

April 11, 2006

Crash Is Planned in Hunt for Lunar Water

By **WARREN E. LEARY**

WASHINGTON, April 10 — A NASA spacecraft will deliberately crash into the Moon in January 2009, in a kind of two-way bank shot that will help scientists search for water that might be lurking in deep, dark craters, the space agency announced Monday.

In part, the intent is to help find future landing sites for human exploration of the Moon, a goal announced by President Bush in 2004.

Earlier lunar missions identified abundances of hydrogen in craters near the south pole that are permanently shielded from sunlight, leading to speculation that the hydrogen was bound with oxygen in the form of water.

If areas on the Moon contain water ice, officials at the National Aeronautics and Space Administration said, they would be prime landing sites for humans.

Water can be broken apart to produce hydrogen for rocket fuel and oxygen for fuel and breathing, helping astronauts live off the land while exploring.

The spacecraft — the first to strike the Moon since the Lunar Prospector, in 1999 — will be part of a previously announced mission in which a larger craft, the Lunar Reconnaissance Orbiter, will fly around the Moon to map its surface.

Both craft will be launched on the same rocket on October 2008, but the smaller impact craft will circle the Earth and Moon for 90 days before slamming into the Moon's south pole.

The project is called Lcross (pronounced L-cross), for Lunar Crater Observation and Sensing Satellite. Its manager, Daniel Andrews of the space agency's Ames Research Center at Moffett Field, Calif., said the upper stage of the rocket that was to send the orbiter to the Moon would be used as an impact vehicle.

When the 4,400-pound used rocket slams into a crater at about 5,600 miles per hour, Mr. Andrews said, it should send up a plume of vapor and debris, perhaps 1,000 metric tons of it, rising 30 to 40 miles above the surface.

About 15 minutes later, the trailing "shepherding spacecraft," loaded with infrared cameras and spectroscopes to determine chemical composition, is to fly through the plume, taking and relaying data before itself hitting the Moon.

"We're going to see the impact," Mr. Andrews said, "and then fly through the plume while looking into the crater and also looking sideways 90 degrees out into space to see the plume material against the darkness."

Scott Horowitz, the associate NASA administrator in charge of the agency's new exploration initiative, said the opportunity for a second payload came because of a recent decision to use a larger rocket to launch the robotic reconnaissance orbiter. The extra payload capacity allowed NASA to consider supplementing the primary mission with something new, he added.

"This gave us a chance to consider additional high-risk, high-payoff science," Mr. Horowitz said after a news conference announcing the new mission. "We got some terrific proposals for using the extra payload and selected one that buys us an early attempt to look at the resources that may exist on the Moon."

In January, NASA asked its centers to develop proposals that would increase understanding of the Moon without interfering with the timing and primary mission of the orbiter, which is designed to do high-resolution lunar mapping to find potential landing sites. Officials narrowed an initial batch of 19 proposals to four before selecting Ames's polar impact mission, Mr. Horowitz said.

The expended rocket will probably be aimed at Shackleton crater, a 12-mile-diameter structure near the Moon's southern axis, Mr. Andrews said. The impact should create a crater about one-third the size of a football field and 16 feet deep.

Observatories on Earth as well as various spacecraft will also study the impact, officials said, and some amateur astronomers may be able to observe the event with their telescopes, depending upon weather and their location.

The mission will not be NASA's first effort to do geological studies by smashing robotic probes into distant bodies. In 1999, scientists decommissioned the orbiting Lunar Prospector probe by crashing it into the Moon's south pole, but it disappointed them by producing little or no debris because of its shallow impact angle.

In 2005, the Deep Impact project successfully sent a heavy copper impactor into comet Tempel 1 while a flyby craft monitored the resulting blast and ejected matter.

The robotic Moon missions are the first steps in NASA's plans to return astronauts to the Moon by 2018 as a steppingstone to going on to Mars. The Lunar Reconnaissance Orbiter mission, with the new addition of the impactor, is to cost about \$600 million, including the launching rocket, said Butler Hine, a NASA

Ames lunar robotics official. The added cost of Lcross is capped at \$80 million, Mr. Hine said.

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