LADEEVIEW: ELEMENTAL COMPOSITION ANALYSIS OF LUNAR SURFACE D. Nikolić[1] and M. Darrach[1], [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA

Introduction: In its 2007 final report, the NRC's Committee on the Scientific Context for Exploration of the Moon states that "*over 90% of the molecules in the Moon's atmosphere are currently compositionally unidentified*". The key scientific question to be addressed is the composition and the variability of the lunar atmosphere with solar activity, diurnal cycles, and meteoritic impacts.

The recent global characterization of neutral He and Ar in the lunar exosphere [1,2], along with the discovery of neutral Ne over the night side at levels comparable to He, was performed by the Ion and Neutral Mass Spectrometer (INMS) [3] onboard the Lunar Atmosphere and Dust Environment Explorer (LADEE) [4]. The equatorial distribution of surface densities of these neutral noble gases, as well as detections of exospheric ions [5], revealed novel temporal variations made possible by combined analysis of data from Lunar Reconnaissance Orbiter (LRO) Lyman Alpha Mapping Project (LAMP) [6] and the ARTEMIS mission that monitored the solar wind alpha particle flux to the Moon [7].

Apart from the solar wind alpha particles as the dominant supply of helium to the exosphere, Benna *et al* [2] argue the presence of an internal source of helium at rate of 1.9E23 atoms/s; they also identify neon with the spatial distribution of a surface bound non-condensable gas having the source rate comparable to that of helium, whereas the global transient variability of argon has been coupled to the local enhancement such as those found in the west maria region (see Fig.1).

We present the modular computer program LADEEView designed to aid multi-parameter analysis of mass spectrometry data obtained by the INMS onboard the LADEE spacecraft. LADEEView is an in-house C++ program that utilizes hardware-accelerated rendering of realistic 3D graphics via OpenGL API. As currently envisioned, its primary purpose is to aid researchers in characterization of the global density, composition, and time variability of the lunar surface boundary exosphere.

LADEEView Program Structure: LADEEView aims to be a comprehensive Lunar Data Analyzer with modular architecture for inclusion of data from other instruments. At present stage LADEEView performs detailed cross-analysis of data measured by the INMS onboard LADEE. It uses LADEE SPICE data archived in the Planetary Data System to accurately determine the spacecraft position and orientation with respect to the lunar surface, solar wind and Earth's magnetosphere. From these, the INMS operational field of view is precisely known. Currently LADEEView deploys the completed mass spectrometry module in mapping the elemental abundances along the LADEE trajectories (see Fig.1). These maps are expected to be extremely useful as constraints and input for future models of lunar exosphere especially those that address volatile transport.

The detailed knowledge of lunar surface temperature is crucial for exospheric simulations of volatile transport via ion sputtering processes and for modeling the gas-surface thermal and chemical equilibration. The surface temperature governs the thermal desorption/diffusion of particles from the regolith and affects the initial velocity distribution of exospheric particles. Presently LADEEView uses the topographically smoothed approximation to the temperature of the surface of the Moon as measured by the Diviner Lunar Radiometer Experiment onboard the LRO. However, the actual temperature near the terminator strongly depends on the local topographic features. Therefore, future development of LADEEView will include the digital elevation model (DEM) data from the Lunar Orbiter Laser Altimeter (LOLA) onboard LRO spacecraft. In addition, we plan to enhance the LADEEView with magnetometer spectrograms onboard the Advanced Composition Explorer (ACE) to provide an easy access to local magnetic field strengths influencing the ion trajectories and the efficiency of their detection by the INMS instrument.

The current version of the LADEEView program contains three main components: mass spectra module, SPICE engine, and flyby simulator. Mass Spectra module offers a visualization of the count rate as a function of the mass-to-charge ratio as well as the total number of events detected per each second of measurement. SPICE engine serves to determine the variability of LADEE spacecraft orientation and position with respect to the Moon, Earth, and the Sun. For each recorded event the position and the orientation of the INMS instrument is known in terms of the instrument's field of view at given altitude and velocity; the local solar time as well as the selenographic latitude and longitude are also given for the spacecraft's, Earth's, and Sun's subpoints on the lunar surface. Flyby simulator exhibits the detailed visual information as spacecraft approaches and orbits around the Moon.

LADEEView is scriptable application for a fully automated event search data analysis.

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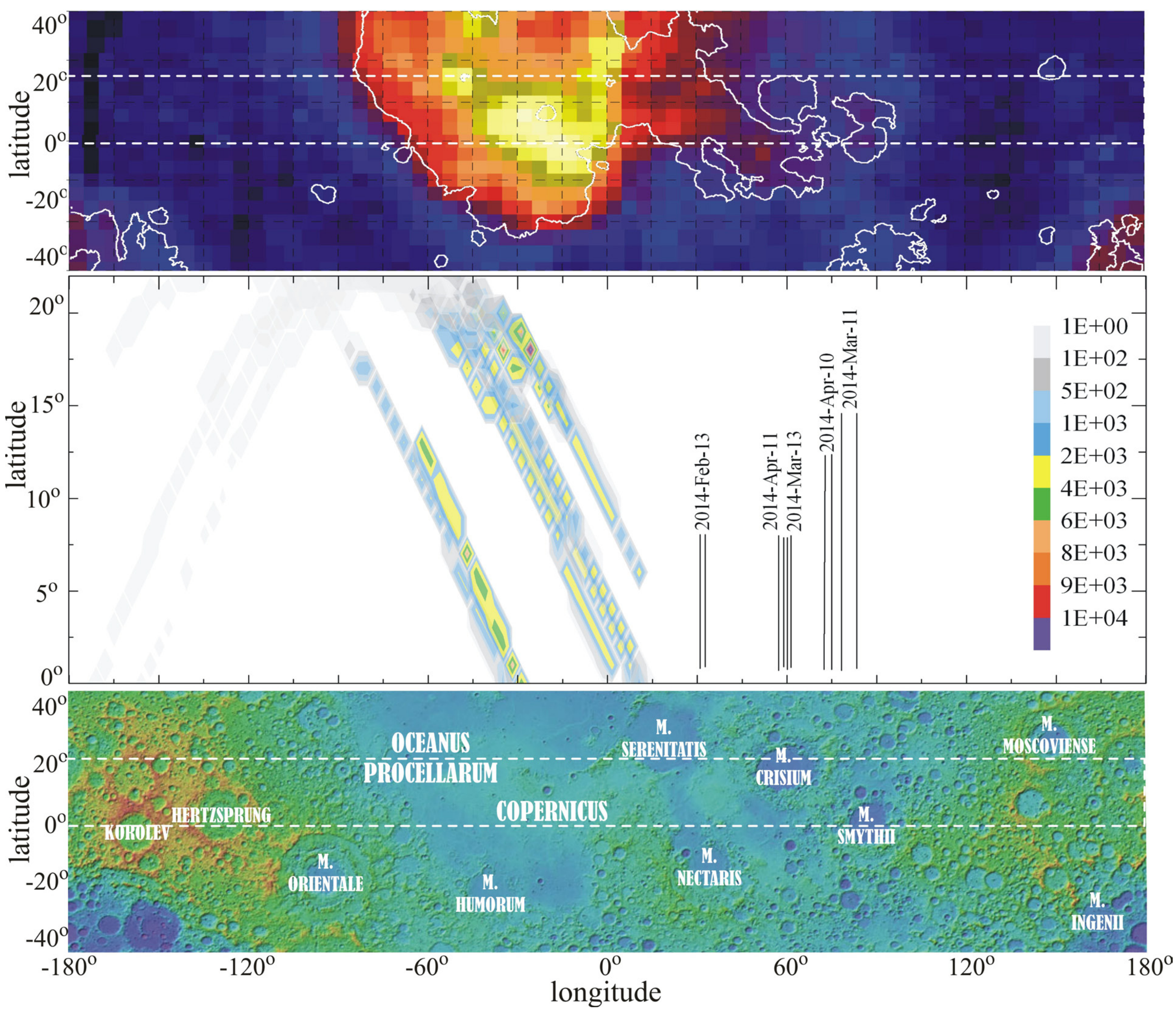

Figure 1: Variability of KREEP-rich materials (potassium K, rare earth elements REE, and phosphorus P) in the lunar highlands around the nearside western maria: (top) delineation of large compositional variation map of ^{40}K [8] with color blue (355 cnts) and yellow (490 cnts); (middle) LADEEView surface number density derived from LADEE INMS closed source neutral count rate within 39.46-40.46Th mass-to-charge channels; vertical lines denote subsolar meridian; (bottom) mid-latitude portion of elevation map (Lunar LOLA Color Hillshade 128ppd v04) with color blue (-6km) and red (+11km).