ASTOUNDING NEW ASPECTS TO THE LUNAR EXOSPHERE.

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Motivation for an Update. When the first 'New Views' perspective was present in 2006, it is difficult to imagine the authors could have predicted the numerous new findings made over the next 10 year. This is especially true in the area of lunar exospheric research - which made extraordinary strides including: 1) The discovery of a number of new exospheric components (including impact-generated dust) by the LADEE mission, 2) the LRO/LAMP instrument's inventory of the exospheric content made via FUV florescence [Cook et al., 2013], 3) the entry into lunar orbit of the twin ARTEMIS spacecraft and the observation of exo-ions, and 4) the unique 2009 LCROSS plume (transient dusty exosphere) experiment which exposed lunar water in polar cold traps [Colaprete et al., 2009].

A review chapter updating new activity has to incorporate these outstanding new findings from these missions along with tying the observations into some of the new concepts on the lunar system.

The Bigger Picture. While each of these spectacular missions contributed their own unique observational set and new discoveries, it is actually the merging across missions of the various findings that has lead to an entirely new view of the exosphere.

Specifically, its is becoming clear that a tenuous **lunar water cycle** may exist – hinted at in earlier works like Butler, 1999; Crider and Vondrak, 2000. Figure 1 shows 4 sources of OH and water on any given mid-latitude stretch of lunar regolith. Specifically, modeling suggests that the polar reservoirs are themselves exospheric sources with water liberated by impact vaporization and plasma sputtering process. Volatile-rich micrometeoroids also deliver water and OH to the lunar surface. Hydrogen infused minerals can contribute to the H in the exosphere via plasma sputtering from these surfaces.

Finally, there is clear observational evidence to indicate that much of the incoming solar wind is not retained in the surface, but converted and re-emitted to neutral H (from thermal to high energies), H_2, and reflected protons; all channels constituting branches of a **lunar hydrogen sub-cycle**. Some fraction of the neutral H atoms may be retained in the cooler surface regions, possibly accounting for the diurnal effect reported in the surface 3 micron IR observations [Sunshine et al., 2009].

Such exciting new perspectives could be incorporated in any new chapter that is updating views of the Moon.

Other System-Level Topics For Consideration. Other topics that could be considered in an update of the latest research include the full assessment of oxygen in the exosphere – has it been fully measured and do we know where it goes? After LADEE, consideration could be given to the redefined role of impactors in releasing surface vapor into the exosphere. Given our new understanding of the solar wind plasma flow near the surface in polar regions, we can assess how such plasma ions might alter the surface of polar crater floors, including possibly releasing trapped volatiles via sputtering.

An update can address these new system-level topics, and in this workshop we will consider these and other suggested topics for inclusion into the chapter review.

Over the next ten years, we anticipate an even greater understanding of these processes and the discovery of new aspects not even possible to consider now – which will likely make the NVM II exosphere chapter outdated in its perspective. We look forward to such exciting activity.

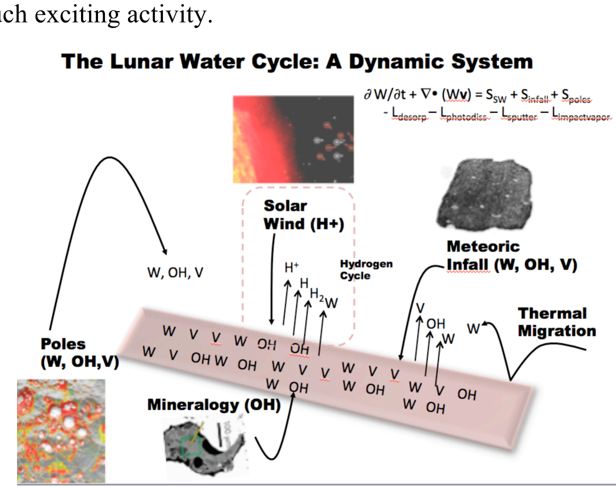

Fig 1. A Concept of the Lunar Water Cycle. W = Water, V= Volatile, OH = Hydroxyl.

References. Cook JC et al., 2013, Icarus, 225, 681. Colaprete A et al., 2010, Science, 330, 463. Butler BJ, 1997, J. Geophys. Res., 102, 19283. Crider DH and RR Vondrak, 2000, J. Geophys. Res., 105, 26773. Sunshine JM, 2009, Science, 326, 565.