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Toward a Unified View of the Moon's Polar Volatiles from the Lunar Reconnaissance Orbiter

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Although the scientific basis for the possibility of water and other volatiles in the cold traps of the lunar polar regions was developed in the 1960's and '70's [1,2], only recently have the data become available to test the theories in detail. Furthermore, comparisons with other planetary bodies, particularly Mercury, have revealed surprising differences that may point to inconsistencies or holes in our understanding of the basic processes involving volatiles on airless bodies [3]. Addressing these gaps in understanding is critical to the future exploration of the Moon, for which water is an important scientific and engineering resource [4].

Launched in 2009, NASA's Lunar Reconnaissance Orbiter (LRO) has been acquiring data from lunar orbit for more than six years. All seven of the remote sensing instruments on the payload have now contributed significantly to advancing understanding of volatiles on the Moon. Here we present results from these investigations, and discuss attempts to synthesize the disparate information to create a self-consistent model for lunar volatiles. In addition to the LRO data, we must take into account results from earlier missions [5,6], ground-based telescopes [7], and sample analyses [8]. The results from these inter-comparisons show that water is likely available in useful quantities, but key additional measurements may be required to resolve remaining uncertainties.

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