

LUNAR RECONNAISSANCE ORBITER: Permanently Shadowed Regions on the Moon

Permanently Shadowed Regions on the Moon

Data from prior lunar missions such as Lunar Prospector suggested that the Moon's polar regions may be hiding ice. One of the primary reasons the Lunar Reconnaissance Orbiter (LRO) was placed into a polar orbit around the Moon was to search for water near the Moon's poles. Scientists use data from several LRO instruments to piece together the story of water on the Moon. Some instruments measure whether water could be stable at or near the surface, while others use a variety of detection techniques to measure the abundance of water.

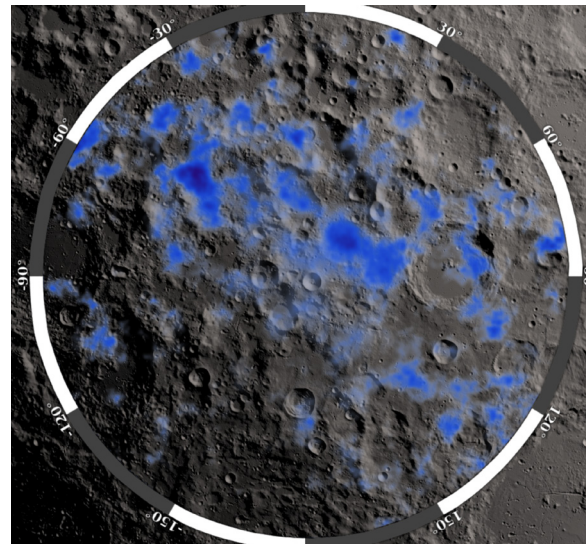
How could water exist on the Moon?

The Moon's axis tilts only 1.5 degrees from the ecliptic plane (the plane containing the path of the Earth and the Moon around the Sun). Because of this unique geometry, sunlight never shines on the floors of some craters near the Moon's poles (figure 1). These areas are known as Permanently Shadowed Regions, or PSRs. Water that happens to find its way into PSRs may remain there for long periods of time. Data from the Diviner instrument on board LRO, which measures temperatures across the Moon, including PSRs, indicate that some surfaces are cold enough so that water is stable at the surface.

How do instruments on LRO detect water?

Some of the instruments on LRO have the capability of detecting the presence of water. These instruments look for surface brightness as a possible indication of water. The Lyman Alpha Mapping Project

(LAMP) and Lunar Exploration Neutron Detector (LEND) instruments take measurements that can detect water. The LAMP instrument uses reflected ultraviolet light from stars to 'see' into PSRs. Outside our solar system, stars are found in all directions, including above and below the ecliptic plane. Light from these stars has the capability of shining into areas on the Moon that are permanently shadowed from



our Sun. In ultraviolet light, water frost either absorbs or reflects energy, depending on the wavelength. LAMP has detected the presence of water frost in PSRs at the lunar poles.

Because of its mass, hydrogen alone would escape the Moon's gravity, even at cold temperatures. Hydrogen in water form, however, can stay frozen in permanently shadowed regions for long periods of time. The LEND instrument has detected fewer neutrons coming from some areas near the Moon's poles, indicating the presence of hydrogen and by inference, water.



More Information

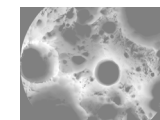
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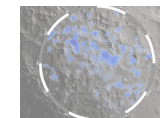
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Goddard Space Flight Center manages the Lunar Reconnaissance Orbiter for NASA's Science Mission Directorate.

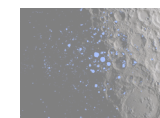
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Multi-temporal illumination map of the lunar south pole. Shackleton crater (19 km diameter) is in the center. The south pole is located approximately at 9 o'clock on its rim. Darkest regions are permanently shadowed regions and brightest regions are nearly always in sunlight. Image credit NASA/GSFC/Arizona State University.



Neutron count rates at the lunar south pole demonstrate locations where water ice is likely to exist. LEND data show that ice is not confined to permanently shadowed regions. Image credit NASA/GSFC/IKI



Data from the Lunar Orbiter Laser Altimeter is used to show locations of permanent shadow at the lunar south pole. Image credit NASA/GSFC

