HOW EXOSPHERIC SODIUM AND POTASSIUM MIGRATE ON THE MOON: THE VIEW FROM LADEE. M. Sarantos[1], A. Colaprete[2], J. Szalay[3], J.L. McLain[4], D. H. Wooden[2], A. Poppe[5] , [1]Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD 20771 USA, [2]NASA Ames Research Center, Moffett Field, CA 94035 USA, [3]LASP, University of Colorado, Boulder,CO 80309 USA, [4]Solar System Exploration Division, NASA Goddard Space Flight Center, Greenbelt, MD 20771 USA, [5]Space Sciences Laboratory, UC Berkeley, Berkeley, CA 94720 USA.

Introduction: Almost thirty years after the discovery from Earth telescopes of tenuous Na and K exospheres enveloping the Moon [1], recent measurements from the Lunar Atmosphere and Dust Environment Explorer (LADEE) spacecraft posed new questions [2]. With their high temporal cadence and continuous coverage, LADEE data revealed the long-term and short-term evolution of these exospheres, thus providing previously unavailable information about the time scales for loss of Na and K. These observations advance our understanding of how Na and K - two particular examples of volatiles that are easy to observe because of their good spectroscopic properties - are distributed, transported, and sequestered in near-surface environments of Inner Solar System bodies.

Findings: We present models of the exosphere-extreme surface system used to interpret the LADEE measurements. The simulator accepts as input partially constrained microphysical parameters of the gas-surface interaction (such as source rates, cross sections for different source processes [3]) to make testable predictions of the exosphere and extreme surface (~top 1 Å).

Two key pieces of evidence provided by LADEE are the response of the atmosphere to showers, and the amplitude of the observed monthly variation for these exospheric species with lunar phase. By combining parameters that are required to explain the rise and fall of the atmosphere during and following showers with parameters required to explain the monthly variation, we can derive: 1) the "temperature" of the impact vaporization source; 2) the relative importance of source processes for adsorbed particles; 3) the residence times and sink rates for adsorbed particles of these species on the lunar surface; and 4) the exogenous amount of Na and K brought in by interplanetary dust.

We find that the migration parameters of Na and K likely differ in time and/or with selenographic location. For instance, the best qualitative agreement with the observed monthly amplitude of lunar Na was achieved either when the Na source rate is assumed to peak at Mare, or – alternatively - if the residence time for photodesorption of adsorbed Na is much shorter on Mare soils, or even if Highlands soils are more reactive. Soil maturity appears to be affecting the redistribution rates. These findings underline the need for new laboratory experiments to be performed on lunar samples in order to fully interpret LADEE measurements.

References: [1] Potter, A.E. and T.H. Morgan (1988) *Science*, doi: 10.1126/science.241.4866.675; [2]Colaprete, A. et al. (2016) *Science*, doi: 10.1126/science.aad2380; [3] Yakshinskiy, B. V. and T. E. Madey (2004) *Icarus*, doi:10.1016/j.icarus.2003.12.007.

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