Title:

Diurnally Varying Hydrogen Volatiles or Regolith Temperature? Mare and Highlands studies of the Moon's Diurnally Modulating Epithermal Neutron Flux using LRO's LEND, Diviner and LOLA instruments.

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Abstract:

The primary objective of this study is to determine the source of variation that is modulating the epithermal neutron flux detected by the Lunar Reconnaissance Orbiter's Lunar Exploration Neutron Detector and Lunar Prospector Neutron Spectrometer (LPNS) [1-5]. Two independent studies have suggested alternative explanations for the modulation (1) diurnal surface hydration and (2) regolith temperature variation. Both explanations are possible. The regolith temperature hypothesis was tested in a subsequent high latitude study of correlated LEND, Diviner radiometer and LOLA topography maps. Studies of Diviner temperature observations showed that the diurnal amplitude of the surface temperatures on equator-facing slopes (EFS) are more than a factor of two greater than the diurnal temperature amplitude measured on corresponding poleward-facing slopes (PFS). If regolith temperature is the source of the diurnal neutron flux variation then one would expect the EFS should be the dominant contributor to the flux modulation. However, results indicated that the amplitude of the neutron flux modulation from PFS were significantly greater than the EFS. The conclusion of the study suggested that and other evidence is consistent with an interpretation that the Moon's high-latitude surfaces are being diurnally hydrated.

A recent study of the mid-to-high latitude bands found that the amplitude relationship of the EFS and PFS diurnal flux is equivalent near ±(65° to 72°). Towards higher latitudes the EFS amplitudes systematically decrease and the PFS amplitudes increase, thus the PFS trend is in opposition to the regolith temperature hypothesis. Towards equatorial-latitudes, both EFS and PFS amplitudes increase and the EFS show the greater amplitude, consistent with a regolith temperature dominated contribution to the neutron flux. In particular, the preliminary analysis of northern mid-latitudes containing significant aerial quantities of mare showed a significant increase in both the EFS and PFS amplitudes, with the EFS amplitude significantly greater. The preliminary result from [8] suggests that a latitude dependent combination of diurnal surface

hydration and/ or regolith temperature is modulating the neutron flux. However, regolith temperature induced modulation of the flux cannot be excluded as the sole source if insolation dependent regolith sub-surface composition and/or thermal inertia variation can account for the greater PFS diurnal amplitude observed in the high latitudes [8].

In this study analyze the mare and highlands regions in the northern mid-latitudes. To achieve this task we will perform independent analyses of epithermal neutron count-rate maps from the mare and highlands regions in the northern mid-latitudes. Co-registered epithermal neutron count-rate maps from LEND's Collimated Sensor for EpiThermal Neutrons (CSETN) will be correlated with Lunar Observing Laser Altimeter (LOLA) topography as a function of insolation [6]. Diurnal count rate profiles derived from CSETN observations of equator-facing slopes (EFS) and poleward-facing slopes (PFS) will be characterized and compared [7].

References:

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