LUNAR HYDRATION AS OBSERVED BY LRO LAMP. Amanda R. Hendrix[1], Dana M. Hurley[2], William M. Farrell[3], Michael J. Poston[5], Benjamin T. Greenhagen[2], Paul O. Hayne[4], Kurt D. Retherford[5], Kathleen Mandt[2], Faith Vilas[1], Josh T. S. Cahill[2]. [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 using the photometric correction of Liu et al. [8]. Steeper (redder) slopes are expected to be consistent with increased hydration.

Results: In looking at a mostly-mare region and a mostly-highlands region, we find that spectral slopes in each region decrease at mid-day, consistent with a loss of hydration. The decrease in slope is statistically significant only for the highlands region. 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 <1% of a monolayer [9], suggesting that $\sim 6 \times 10^{12}$ molecules/cm^2 are released diurnally from these regions of the surface.

In this report, we expand our analysis to larger regions of the lunar surface to investigate larger-scale trends in diurnally-varying hydration.

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. [8] Liu, Y. et al. (2018) *JGR, 123*, 2550–2563. [9] Hendrix, A. R. et al. (2019) *GRL 46*. DOI 10.1029/ 2018GL081821