THE LUNAR RECONNAISSANCE ORBITER: A FOCUSED STUDY OF FUNDAMENTAL SOLAR SYSTEM PROCESSES AT THE MOON. N. E. Petro and J. W. Keller, NASA Goddard Space Flight Center, Solar System Exploration Division (Noah.E.Petro@nasa.gov; John.W.Keller@nasa.gov).

Introduction: The Lunar Reconnaissance Orbiter mission (LRO) is midway through a two-year extension, running through September 2018, to study the fundamental processes recorded on the Moon. LRO's instruments are measuring processes that operate not only at the Moon but also generally throughout the Solar System, especially on bodies without a significant atmosphere.

This "Cornerstone Mission" (CM) employs all seven LRO instruments in a mission-wide approach to constrain focused science questions. This synergistic approach allows processes to be constrained at distinct spatial (both lateral and vertical) and temporal scales. These processes are divided into three eras of lunar history.

Contemporary Processes [2009 – Today]: LRO has been at the Moon for over 8 years, making it NASA's longest duration lunar mission. This unprecedented baseline of observations enables fundamentally new science, especially in observations of changes to the lunar surface and its environment. In addition to the detection of new impact craters and surface changes [e.g., 1] we also examine the possibility of volatile transport on diurnal timescales [e.g., 2, 3, 4] and constrain the presence of dust in the exosphere [5, 6].

These contemporary processes are observed the Moon, but applicable to any airless body, and are best detected by continuous observations by LRO. With the growing baseline of measurements the detection of changes across all spatial scales is possible. As LRO continues operations the chances of larger impacts being detected grows.

Evolutionary Processes [~1 Ga – ~2009]: LRO is looking to the geologic past to study processes taking place within the interior of the Moon and their reflection on the surface, such as those that provide evidence of the Moon's recent volcanism, and the evolution of the regolith over longer periods of time. These observations include constraining Copernican era volcanism [7] with additional observations of the Irregular Mare Patches as well as the constraining the regolith formation at several locales [8, 9].

These observations also include constraining the distribution of volatiles at and near the surface using multiple instruments at various sensing depths [4, 10].

Fundamental Processes [> 1 Ga]: Reaching farther back in time, LRO will employ new observations to determine the relative timing and duration of basin-forming impacts during the proposed period of Late Heavy Bombardment, the formation and evolution of the early crust, and the styles of early volcanism. These observations help constrain the evolution of volcanism as well as clarify stratigraphic relationships between basin units [e.g., 11].

Science Focus During the CM: The LRO science teams identified three science themes for the CM, which build on Decadal-relevant science questions: 1) Volatiles and the Space Environment, 2) Volcanism and Interior Processes, and Impacts and 3) Regolith Evolution.

Each theme has a corresponding theme lead, responsible for cross-team collaborations. In addition a number of focused workshops have been held in order to facilitate integrated analyses of the LRO data [12].

PDS Data Deliveries: LRO will continue to deliver data to the PDS at a three-month cadence. Currently over 800 Tb of data has been delivered to the PDS, the largest data volume of any NASA Planetary Science Division mission. A number of higher-level data products are in the PDS archive, including mosaics, topographic products, and derived products (*e.g.*, rock abundance from Diviner, local slope). These products are available on the LRO PDS archive (http://pds-geosciences.wustl.edu/missions/lro/) and on individual teams websites.

LRO Support for Future Lunar Missions: LRO data is critical for future surface missions and several outstanding science questions derived from LRO observations could be addressed by orbital observations [e.g., 13]. A number of derived data products have been generated by the LRO science teams in support of future surface exploration. These tools enable safe exploration of the lunar surface [14-16], and with continued operations LRO can continue to collect targeted observations of potential landing sites, a resource unavailable from any other asset.

Conclusions: LRO remains a highly productive, scientifically compelling mission. During its Cornerstone Mission LRO will continue to advance the leading edge of lunar and Solar System science. The LRO mission looks forward to many more years of providing critical data for the revolution in our understanding of the Moon, and by association the Solar System.

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