LUNAR RECONNAISSANCE ORBITER CAMERA: FIRST RESULTS. M.S. Robinson[1], E.M. Eliason[2], H. Hiesinger[3], B.L. Jolliff[4], A.S. McEwen[2], M.C. Malin[5], M.A. Ravine[5], P.C. Thomas[6], and E.P. Turtle[7], Ernest Bowman-Cisneros[1], and the LROC Team [1]School of Earth and Space Exploration, Arizona State University, Box 871404, Tempe, AZ, 85287, [2]LPL, Univ. of Arizona, Tucson AZ, [3]Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Münster, Germany, [4]Washington Univ., St. Louis MO, [5]Malin Space Science Systems, San Diego CA, [6]Cornell University, Ithaca NY, [7]Applied Phsyics Laboratory, Johns Hopkins University, Laurel, MD.

Introduction: The Lunar Reconnaissance Orbiter Camera (LROC) Wide Angle Camera (WAC) and Narrow Angle Cameras (NACs) are currently returning data from lunar orbit. The WAC is a 7-color push-frame camera (100 and 400 m/pixel visible and UV, respectively), while the two NACs are monochrome narrow-angle linescan imagers (0.5m/pixel).

LROC was designed to address two of the primary LRO measurement requirements and six other key science objectives. **1)** Assessment of meter and smaller-scale features in order to facilitate safety analysis for potential lunar landing sites near polar resources and elsewhere on the Moon. **2)** Acquire multi-temporal synoptic 100 m/pixel imaging of the poles during every orbit to unambiguously identify regions of permanent shadow and permanent or near-permanent illumination. **3)** Meter-scale mapping of regions with permanent or near-permanent illumination of polar massifs. **4)** Repeat observations of portions of potential landing sites and elsewhere for the derivation of high resolution topography. **5)** Global multispectral observations in seven wavelengths to characterize lunar resources, in particular ilmenite. **6)** A global 100-m/pixel basemap with incidence angles (60°-80°) favorable for morphological interpretations. **7**) Sub-meter imaging of a variety of geologic units to characterize their physical properties, the variability of the regolith, and other key science questions. **8)** Meter-scale coverage overlapping with Apollo-era panoramic images (1-2 m/pixel) to document the number of small impacts since 1971-1972. Little is known of the current impact rate for bolides in the size range 0.5 to 10 meters. Elucidating the impact rate at these sizes enables engineering remediation measures for future surface operations and interplanetary travel.

LRO was launched 18 June 2009 on an Atlas V 401 rocket from the Cape Canaveral Air Force Station Launch Complex 41. Following a four day Earth-Moon transit, the spacecraft first entered a three month commissioning phase in an elliptical 30×200 km orbit. LRO entered a quasi-circular 50-km mapping orbit on 15 September 2009 for a planned one-year nominal mapping mission. Following the conclusion of the nominal mission, a multi-year extended mission in a fixed 30×200 km orbit is possible.

Uplink: Typically the WAC requires no special targeting, it is simply left in data acquistion mode over the illuminated Moon. Each NAC image is indivually targeted through prioritized requests generated by the Science and Operations teams. The priorities are as follows: (1) exploration targets requested by NASA's Project Constellation (Cx) [**1**], (2) targets that fulfill other LROC Level 1 Requirements, (3) targets that support LROC Science Team and LRO mission science objectives, (4) science requests from outside the LRO team, (5) public target requests.

The LROC Science Operations Center generates command loads for the NAC and WAC on a daily basis. Based on the most recent predicted LRO spacecraft ephemeris (which will be received and updated daily from the LRO Mission Operations Center (MOC)) and the NAC Target Request Database for upcoming orbits, an operations plan for the next 72 hours of normal operations will be generated and submitted to the MOC each day. The NACs can be commanded individually or together, and in normal operating mode can acquire images of any length in 1024-line increments up to the full length of 52,224 lines with a maximum of 15 NAC image-pairs of the illuminated surface possible per orbit, for a theoretical daily total of 180 NAC pairs (or 360 images). Each LROC operational plan will therefore include NAC requests for at least 1000 images. Before NAC images are written to the spacecraft's solid-state data recorder, they are temporarily stored in a 256 MB buffer in the camera. It takes approximately 15 seconds to acquire a full NAC image pair and another 220 seconds to read that image pair through the Sequence and Compressor System to the LRO solid-state recorder. It is not possible to obtain another NAC image until the buffer is cleared, so after the collection of each NAC pair there is an 11° down-track latitude zone where additional imaging cannot be acquired. In addition to NAC commands for target requests, each 3-day plan also includes systematic mapping commands for the WAC.

Dowlink: LRO has completed 2,086 orbits of the Moon as of December 9, 2009 (1017 orbits during Commissioning and 1,069 orbits during the mapping phase). LROC has operated on 1898 of the orbits (91%) and acquired 83,085 images (53,602 NAC and 29,483 WAC), totaling approximately 10.7 TB of data. The first PDS data release of LROC data will be 15 March 2010, and will include all images from the Commissioning and the first 3 months of the mapping phase.

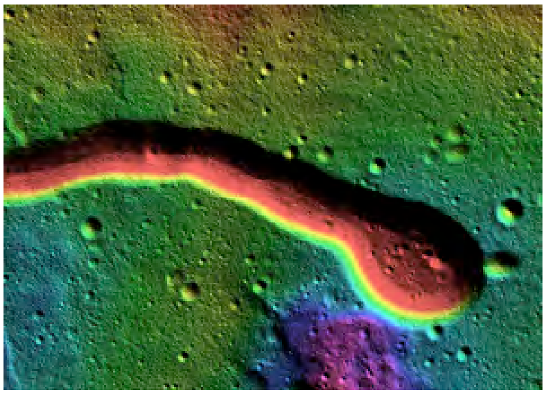

Fig. 1. Color coded shaded relief of sinuous rille near Marius Hills. NAC derived DTM, 5m/pixel.

Images: The WAC has imaged nearly the entire Moon in seven wavelengths (8 Dec 2009). A preliminary global WAC stereo-based topographic model is in preparation [2] and global color processing is underway [3]. As the mission progresses repeat global coverage will be obtained as lighting conditions change providing a robust photometric dataset.

The NACs are revealing a wealth of morphologic features at the meter scale providing the engineering and science constraints needed to support future lunar exploration. All of the Apollo landing sites have been imaged as well as the majority of robotic landing and impact sites. Through the use of off-nadir slews a collection stereo pairs is being acquired that enable 5-m scale topographic mapping (**Fig. 1**) [4-8]. Impact morphologies (terraces, impact melt, rays, etc) are preserved in exquisite detail at all Copernican craters and are enabling new studies of impact mechanics (**Fig. 2**) [9,10]. Other topical studies are underway and will be presented at LPSC and other meetings [11-17].

References: [1] Jolliff et al. (2010) 41st LPSC [2] Scholten et al. (2010) 41st LPSC this volume [3] Denevi et al. (2010a) 41st LPSC [4] Beyer et al. (2010) 41st LPSC [5] Archinal et al. (2010) 41st LPSC [6] Mattson et al. (2010) 41st LPSC [7] Tran et al. (2010) 41st LPSC [8] Oberst et al. (2010) 41st LPSC, [9] Bray et al. (2010) 41st LPSC [10] Denevi et al (2010b) 41st LPSC [11] Hiesinger et al. (2010) 41st LPSC [12] Van der Bogert et al. (2010) 41st LPSC [13] Plescia et al. (2010) 41st LPSC [14] Lawrence et al (2010) 41st LPSC [15] Gaddis et al. (2010) 41st LPSC [16] Watters et al (2010) 41st LPSC [17] Garry et al (2010) 41st LPSC.

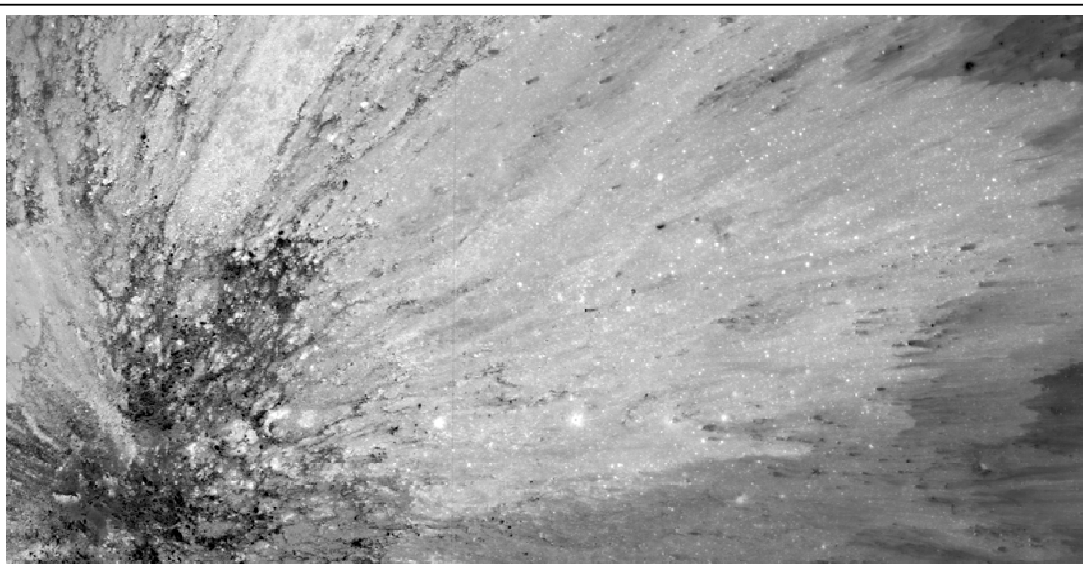

Fig 2. High Sun image of Copernican-aged crater (800 m diameter) revealing complex nature of ejecta movement and deposition. Crater center is in lower left, image width is 1,500 meters, M108992058R.