**ANALYSIS OF HIGHLY ILLUMINATED ZONES NEAR THE LUNAR POLES.** E. J. Speyerer[1] and M. S. Robinson[1], [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ (espeyerer@ser.asu.edu).

**Introduction:** The spin axis of the Moon is tilted by only 1.5° (compared with the Earth's 23.5°), leaving some areas near the poles in permanent shadow, while other nearby regions remain sunlit for the majority of the year. Previous studies have delimited these regions using theoretical models, Clementine images, and topography from Kaguya and LRO [1-5]. Theory, radar data, neutron measurements, and Lunar CRater Observation and Sensing Satellite (LCROSS) observations suggest that volatiles may be present in cold traps in permanently shadowed regions [6-10]. Thus, areas of near permanent illumination are prime locations for future lunar outposts due to their benign thermal conditions and near constant access to solar power [11-12].

One of the primary scientific objectives of the Lunar Reconnaissance Orbiter Camera (LROC) is to unambiguously identify regions of permanent shadow and near permanent illumination using its two imaging systems that provide medium and high-resolution views of the poles [13]. Since the start of the nominal mission, LROC has acquired over 11,000 Wide Angle Camera (WAC) images and over 6,500 Narrow Angle Camera (NAC) image pairs within 2° of the poles. We reduced a subset of these images (illumination maps, movie sequences, and high resolution maps) to delimit lighting conditions over one year. Analysis of these products reveal a region near the south pole that remain illuminated for a majority of the year (92% of the year, a 10% increase over some previous studies [1,4]).

**Wide Angle Camera Products:** LRO's 50-km polar orbit enables images of each pole to be acquired every ~2 hours during normal spacecraft and instrument operations (average time between WAC observations is 2.3 hours including spacecraft and instrument disturbances). This repeat coverage enables the creation of illumination movies and multi-temporal illumination maps that can be used to delimit permanently shadowed regions and permanently (or near permanently) illuminated regions [14].

**Narrow Angle Camera Products:** The two NACs provide high-resolution (0.7 to 1.5 m/pixel) images of select regions around the each pole. Due to the NAC's 2.85° field of view (5.7° combined) broad scale multi-temporal mapping is limited. However, during summertime months, when shadows are at a minimum, the NACs acquire 100s of images that are used to create meter scale maps of the illuminated terrain at the south pole. During the winter months, a majority of the region is in shadow, so NAC imaging is focused on previously identified illuminated peaks that stay illuminated for a majority of the year [1, 3-4]

Due to its high resolution, the NAC images can be used to validate previous illumination studies that used lower-resolution topographic models (200-500 m/pixel). NAC images revealed several cases where small regions of the surface were illuminated when previous models predicted they would be in shadow. Similarly, NAC images have also shown some regions in shadow at times in which models showed them illuminated.

**South Pole Illumination Analysis:** Previous studies have identified peaks around the south pole that remain illuminated for a majority of the year, including a massif (Point B) located ~10 km off the edge of Shackleton crater that is estimated to be illuminated for 82% of the year [4]. Due to the much higher resolution dataset provided by the WAC and the NAC, we can investigate in greater details these highly illuminated regions.

Currently we have not found a point near either pole that is illuminated all the time, however, we have located a 2.25 km$^2$ region (centered at 89.4° S, 223° E) that remains illuminated for 92% of the year, which is 10% higher than the value previous reported in studies that examined only single points in only topographic models [4]. A recent work by Mazaeico et al. [5] identifies a 240m x 240m region centered at the same location to have an average solar visibility of 92.66%. This difference maybe due to our conservative threshold values and that our accuracy will be improved with a dynamic threshold that accounts for residual scattered light in the instrument as well as scattered light off of nearby illuminated surfaces.

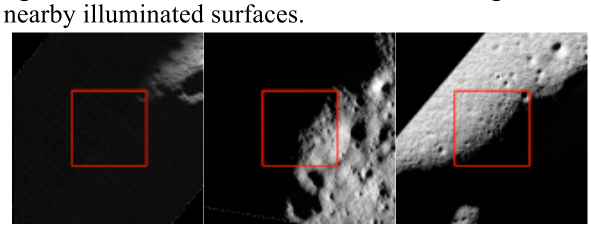

Figure 1- Detailed look at the illumination conditions of the same 2.25 km$^2$ region (red box centered at 89.4° S 223° E) throughout the mission using NAC images. Left to Right: M108578776, M121951177, and M112490681.

**Conclusions**: The Moon's slightly tilted axis provides a unique opportunity for regions near the vicinity of the pole to be permanently shadowed while other nearby regions can have extended periods of sunlight. Illumination in these regions has been previously studied with Clementine UVVIS data and topographic models from laser altimeters. LROC compliments this analysis with higher resolution data (up to meter scale) that can unambiguously identify these regions. Together, the NAC and the WAC can enhance our knowledge of the lighting conditions at the pole and provide a new dataset planning future science and exploration missions to these unique regions.

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