SHALLOW LUNAR HYDROGEN AND FORWARD-SCATTERED ALBEDO PROTONS. J. K. Wilson[1,2], N. Schwadron[1,2], H. E. Spence[1,2], A. P. Jordan[1,2], M. D. Looper[3], L. W. Townsend[4], [1]Space Science Center, University of New Hampshire, Durham, NH, (jody.wilson@unh.edu), [2]Solar System Exploration Research Virtual Institute, NASA Ames Research Center, CA, [3]The Aerospace Corporation, Los Angeles, CA, [4]University of Tennessee, Knoxville, TN.

Introduction. Since the launch of LRO in 2009, the CRaTER instrument has been mapping high-energy albedo protons (> 65 MeV) from the Moon [1,2]. These protons are produced by nuclear spallation, a consequence of galactic cosmic ray (GCR) bombardment of the lunar regolith. Just as spalled neutrons and gamma rays reveal elemental abundances in the lunar regolith, albedo protons may be a complimentary method for mapping compositional variations, including volatiles.

Hydrogen in the regolith. We have discovered a latitudinal trend in the yield of lunar albedo protons that we attribute to thin (< 10 cm) hydrated layer of regolith [3]. Hydrogen atoms at these shallow depths can be forward-scattered by upwelling albedo neutrons, enhancing the total yield of protons. This would constitute both the first detection of volatiles in the regolith by albedo protons, and the first evidence from CRaTER of forward-directed knock-on collisions between nucleons within the regolith.

New observations. To further test the hypothesis that CRaTER can detect and distinguish forward-scattered protons, we have begun a series of targeted CRaTER observations of grazing-angle albedo protons. If the hypothetical shallow hydrogen layer is present, then there should be a higher flux of grazing-angle albedo protons relative to the flux coming up from the nadir direction; this excess population would result from forward-scattering knock-on collisions with grazing-angle incidence GCR protons.

Preliminary results from the first grazing-angle observations on May 26-28 show a ~40% increase in the proton yield near the horizon compared to the nadir direction, supporting our hypothesis. With additional observations we will search for spatial features (e.g.: mare vs. highlands and high-latitudes vs. low-latitudes) in the grazing-angle yield which may reveal variations in volatile (H) and other elemental abundances.

References: [1] Wilson et al. (2012), *JGR-Planets*,117, E00H23. [2] Wilson et al. (2015), *submitted to Icarus*. [3] Schwadron et al. (2015), *submitted to Icarus*.