THE LUNAR RECONNAISSANCE ORBITER CAMERA: TWO YEARS EXPLORING THE MOON. M. S. Robinson[1] and the LROC Team, [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ.

Introduction: The Lunar Reconnaissance Orbiter Camera [**1**] acquired its first Wide Angle Camera (WAC) image of the Moon 30 June 2009 at 15:08:17.555 UTC and its first Narrow Angle Camera (NAC) on the same day a few minutes later (15:11:03.741 UTC). Since that exciting day the WACs have returned over 183,630 images and the NACs 408,287 images. Of these 114,000 WAC images and 367,000 NAC images cover the illuminated surface (as of 14 September 2011). The remaining observations are of the night side and looking into space (including Earth views) for calibration purposes.

The WAC images represent more than twenty complete near-global maps with pixel scales of ~100 m, each with unique lighting conditions, comprising the most complete photometric dataset [**2**] for any Solar System body besides the Earth. Since the WAC field-of-view (61° in color mode) has >50% overlap at the equator global stereo coverage exists providing the means to complete a 100-m pixel scale near-global Digital Elevation Model (DEM) [**3**]. Due to persistent shadowing at the poles the DEM covers latitudes 80°S to 80°N (*Fig. 1*).

From the 50-km mapping orbit the NACs have imaged 34% of the equatorial region (45°S to 45°N) with pixel scales ~50 cm. Within that same equatorial region 17% of surface was imaged with beta angles (angle between the Sun line and spacecraft orbit plane) less than 45° (high Sun) and 20% coverage for beta angles between 45° and 80°. Total coverage of the equatorial region with beta angles 0° to 80° is 34%. By slewing the spacecraft from two orbits and imaging the same area the NACs have returned over 750 stereo observations. The stereo pairs enable DEM production with 1.5-m to 2.0-m pixel scales and elevation precision of 1-m and accuracy better than 10-m (*Fig. 2*) [**4**].

These new data have lead to many discoveries, and will continue to do so for decades to come. A few highlights are presented in the following paragraphs.

Impact Melt: LROC NAC images of fresh impact melts show well-preserved sub-meter detail [**5**]. For craters smaller than 15-km in diameter impact melts can occur as thin veneers, ponds, sheets, or lava-like flows. Two types of impact deposits have been identified: 1) a lower reflectance and smooth material (LSM), and 2) deposits of moderate to higher reflectance and often rubblier material (MRM). Melt ponds often have variable albedo, both from crater to crater and sometimes within the same crater. LSM ponds typically appear fresh, with no superposed craters from later impacts, have smooth and undulating surfaces, and often have cooling cracks. MRM floor deposits occur as flat-lying, hummocks, or mounds, implying that there may be different types of MRM associated with impact craters. In some craters, LSM melt veneer coats the crater interior on the side opposite the most prominent LSM exterior melt, consistent with an oblique impact. Impact melt flows have been identified within one crater diameter of impact craters as small as 3-km in diameter. Craters with floor MRMs more frequently have superposed craters, suggesting that some MRM craters may be older than those with LSM. Impact melts can be used to infer the properties of the target material, and can be used to infer freshness of an impact crater. Small mare and highlands craters allow investigation of the influence of target material and strength on the development and distribution of impact melt and interior deposit morphology.

Farside Extensional Tectonism: Linear and arcuate rilles associated with nearside basins are related to extensional stresses induced by the mare fill. This basin-related extension ceased at ~3.6 Ga while contractional tectonic activity that formed mare ridges continued to ~1.2 Ga. Although small-scale, relatively young (<1 Ga) contractional lobate scarps were previously known, no evidence of extensional landforms in the highlands beyond the influence of mare filled basins were known to occur. NAC images reveal small-scale graben in the farside highlands and in nearside mare basalts. The lack of superposed craters, crosscut impact craters with diameters as small as ~10 m, and depths as shallow as 1 m suggest these graben are <50 Ma. In order for the small-scale graben to form, extensional stresses must locally exceed the global compressional stress that resulted in the young lobate scarps. The formation of these young graben suggests relatively low compressional background stresses [**6**].

Farside Silicic Volcanism: Images from the Wide and Narrow Angle Cameras and derived DEMs provide evidence that a small volcanic complex occurs at the center of the Compton-Belkovich "thorium anomaly." Morphologies seen at high resolution, including domes with slopes exceeding 20° and collapse features, are consistent with a near-surface intrusion that developed late-stage silicic lavas, which then erupted to form domes ranging from 500-m to 6-km base diameters. Comparison of the topographic expression of this volcanism and bright reflectance associated with silicic material further suggests some pyroclastic dispersal of late-stage material. The Compton-Belkovich volcanic complex is the only known occurrence of silicic volcanism on the lunar farside [**7**].

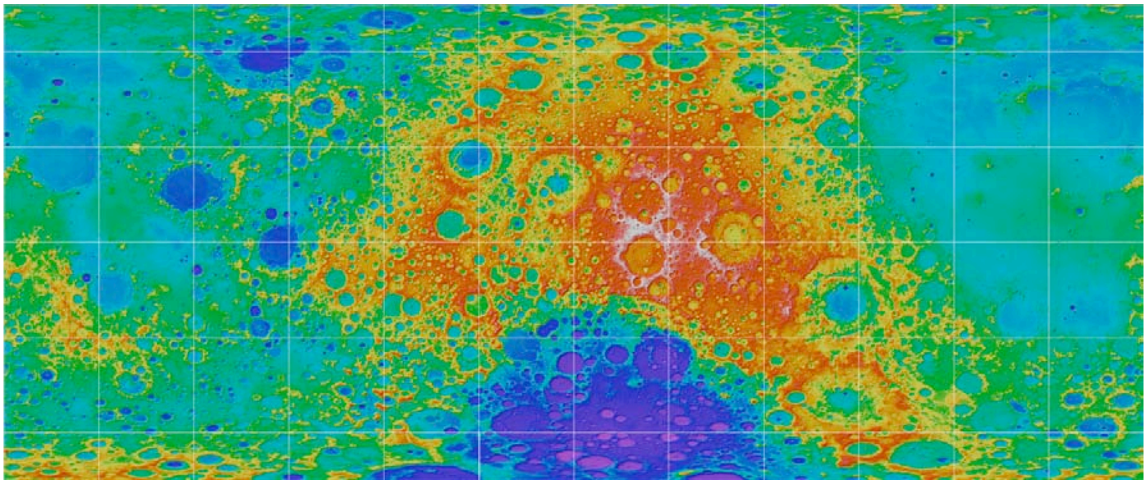

Figure 1. LROC WAC DEM from 75°S to 75°N and 0-360°E, full resolution product is sampled at 100 m.

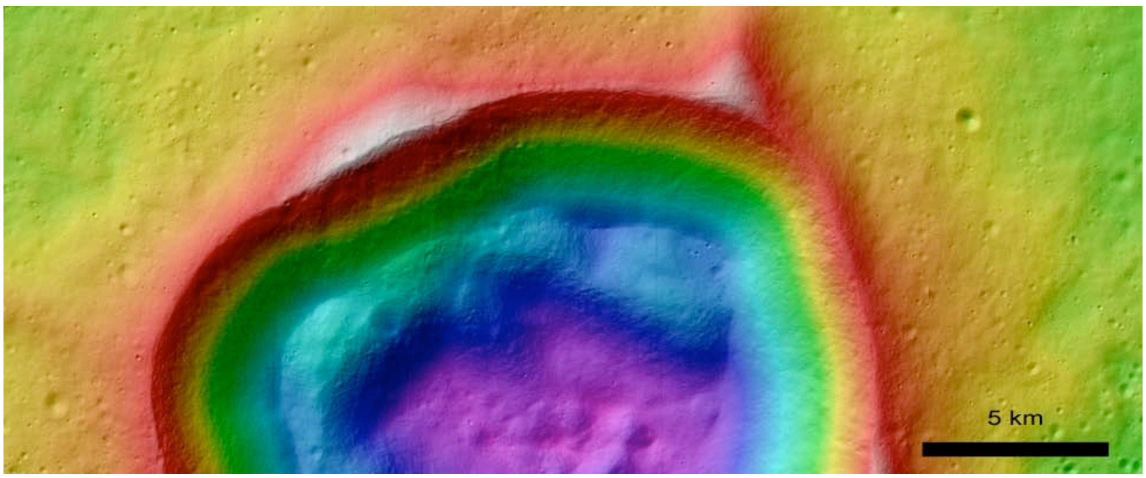

Figure 2. Small portion LROC NAC stereo-derived DEM of central Lichtenberg crater, total relief is 2831 m.

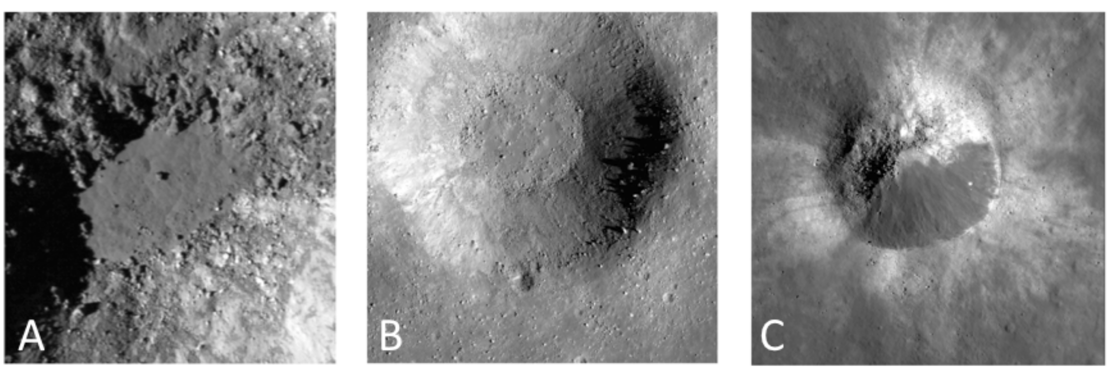

Figure 3. A) A fresh, smooth ~100 m LSM melt pond in a 700-m crater exhibiting an undulatory surface texture. **B)** A 940 m crater with MRM floor deposits, crater superposed on the rim, and less visible ejecta rays. **C)** A fresh 550 m crater with asymmetric distribution of melt veneer.

References: [1] Robinson, M. S. et al. (2010) *Space Sci. Rev., 150*, 81-124. [2] Sato, H. et al (2011) *LPSC*, abstract 1974. [3] Scholten, F. et al. (2011) *LPSC*, abstract 2046. [4] Tran, T. et al. (2010) *ISPRS Commission VI, WG VI/4*, abstract. [5] Stopar et al, this meeting. [6] Watters et al, *Nature Geosciences*, in press. [7] Jolliff et al. (2011) *Nature Geosciences* 4, 566–571.