LRO LAMP OBSERVES DIURNALLY MIGRATING WATER ON THE MOON. Amanda R. Hendrix[1], Dana M. Hurley[2], William M. Farrell[3], Benjamin T. Greenhagen[2], Paul O. Hayne[4], Kurt D. Retherford[5], Faith Vilas[1], Josh T. S. Cahill2, Michael J. Poston5, [1]Planetary Science Institute, [2]JHU/APL, [3]NASA GSFC, [4]LASP/CU, [5]Southwest Research Institute (arh@psi.edu).

Introduction: The Lyman Alpha Mapping Project (LAMP), a far-ultraviolet (FUV) spectrograph on the Lunar Reconnaissance Orbiter (LRO), has been observing the Moon since September 2009. In addition to using stellar sources and interplanetary hydrogen to study the dark polar regions [1] and night side of the Moon, LAMP measures reflected sunlight from the dayside of the Moon. The presence of a strong water ice absorption at 165 nm allows small amounts of hydration to be sensed in the LAMP reflectance spectra with no thermal emission effects, and indeed LAMP measures spectral variations across the surface [2] attributable to diurnally-varying levels of hydration. Here we present results using data between October 2009 and September 2016.

Analysis: In this analysis, we utilize the dayside measurements of lunar FUV reflectance. Hendrix et al. [2] showed that the lunar spectral slopes measured in the 164-173 nm region are controlled by hydration level and are found to be diurnally variable; an adjacent spectral region (175-190 nm) is not affected by hydration and shows no trend with local time, supporting the case that the slopes in the 164-173 nm region - and their variation throughout the lunar day - are indeed due to hydration. To analyze hydration, we made a straight line fit to each reflectance spectrum in the 164-173 nm range and determined the slope of that line, after photometrically correcting using the Lommel Seeliger term $m_0/(m+m_0)$. Steeper (redder) slopes are expected to be consistent with increased hydration.

Results: We find that the loss of hydration, indicated by a decrease in slope, occurs at different temperatures (as measured by Diviner) depending upon latitude. The spectral slopes at the highest latitudes in each region begin to decrease, indicating a loss of hydration, at roughly 350 K, with lower latitudes losing progressively more and more hydration at higher temperatures. This difference in temperature for hydration loss at each latitude indicates that temperature is not the only factor controlling hydration. The observed trends are consistent with chemisorption and desorption of H_2O, where H_2O molecules adsorb directly onto soil grains and then desorb when the temperature is sufficiently high [3][4][5]. The adsorption residence time is related to U_e/T where T is temperature and U_e is activation energy [6].

We model the signature in terms of a layer of H_2O overlying lunar regolith [7] and determine the range of optical depths of the water layer required to produce the observed spectral slopes. For the maximum optical depth, the areal coverage is significantly less than a monolayer.

References: [1] Gladstone, G R. et al. (2012) *JGR*, *117*; [2] Hendrix, A. R. et al. (2012) *JGR, 117,* E12001, [3] Hibbitts, C. et al. (2011) *Icarus, 213,* 64-72; [4] Poston, M. J. et al. (2015) *Icarus*; [5] Poston, M. J. et al. (2013) *JGR, 118, 105*; [6] Barrie, P. J. (2008) *Phys. Chem. Chem. Phys., 10,* 1688-1696; [7] Hapke, B. (1993) Theory of Reflectance and Emittance Spectroscopy. Cambridge Univ. Press, New York