

MORE WATER ON THE MOON? NEW FINDING DEEPENS PUZZLE

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Astronomers from the National Aeronautics and Space Administration for the first time have detected water molecules on the sunlit surface of the moon, raising hopes that water there may be more plentiful than previously believed, the space agency said Monday.

Until now, scientists had only detected water in the cold, dark shadows of craters at the lunar poles. The new findings published Monday in the journal *Nature Astronomy* involve the detection of water molecules in one of the largest, sunniest lunar craters that is visible from Earth.

"To be clear, they are not puddles of water but instead they are water molecules that are so far apart that they do not [form] ice or liquid water," said Casey Honniball, lead author of the study and a postdoctoral fellow at NASA's Goddard Space Flight Center in Greenbelt, Md. The study formed part of her graduate thesis work at the University of Hawaii at Mnoa in Honolulu.

Scientists said the finding only deepened the puzzle of lunar water.

"The discovery raises new questions about how water is created and how it can persist in the harsh airless conditions of the sunlit lunar surface," said Paul Hertz, director of NASA's astrophysics division.

Since 2008, scientists have known that ice deposits existed in the deep freeze of lunar polar craters. But space agency planners preparing for crewed missions to the moon have expected that astronauts will have to bring their own water with them to survive because such caches of lunar ice may be too inaccessible or hazardous to mine.

"We know there's water on the Moon, but we don't know exactly how accessible lunar water is for our future explorers," said Jacob Bleacher, chief exploration scientist for NASA's Human Exploration and Operations Mission Directorate. "So, finding water that is easier to reach is really important to us."

In a news briefing Monday, the agency scientists offered two theories. A steady rain of micrometeorites over millions of years may have deposited the water on the lunar surface in a pitter-patter of tiny but violent impacts. The water molecules also might have been created in a series of chemical reactions between hydrogen borne on the solar wind and oxygen-bearing minerals, the scientists said.

Using an infrared telescope aboard a NASA jet flying over Nevada, the researchers spotted the distinctive spectral wavelength emitted by water molecules on the sun-bleached surface of the moon. That suggested water may be locked inside grains of lunar grit, just like liquid in a thermos bottle, the scientists said.

Dr. Honniball and her colleagues detected the water molecules in Clavius Crater, one of the largest craters visible from Earth, located in the moon's sunny southern hemisphere. By extrapolating from the infrared signal, the scientists calculated that the concentration appeared to be roughly equivalent to a 12-ounce bottle of water within a cubic meter of lunar soil. If that estimation is correct, the Sahara Desert contains about 100 times more water.

The aerial observatory used to spot the new water deposits—a modified Boeing 747 jet—is called the Stratospheric Observatory for Infrared Astronomy. Operating at an altitude of up to 45,000 feet, it normally studies some of the most distant, dim objects in the universe, such as black holes and far-flung galaxies.

“This was actually the first time that SOFIA observed the Moon,” said SOFIA project scientist Naseem Rangwala at NASA’s Ames Research Center near Mountain View, Ca. “And we did it as a test case because the questions surrounding the Moon’s water were so compelling.”

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