THE LUNAR RECONNAISSANCE ORBITER IN 2021 AND BEYOND: STATUS AND FUTURE PLANS.

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Introduction: The Lunar Reconnaissance Orbiter (LRO) is in its 12th year of operations at the Moon. This duration enables fundamentally new science, observing changes to the lunar surface and environment over the human timescale. Additionally, the ability of LRO to respond to data acquisition requests in support of robotic and crewed missions to the surface, is a critical resource for the agency [1].

Landing Site Characterization*:* LRO data was envisioned to be used to support human and robotic missions to the surface. With over decade of observations, LRO has delivered over 1.3 Pb of data available for use in the PDS. This data volume includes maps of topography, slope, temperature, rock abundance, *etc*. [e.g.,2].

This new era of lunar surface exploration also enables a new age of coordinated lunar science between an orbital asset and surface assets. During Apollo, the best example of coordinated measurements between the surface and an orbital asset occurred with a comparison of surface magnetic fields by ALSEP and the deep space environment by Explorer 35 [3]. During this modern period of exploration, we may offer similar coincident measurements that benefit both LRO, CLPS landers, and Artemis operations.

Future of LRO: LRO is currently funded to operate through September 2022, however we have fuel onboard to support at least 6 more years of operations and are currently preparing an extended science mission proposal to extend operations until at least September 2025. During that time our orbit will continue to densify data coverage away from the poles (Figure 1, 2), we will continue to pass over areas within the "Artemis Zone" (poleward of -84°) (Figure 2).

Future Science for LRO: In addition to supporting future missions by characterizing landing sites and observing the effects of landing and surface operations, LRO will continue its science mission with a focus on volatiles [4], the thermal history of the Moon as expressed by volcanism and tectonics [5], and the evolution of the regolith [6]. The LRO science teams are actively developing new science questions that require additional data over the three years of our next extension. In the time frame of 2022-2025 we expect an unprecedented set of opportunities to connect our observations of the lunar surface and environment with *in situ* measurements from CLPS landers as well as the VIPER mission. These observations are a critical part of our preparation for future Artemis explorations of the South Pole.

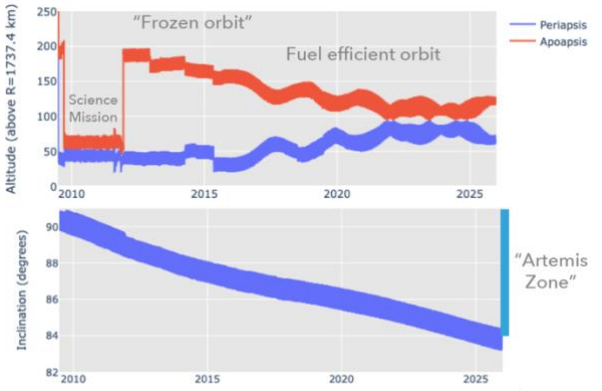

Figure 1. History of the LRO mission in a single figure! The orbital history (top) shows the evolution of our apoapsis and periapsis over time. Since late 2011 we have been in a quasi-stable orbit, and since 2015 we have stopped performing annual station keeping burns, allowing our orbit to naturally drift. As LRO continues its inclination drifts away from the pole. This shift allows for an increase in coverage in the areas, including the ability to image illuminated regions of interest for future missions, and densify measurements from other instruments (Fig. 2).

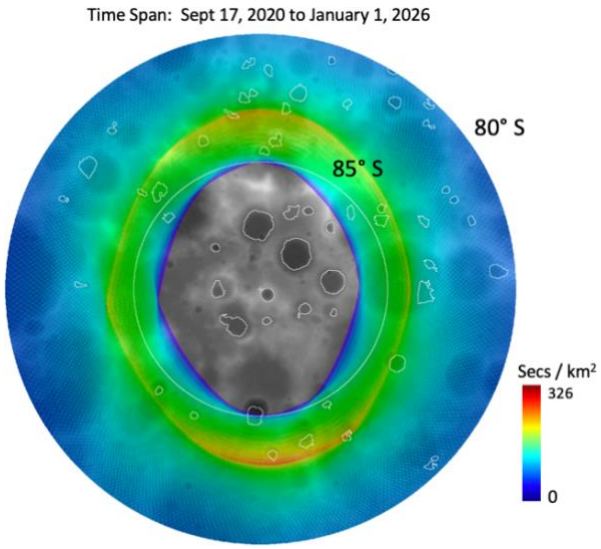

Figure 2. LRO's shifting orbit creates a zone of dense measurements near the South Pole (the so-called "Ring of Fire"). LRO will expand the dense zone of data out to roughly -84º South during our next extended mission.

References: [1] Banks, M. (2021) this conference. [2] Jolliff, B. L., et al., (2017) Selecting and Certifying Landing Sites for MoonRise in South Pole-Aitken Basin. [3] LSI, (1972) *Post-Apollo Lunar Science*, 104 p. [4] Stickle, A. (2021) this conference. [5] Stopar, J. (2021) this conference. [6] Elder, C. (2021) this conference.