HYDROGEN-BEARING VOLATILES AT THE LUNAR EQUATORIAL TERMINATOR.

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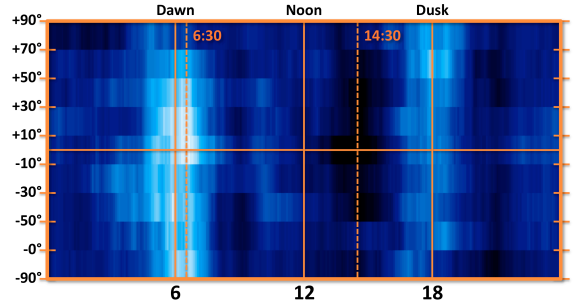
Introduction: We detect suppression of epithermal neutron detection rates at the Lunar Reconnaissance Orbiter (LRO) using the Lunar Exploration Neutron Detector (LEND) collimated detectors when the LRO spacecraft is near the dawn and dusk terminators at near-equatorial latitude (30°S to 30°N). The greatest neutron count rate (least flux suppression) is found at post-meridian local time, at about 14:30. Suppression of epithermal neutrons is consistent with the presence of hydrogen in the regolith near the terminator. Since the terminator moves across the surface as the Moon rotates, this implies a mobile population of hydrogenated volatiles that dwells near the terminator but resides only transiently in the regolith. The observed pattern of neutron flux suppression is consistent with the distribution of mineral hydration observed by Sunshine et al. (2009) in reflected light, if the inferred layer of transiently hydrated minerals extends to a depth of order 15 cm or greater into the regolith to accommodate the observed degree of neutron flux suppression.



Cylindrical projection of water-equivalent hydrogen map transformed from a smoothed map of CSETN (epithermal+fast) neutron count rate, in units of local time (hortizontal) and latitude (vertical), north at the top. Local maxima in hydrogen content are found at dawn and at dusk over nearly the full range of latitude.

Modulated Neutron Flux: The CSETN detectors exhibit minima at dawn and dusk terminators, consistent with local enhancement of hydrogen/H_2O; count rate peaks in the afternoon sector, consistent with desiccated regolith with a phase lag for dehydration. Contrast between the maximum and minimum count rates implies ~0.075 wt% H_2O centered on dawn terminator, about 0.05 wt% H_2O at dusk. Comparison to the Sunshine *et al.* [1] extreme upper limit of ~0.5 wt% hydration, suggests relevant depth of hydrated surface layer is of order 15 cm or more.

Conclusions: Water group ions migrate from the warmest region to the terminator and pile up at the cold surface at the terminator. The dawn and dusk terminators are not identical: hydrated regolith at the dawn terminator rotates into sunlight and ions/molecules migrate back to the terminator along with fresh molecules migrating from the subsolar region. Dusk-side molecules always rotate and transport in the same direction, thus with less cumulative build-up. The diurnal hydration cycle appears to persist even at polar latitudes. Lawrence et *al.* [5] argue for a slight *increase* in epithermal flux from a thin hydrated layer on top of dry regolith. Different energy sensitivity between SETN and CSETN in presence of this effect is possible explanation for observed discrepancy, since SETN and CSETN sense somewhat different populations.

References: Use the brief numbered style common in many abstracts, e.g., [1], [2], etc. References should then appear in numerical order in the reference list, and should use the following abbreviated style:

[1] Sunshine, J. M. *et al.* (2009) *Science* **326**, 565–568. [2] Lawrence, D. J. *et al.* (2010) *Astrobiology* **10**, 183–200. [3] Mitrofanov, I. G. *et al.* (2010) *Space Sci. Rev.* **150**, 183–207. [4] Mitrofanov, I. G. *et al.* (2012) *JGR-Planets*, 10.1029/2011JE003956. [5] Lawrence, D. J. *et al.* (2011) *JGR-Planets* **116**, E01002.