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NASA spacecraft confirms water ice deposits on moon

by William Harwood

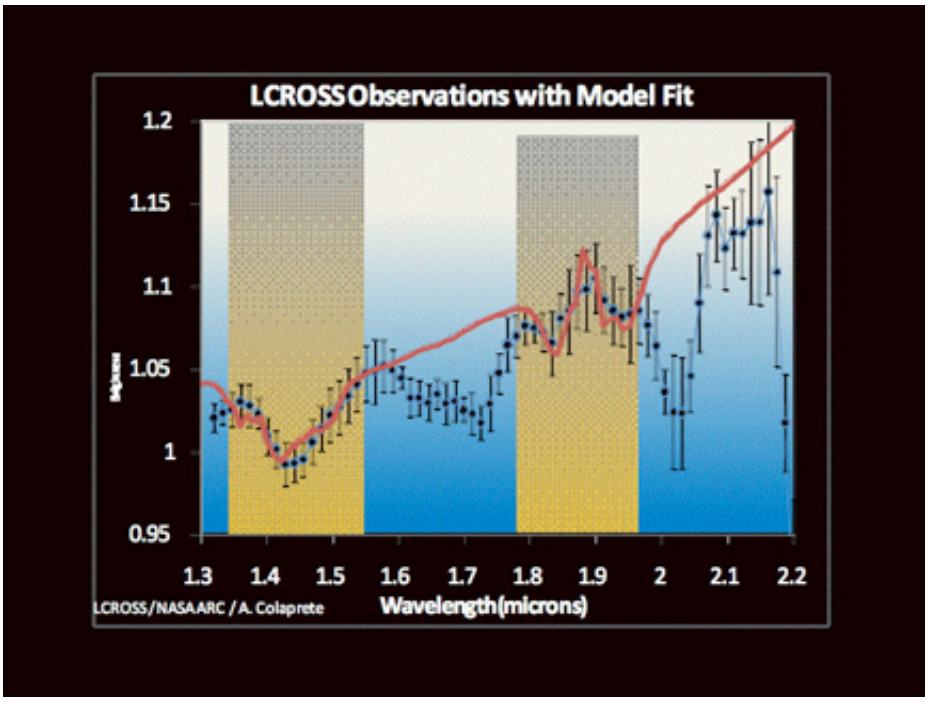
Making a bigger splash than expected, **the crash of an empty rocket stage** in a permanently shadowed crater near the moon's south pole last month kicked up a surprising amount of water ice and vapor, confirming the presence of a potentially valuable resource for future space travelers.

"I'm here today to tell you that indeed, yes, we found water," said Anthony Colaprete, the project scientist and principal investigator for the Lunar Crater Observation and Sensing Satellite. "And we didn't find just a little bit, we found a significant amount."

Holding up water jugs to make the point, he said "if you remember, a month ago we were talking about teaspoons going into glasses over football fields. Well, now I can say today that in the 20- to 30-meter (65- to 100-foot-wide) crater LCROSS made, we found maybe about a dozen of these two-gallon buckets worth of water."

And more than water. Data from the LCROSS instruments show signs of other compounds that may shed light on the moon's evolution.

"It's a whole lot more beyond the water," Colaprete said. "That's the exciting part in my mind, it's not only about the water now. There's actually a lot more here that we're going to be talking about in the months ahead, looking at the LCROSS data."



Spectroscopic data from NASA's LCROSS lunar impactor shows the presence of water in two specific bands (yellow regions). (Credit: NASA)

Said Greg Delory, a researcher at the University of California at Berkeley: "This is not your father's moon. Rather than a dead and unchanging world, it could in fact be a very dynamic and interesting one that could tell us unique things about the Earth-moon system and the early solar system."

Michael Wargo, chief lunar scientist at NASA headquarters in Washington, said the discovery holds promise for future exploration. Using solar energy, future astronauts could, in theory, break down recovered ice and in effect live off the land.

"Water can be used for the kind of things we think about every day, drinking water if we have extended crews on the surface," he said. "You can break it down and have breathable air for crews to breathe. But also, if you have significant quantities of this stuff, water really is the constituents of one of the most potent rocket fuels: oxygen and hydrogen."

Whether the water ice detected by LCROSS might be accessible to future astronauts remains to be seen. But scientists were elated with the initial findings.

The $79 million LCROSS mission was launched June 18 as a companion payload to NASA's $504 million **Lunar Reconnaissance Orbiter** spacecraft. Working in a 31-mile-high orbit, LRO is designed to create a high-resolution map of the moon's surface to help identify sites

for future manned missions.

It also is measuring the solar and cosmic radiation that future lunar explorers will face and mapping out the surface topology, mineralogy, and chemical composition of Earth's nearest neighbor. One year will be spent scouting future landing sites followed by three years of purely scientific observations.

While LRO was launched directly to the moon by an Atlas 5 rocket, LCROSS and the booster's empty Centaur upper stage were sent into a looping four-month orbit back around the Earth.

The spacecraft aimed itself and the attached Centaur stage back at the moon, targeting a permanently shadowed crater near the south pole. Data from previous spacecraft indicated the presence of hydrogen in the polar regions, possibly associated with water ice just below the surface.

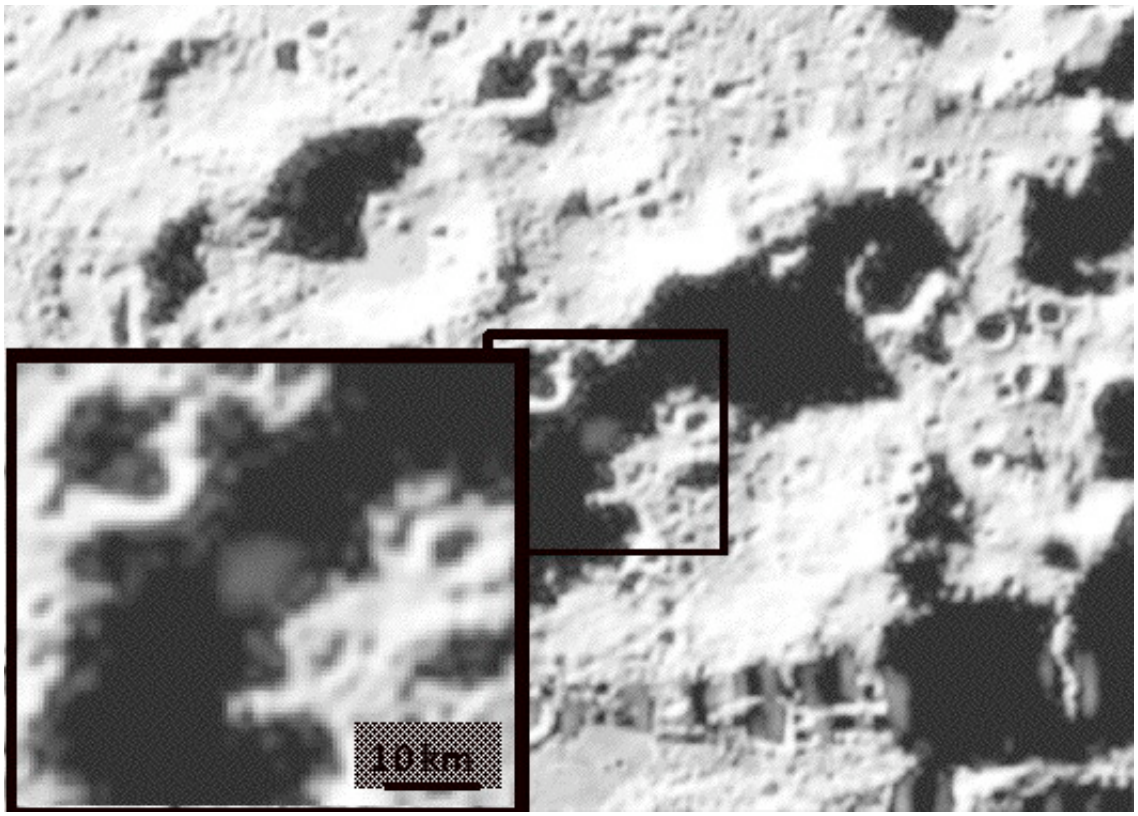
LCROSS mission managers initially selected a target crater known as Cabeus A, but after additional analysis of topographic data, the target was switched to nearby Cabeus, a crater measuring some 62 miles across and about two-and-a-half miles deep.

LCROSS successfully separated from the Centaur stage the night before impact, rotated 180 degrees to aim its instruments forward and then followed its doomed companion to the surface, trailing it by about four minutes.

The Centaur is believed to have hit the moon within about 650 feet of the planned target, blasting out a crater 65 feet to 100 feet across. Colaprete showed photographs from LCROSS Friday that clearly showed the plume of debris kicked up by the crash. Another photo showed the crater itself. LCROSS flew through the ejecta cloud, collecting data all the while, before crashing a short distance away.

The Centaur impact was not particularly impressive to the untrained eye--a pinpoint flash of light in the inky darkness of the crater's shadowed terrain--and many observers, expecting a more dramatic show as indicated in NASA animations, were disappointed.

But Colaprete said Friday the impact more than lived up to scientific expectations. Spectroscopic data from two instruments aboard LCROSS clearly showed the presence of water ice, along with a variety of other materials, in the ejecta plume.



Shown is the ejecta plume at about 20 seconds after impact.
(Credit: NASA)

"We can constrain right now how much water we think is in the field of view of our instrument," he said. "Based on these measurements, there is more than 100 kilograms in the field of view of our instrument. What does that mean, a hundred kilograms? That's the dozen or so two-gallon buckets I described.

"But what we need to do next is take all the information, the amount of ejecta, the size of the crater, how this all changed over time and actually reconstruct the entire event, understand how it all fits back into the ground along with all the other things we've seen in the ejecta plume to really understand this whole thing."

Delory said more analysis will be needed to figure out where the water ice originated.

"One possible source of the water is from comets," he said. "If that's true, and the lunar polar regions really are repositories for this material, they are a literal treasure trove of information in terms of the composition of comets, which are themselves indicative of early solar system conditions. That would be of extreme interest to many planetary scientists."

Another possibility, he said, is that the water ice is the result of chemical reactions that start

with the solar wind, "which is basically an ionized gas streaming from the sun composed mainly of hydrogen."

"It impacts the lunar surface, undergoes chemistry, eventually these molecules hop around the moon and end up concentrated around the poles," he said. "Studying those deposits would tell us something about solar history, also about the history of chemical reactions occurring on the surface of the moon. Two completely different theories, we don't know which one is right yet."

Other sources are also possible, he said, including deposits from molecular clouds the solar system may have passed through earlier in its evolution as well as subtle chemical processes on the moon itself.

Originally posted at The Space Shot

William Harwood has been covering the U.S. space program full-time since 1984, first as Cape Canaveral bureau chief for United Press International and now as a consultant for CBS News. He has covered more than 115 shuttle missions, every interplanetary flight since Voyager 2's flyby of Neptune, and scores of commercial and military launches. Based at the Kennedy Space Center in Florida, Harwood is a devoted amateur astronomer and co-author of "Comm Check: The Final Flight of Shuttle Columbia." You can follow his frequent status updates at the CBSNews.com Space Place, where this story was first published.