CORRELATED OBSERVATIONS OF EPITHERMAL NEUTRONS AND POLAR ILLUMINATION FOR ORBITAL NEUTRON DETECTORS.

T.P. McClanahan[1], I.G. Mitrofanov[2], W.V. Boynton[3], G. Chin[1], G. Droege[3], L.G. Evans[1,6], J. Garvin[1], K. Harshman[3], M.L. Litvak[2], A. Malakhov[2], T. Livengood[1,5], G.M. Milikh[4], M. Namkung[1], G. Nandikotkur[5], G. Neumann[1], D. Smith[1,7], R. Sagdeev[6], A. G. Sanin[2], R.D. Starr[1,4], J.I. Trombka[1,5], M.T. Zuber[1,7], [1]Space Exploration Division, NASA Goddard Space Flight Center, Greenbelt, MD, USA., [2]Inst. for Space Research, Moscow, Russia, [3]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA, [4]Catholic Univ., Washington , DC, USA. [5]Space Physics Dept., Univ. of Maryland, College Park, MD, [6]Computer Sciences Corp., Glenn Dale, MD, USA, [7]Dept. of Earth, Atmos., and Planet. Sci., MIT, Cambridge, MA, USA

Introduction: We correlate Lunar Reconnaisance Orbiter's (LRO) Lunar Exploration Neutron Detector (LEND) and the Lunar Prospector Neutron Spectrometer's (LPNS) orbital epithermal neutron maps of the Lunar high-latitudes with co-registered illumination maps derived from the Lunar Orbiter Laser Altimeter (LOLA) topography [1-4]. Epithermal neutron count rate maps were derived from the LEND: 1) Collimated Sensor for Epithermal Neutrons, CSETN1-4 2) Uncollimated Sensor for Epithermal Neutrons, SETN and the Uncollimated Lunar Prospector: 3) Low-altitude and 4) High-altitude mapping phases. In this abstract we illustrate 1) and 3) and include 2) and 4) in our presentation. The correlative study provides unique perspectives on the regional epithermal neutron fluences from the Lunar polar regions under different detector and altitude configurations.

Methods: LEND and LPNS epithermal neutron count rate maps were identically prepared for North and South latitudes ±65° to poles. Epithermal maps were configured to be registered with 480m pixel resolution topographic illumination models. For LEND, low altitude north polar maps were derived from the primary mapping phase Sept 15, 2009 to July 25, 2010 and south polar maps included the low altitude commissioning data starting July 3, 2009. LPNS epithermal data were obtained from the low-altitude, 8-sec Planetary Data System (PDS) archives. All mapping was performed using a 2-D, 25km diameter uniform area mapping disk. LOLA illumination models were derived from the topographic maps using a ray-tracing methodology described in [5].

Approaching the poles illumination distributions become increasingly bimodal reflecting local extremes in illumination condition [6]. Due to the lack of normally distributed polar illumination data, we perform correlation between epithermal rates and illumination in two ways, 1) by calculating the mean epithermal neutron count rates in 2.5° latitude bins cut by the azimuthal plane similar to [4]. Within each latitude bin we select and average pixels as a function of four levels of illumination [0% = Permanent Shadow, 0 to 15%, 15 to 35%, >35%]. Results of these analysis are reported in Figures 1 to 4. Rank ordered epithermal-illumination rate plots are an indication of positive correlation. The 1-σ latitude band average uncertainties are listed to the left of figures and the epithermal rate avg / latitud band is dashed (*green*) 2) In Figures 3 and 6 we calculate the latitude band Pearson correlation coefficient between epithermal count rates and illumination.

Conclusions: All detector system and configurations indicate the large-scale polar suppression in epithermal rates observed by both LEND and LPNS.

South Observations: Figs. 1-2 both indicate the poleward suppression whose slopes are asymmetric, with the steeper slopes in the (0 to 180°), east longitude side of the pole vs. west longitudes (180 to 360°). From -65° to -82.5° (east longitudes) correlations are consistently lower than the west lons and both LPNS and LEND indicate a slight anti-correlation in this region (ref. Fig 3.) -80° which intersects the southern rims of Scott and Hedervari craters. From -82.5° east longitude to plot right, the observed epithermal rates generally indicate increased positive correlations as reflected in the rank ordering of epithermal rates with illumination and Pearson correlations in Fig 3. Moving from the pole to lower latitudes in the west longitudes the correlations generally decrease which may be due to decreased coverage / higher uncertainties. Alternately, it is possible that the illumination distributions have lower averages near the poles, increasing towards lower latitudes. In either event we would expect symmetric correlation trends around the poles and this is not the case. In Figs. 1-2 and 3 the correlations reflect distinctly bimodal conditions with consistently low correlations left of -80° (east longitude) not consistent with the west longitudes. We also note from another study to be reviewed, that illumination systematically increased with increased coverage levels in the SP maps in the west longitudes, while east longitudes generally maintained consistently positive-low or anti-correlation to illumination.

North Observations: Overall the North polar correlations are markedly different than the South reflecting relative decreases in correlation towards lower latitudes. Results 70° to pole (0-180° E lon) indicate low-positive correlation to illumination as evidenced by the epithermal contrasts in Fig. 4-6. At -82.5° to -87.5° west longitude all the detector epithermal contrasts were significantly decrease as evidenced by low-negative correlation. This band is coincident with Roshdestvenskiy and Hermite craters which contain fresh, less cratered surface relative to surrounding areas, possibly altering the illumination distributions in these regions. Right of -87.5° epithermal contrasts increase then diminish towards lower latitudes.

Importantly, in our presentation we also review similar results of the LEND uncollimated and LPNS high-altitude results which are consistent in indicating varying regional correlations. Together these results appear to indicate illumination is a factor influencing epithermal neutron rates at the lunar poles. However, other geophysical and geochemical factors appear to play a role. These may influence either the remote sensing of these regions or epithermal neutron fluxes, e.g spatial scale of cratering.

References: : [1] Chin *et al.* (2007) *Sp. Sci. Rev.* #150 [2] Mitrofanov *et al.* (2007) *Sp. Sci. Rev.* #150 [3] Feldman *et al.* (1998) *Science* #281 [4] Smith *et al.* (2007) *Sp. Sci. Rev.* #150 [5] Mazarico et al., (2010) *Icarus* [6] Mazarico *et al.* (2011) *GRL, in Review*

South

North