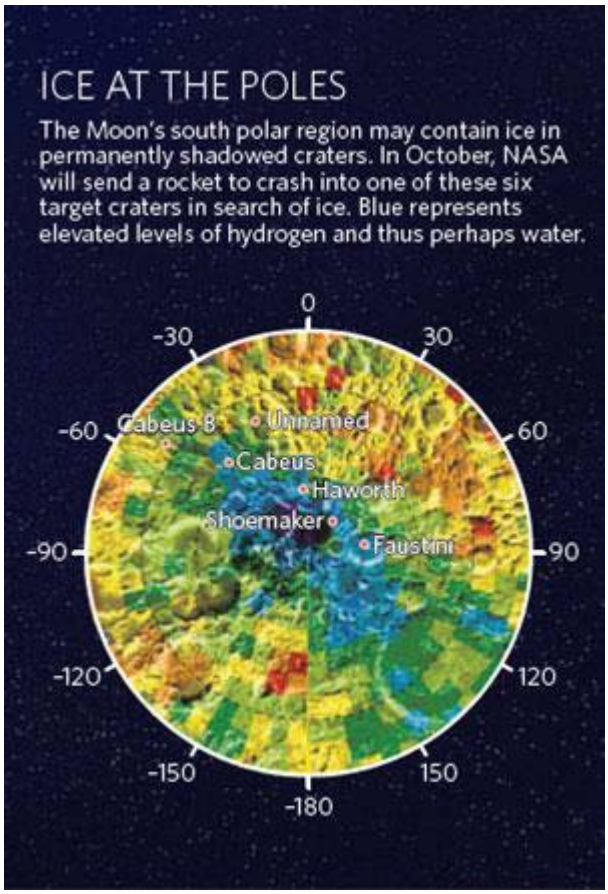

NASA/LUNAR RESEARCH INSTITUTE

NASA's Lunar Reconnaissance Orbiter (LRO), scheduled for launch on 17 June, should end a long-standing debate on whether the Moon has water ice. For nearly half a century, scientists have argued over the idea that bits of ice hide within the frigid darkness of permanently shadowed craters at the Moon's poles. "I sure hope it settles the debate," says Richard Vondrak, LRO project scientist at the Goddard Space Flight Center in Greenbelt, Maryland.

The spacecraft will also mark a beginning. It is the first in a series of planned NASA lunar missions, the next will launch in 2011, to help scout for the return of astronauts to the Moon. If

ice is found, the water could be split into hydrogen and oxygen — for rocket fuel and lungs — to help sustain a lunar outpost.

There are reasons to suspect that ice exists there. A fusillade of water-bearing comets and asteroids could have deposited it, or hydrogen ions carried by the solar wind could have combined with oxygen trapped in minerals on the Moon. Yet there has been no solid detection of ice. The first suggestion came from a radar experiment on the 1994 Clementine mission. The 1998 Lunar Prospector mission added weight to the idea when it found an excess of hydrogen at the poles (see picture, above), which would be consistent with water concentrations of 1% or so. Studies with Earth-based radar, though, have not confirmed the results.

The case against ice would have been stronger had the Earth observatories been able to peer into the darkest parts of the polar craters, but they could not (see 'Target: Moon'). The first dedicated radar to do so has been that on Chandrayaan-1, India's current lunar orbiter. Stewart Nozette, a Clementine veteran who is a science team member on the Indian instrument and principal investigator for a similar one on the LRO, says the Chandrayaan team is seeing intriguing signals at the lunar north pole that could be consistent with ice, although the team is still calibrating its data. Together, Chandrayaan and the LRO are scheduled to perform a 'bi-static' observation this summer, with one transmitting and the other receiving, to see how the polar surfaces reflect at different angles — which could also illuminate the ice question.

Neither of the two other recent Asian orbiters had ice as their main target. Kaguya, a Japanese lunar orbiter that will crash into the surface on 10 June, focused on a map of the Moon's gravity field, and Chang'e 1, a Chinese orbiter, mapped the Moon's minerals before its planned crash on 1 March.

Other instruments on the LRO will 'see' into the dark of the crater shadows. A neutron detector will repeat the Lunar Prospector experiment with greater resolution and sensitivity. A temperature mapper will look for hot and cold spots, down to 30 kelvin above absolute zero. And an ultraviolet instrument will look for surface frost using the illumination of starlight.

NASA

Six of the LRO's seven instruments will make measurements aimed to detect ice — a surprisingly narrow focus, according to Alan Binder, principal investigator for Lunar Prospector. "It really is focused on the water question," he says. That may reflect the fact that the $500-million-plus LRO was paid for by the NASA division that advances human exploration, rather than its science division. Mark Robinson, principal investigator for the spacecraft's main camera, acknowledges that its suite of instruments would probably have been different had its mission arisen via the science directorate.

But Robinson, a geologist at Arizona State University in Tempe, says there will be plenty of data to satisfy scientists of any stripe. The high-resolution camera, working 50 kilometres above the Moon's airless surface, will have a resolution of 1 metre, finally giving scientists maps of the Moon as good as those available for Mars.

The camera will focus first on 50 sites determined by the exploration office (see 'Top targets'), but many of the sites have overlapping science questions. For instance, many of the Moon's maria — sea-like plains of basalt — are rich in titanium, which could be mined. But mapping the deposits could also help scientists understand mysteriously wide differences in titanium concentrations.

Just because NASA's astronaut office is interested in the LRO's data doesn't mean that scientists aren't, says Robinson. "You can't separate the two," he says. "Science enables exploration, exploration enables science."

Updated:

The LRO/LCROSS mission launched on 18 June from Cape Canaveral, Florida.