TARGETING THE LUNAR RECONNAISSANCE ORBITER NARROW ANGLE CAMERAS: TARGET SOURCES AND SELECTION STRATEGY.

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Introduction: The Lunar Reconnaissance Orbiter (LRO) mission will provide unprecedented information about the lunar surface to address fundamental questions in lunar science and to prepare for future exploration and utilization of the Moon. The Narrow Angle Cameras (NAC) of the LRO Camera system (LROC) will obtain the highest resolution imaging to date of targeted locations on the Moon. During the first year of operation, the focus will be on imaging targets that are of specific interest to the Constellation (Cx) Program for future lunar surface exploration. After the first year, the mission will transition to an extended science phase, with a focus on science targets. Most of the exploration targets are in fact high-priority science targets, so the distinction is somewhat artificial. Nonetheless, the targets that are potential landing sites for Constellation will have the highest priority during the first year of operation. In this abstract, we summarize the strategy that is being used by the LROC Team to generate a target list for the NACs. We also describe briefly a workshop that is planned for June 2009 that will provide an opportunity to discuss LRO science and for participants to provide additional input to the targeting plans.

Targeting Priorities: Targets for the LROC NACs are entered into a targeting database using the Rapid Environmental Assessment Composition Tools (REACT) software created by Applied Coherent Technologies (ACT) [1] and are organized in several ways, the most important of which is target priority. The priorities are as follows:

(1) Exploration targets, requested by Cx 10×10 km targets, e.g., Fig. 1 red box
(2) LROC Level 1 Requirements
(3) LROC team and LRO science; Cx 20×20 km targets, e.g., Fig. 1 blue box
(4) Science requests outside LRO; Cx 40×40 km targets, e.g., Fig. 1 red box
(5) Public target requests

During the mission, LROC Targeters will work from the master target database to populate orbits with observations specified according to priority and opportunity. On orbits or portions of orbits with no specified targets the NACs will image regularly using an automated script to obtain some "random" coverage. All target definition is done using global image basemaps in the ULCN2005 coordinate system [2,3].

LROC Targeting Process and Strategy: For the exploration phase (first year) of the LRO mission, priority-1 targets consist of 50 sites specified by the Constellation Project. These sites were selected primarily from three reference target sets: (1) the ten design reference sites listed by the 2005 *Exploration Systems Architecture Study (ESAS)* [4], (2) six sites listed in *A Site Selection Strategy for a Lunar Outpost*, NASA Workshop, Aug. 1990 as part of the *First Lunar Outpost (FLO)* study [5], and (3) fifty-nine sites identified in report from the 1988 Workshop on *Geoscience and a Lunar Base: A Comprehensive Plan for Lunar Exploration* [6,7]. These sources were supplemented by additional targets of potentially high exploration and science value that were not considered in the earlier studies, such as the Compton/Belkovich site (identified as a thorium anomaly in Lunar Prospector gamma-ray maps [8,9]). Together, these targets include a large number of well-studied sites that represent high-priority locations for further exploration and science. The final list was developed by Cx representatives, including D. Eppler, J. Gruener, K. Joosten, W. Mendell, J. Plescia, P. Spudis, and M. Wargo.

Coverage associated with exploration targets includes a 10×10 km priority-1 region of interest (ROI) for complete coverage, including geometric and photometric stereo; a 20×20 km ROI to be filled as a best effort to acquire a nominal set of observations, and a 40×40 km best effort ROI for monoscopic mosaic cov-

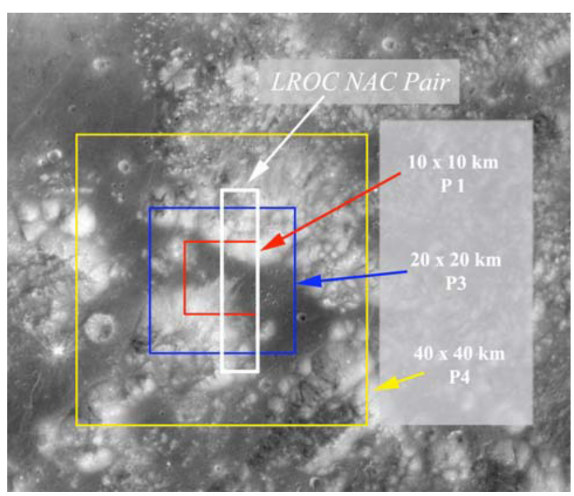

Figure 1. LROC Exploration Target coverage superimposed on a Clementine view of the Apollo 17 landing site. White box represents the footprint of a NAC pair.

saic coverage (Fig. 1). The 20 and 40 km ROIs are targeted at a lower priority than other important science targets to avoid creating downrange "targeting shadows" [10].

Exploration targets were selected through consideration of scientific, resource utilization, and operational merits and a desire to span the range of lunar terrain types and representative selenographic locations (e.g., near side, far side, poles, highlands, lowlands). The exploration targets cover a diverse range of geologic features, including polar sites; mare and cryptomare surfaces, pyroclastic deposits, and other volcanic landforms; impact basin and crater terrains; locations with representative or endmember rock-type exposures; and unusual features such as radar anomalies, magnetic anomalies / albedo swirls, sites of possible outgassing, and compositional anomalies that have been observed from orbit. The nominal image sets are intended to acquire photomosaics of highest quality and resolution for hazard and landing-site safety assessment and construction of digital elevation models of potential landing sites.

The LROC team is also generating targets pertinent to LROC measurement objectives, targets that relate to science objectives of the participating scientists, and targets relating to features of known geologic interest. These targets include the following:

- Anthropogenic sites
- LCROSS target impact sites [11]
- Sites of spectral anomalies [12]
- Copernican craters [13]
- High reflectance spots in Clementine images
- Apollo Panoramic photo areas (for change detection)
- Crater central peaks – Survey [14]
- Sites of pyroclastic volcanism [15]
- Lava flow margins [16]
- Possible lava tubes [17, list of named rilles]
- Mare surfaces for crater counting [e.g., 18]
- Domes [e.g., 19]
- Geologic units and features in the Apennine Mountains and Imbrium backslope [20,13]
- Dark-haloed impact craters, Lomonosov-Fleming region [21]
- Features and dark-haloed impact craters, Schiller-Schickard region [22,23]
- Cryptomare/dark-haloed impact craters in the Balmer Basin [24,25]
- Concentric craters [26]
- Locations of observed impact flashes [27-30]
- Emission, illumination, phase function targets
- Lunar International Calibration Sites [31]
- Highland Scarps, Graben
- Humorum Impact Basin - related features (rim segments, massifs, mountains, faults, etc.)
- Selected Chandrayaan M^3 and Clementine High-Res. targets

LRO Science Meeting: A workshop/meeting on science of the Moon relevant to LRO instruments and LROC targeting is being organized and will take place in June 2009. A key goal of this meeting is to foster understanding of LRO capabilities and the mission planning processes necessary for high-resolution targeting of lunar features by the LRO Narrow Angle Cameras, Mini-RF synthetic aperture radar, and the Diviner Lunar Radiometer Experiment. Another goal is to solicit ideas from the lunar science community for LRO targeting of specific types of features and focused science themes. The meeting will feature presentations and discussion in major areas of active lunar research that have specific application to the capabilities of LRO. This meeting will provide an opportunity for direct communication between the LRO mission stakeholders (ESMD, SMD, LRO Project) and the science community. The primary product of this meeting will be a prioritized list of science targets including rationale and relevant acquisition parameters.

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