PROSPECTS FOR THE DETECTABILITY OF LUNAR EXOSPHERIC REFRACTORIES BY LADEE ULTRAVIOLET-VISIBLE MEASUREMENTS.
M. Sarantos[1,2], R. M. Killen[1], D. Glenar[3], and T. J. Stubbs[1,2] [1]NASA Goddard Space Flight Center; [2]University of Maryland, Baltimore County; [3]Astronomy Dept., New Mexico State University, Las Cruces, NM.

Introduction: The Lunar Atmosphere and Dust Experiment Explorer (LADEE) spacecraft will monitor the surface-bounded, collisionless exosphere of the Moon during a brief, three-month period in 2012 or 2013. Models for the production and loss of regolith–derived exospheric species are relevant to the visible/ultraviolet spectrometry (UVS) investigations planned by LADEE. The release processes considered are micrometeoroid impact vaporization and solar wind sputtering, complemented, for sodium and potassium, by photon–stimulated desorption. Losses include ballistic escape and recycling to the surface.

Modeled column abundances: We modeled column abundancies in the dayside exosphere from all sources for eight species which have strong emission lines in the UVS range (200 – 800 nm). Sightlines for these simulations lie in the equatorial plane and have low-altitude tangent points (10, 40 km). To convert the modeled column abundance to expected intensity due to resonant light scattering, we calculated improved resonance scattering g-factors for ground state transitions for the species of interest including silicon and metallic species.

Assumptions for impact vaporization are: total impact vapor rate for all species 1.78×10^{-16} g cm^{-2} s^{-1}; T=3000 K; and the assumption of no losses to the formation of condensates or molecules within the impact cloud for a "best case" estimate. For sputtering, a yield of 0.1 atom/ion and a solar wind flux of 4×10^{8} ions cm^{-2} s^{-1} are assumed. A mean lunar composition of low-Ti Mare soils was assumed. Furthermore, the intensities that are consistent with the 5-σ limits from ground-based and space-borne observations [1] were calculated for undetected species. Prior to this application, the model was validated with sodium telescopic observations [2]. Sputtering profiles from our model agree with those by [3]. The impact-driven intensities agree with those by [4] when we use the same g-factors assumed in that work.

Detectability in the presence of coronal and zodiacal light: To examine the detectability of these species by UVS, we superimposed zodiacal light onto the modeled intensities in the sunlit hemisphere. Resulting spectra were convolved to the UVS resolution (~0.70 nm) with Gaussian noise added at about the level anticipated for UVS. According to our models, Si, Mg, Al, Fe, Ti and Ca will be measureable with instrument integration times as short as ~10–60 sec, and thus with longitude resolution exceeding ~3°, when the Moon is exposed to the combined influence of micrometeoroids and the solar wind. Dayside sodium and potassium will be observed by UVS with a high signal to-noise ratio under nearly all circumstances. In conclusion, identification of these species from orbit is not only possible, but, given these measurements, we can identify the processes and constrain the microphysical parameters (e.g., sputtering yields, the degree of formation of condensates and molecular constituents, etc.) controlling the supply of lunar gas and its interaction with the surface.

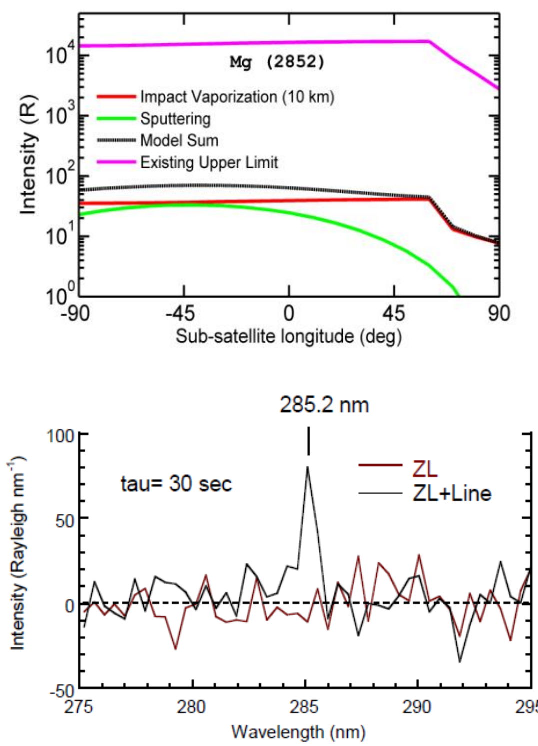

Figure 1: Example of an expected detection by LADEE UVS: (Upper Panel) Model of emission of lunar Mg owing to a number of sources; (Lower Panel) The expected line rises above noise for a 30-s integration

References: [1] Stern, S. A (1999), *Rev. Geophys.*, 37, 4, 453 – 491. [2] Sarantos M. et al. (2010), *Icarus*, 205, 364-374. [3] Wurz P. et al (2007), *Icarus*. [4] Morgan T. H. and Killen R. M. (1997) *Planet. Space Sci.*, *45*, 81-94.