MUCH OF THE HYDROGEN ENRICHMENT NEAR THE LUNAR SOUTH POLAR IS OUTSIDE THE PERMANENTLY SHADOWED REGIONS.

W. V. Boynton[1], (wboynton@LPL.Arizona.edu), I. G. Mitrofanov[2], A. B. Sanin[2], M. L. Litvak[2], D. K. Hamara[1], G. F. Droege[1], V.I. Tretyakov[2], A.S. Kozyrev[2], A.V. Malakhov[2], M.I. Mokrousov[2], A.A Vostrukhin[2], D. V. Golovin[2], A.B. Varenikov[2], V. N. Shvecov[3], R.Z. Sagdeev[4], G. Milikh[4], G. Chin[5], J. Trombka[4], T. McClanahan[4], R. Starr[6], L. Evans[6], V. Shevchenko[8], [1]Lunar and Planetary Laboratory, University of Arizona, Tucson AZ 85722, [2]Space Research Institute, RAS, Moscow, 117997, Russia, [3]Joint Institute for Nuclear Research, Dubna, Russia, [4]University of Maryland, College Park, MD, USA, [5]Goddard Space Flight Center, Greenbelt, MD, USA., [6]Catholic University, Washington, DC, USA, [7]Computer Sciences Corporation, Glenndale, MD, USA. [8]Sternberg Astronomical Institute of Moscow State University, Moscow, Russia.

Introduction: Analysis of S-band radar reflection data returned from the Clementine spacecraft suggested that deposits of water ice might exist in permanently shadowed regions (PSRs) near the lunar south pole [1]. Later, results from the Lunar Prospector (LP) mission showed clear evidence for enhanced hydrogen at both lunar poles [2], but the spatial resolution was not sufficient to determine if the enriched hydrogen was, in fact, located in the PSRs. Consequently NASA recently launched the Lunar Reconnaissance Orbiter carrying the Lunar Exploration Neutron Detector (LEND), which has dramatically better spatial resolution for neutrons [3].

In this work we present maps of epithermal neutron count rates in the south polar region using data from the collimated epithermal neutron detectors on LEND. The flux of epithermal neutrons are significantly suppressed in regions of high hydrogen content, and if the hydrogen were associated with the PSRs, the LEND detectors should see this association.

Results: The map of LEND collimated neutron data are shown in Figure 2. The map is in units of the count rate difference from the average count rate in the region between -75° S to -84° S latitude. Also shown are the locations of the PSRs as determined from the Kaguya data [4]. It can be seen that the high spatial resolution data from the LEND collimated detectors has little relationship to the PSRs. There is a large flux depression associated with the Shoemaker crater, but otherwise none of the other PSRs appear to have any associated flux depression.

The stastical quality of the data are such that even the weaker flux depressions (in yellow) are significant at the 3-sigma level. The largest flux depression is clearly associated with the Shoemaker crater, but there is also a large area of hydrogen enrichment throughout the region, bounded between 90° S to 87° S and 0° to 60° E, that is not associated with any PSRs.

Implications for future lunar missions: The search for water in the polar regions of the moon has been of interest both for scientific reasons as well as for human exploration.

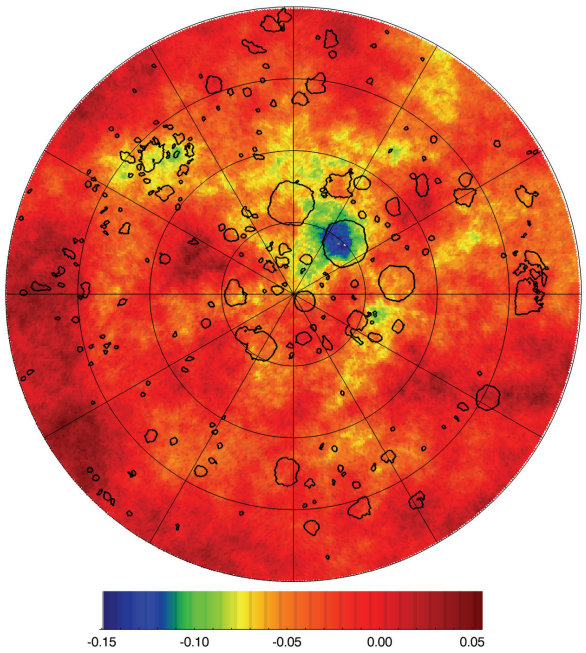

Figure 1. Map of count rate of LEND collimated epithermal neutron detector. Units are in counts/s and are the difference from the values in the -75° S and -84° S latitude band. The uncertainty in count rates range from 0.02 to 0.025 cps. The PSRs are indicated.The limit of the graph is -82°.

If the only source of water were in the deep craters that are in total darkness, it would have made access to the water-rich areas very difficult. The fact that much of the hydrogen is located outside the PSRs should make future access substantially easier.

Considering the scientific implications of these data, understanding hydrogen enrichment shown by these observations will clearly spark new theories and hypotheses on why the hydrogen is located where it is. Most likely future science missions will be conceived to test some of these new hypotheses.

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