THE PAST IS THE PRESENT AND THE KEY TO THE FUTURE: LUNAR RECONNAISSANCE ORBITER OBSERVATIONS OVER THE PAST 13 YEARS AND PLANS FOR THE NEXT 3 YEARS RELEVANT TO LUNAR RESOURCE EVALUATION. N.E. Petro1 and A. M. Stickle[2], [1]NASA Goddard Space Flight Center, Noah.E.Petro@nasa.gov [2]Johns Hopkins University Applied Physics Laboratory, angela.stickle@jhuapl.edu

Introduction: Launched in June 2009, the Lunar Reconnaissance Orbiter (LRO) was sent to the Moon with a goal of providing a "Polar region resources assessment (and associated landing site safety)" [1]. Since arriving at the Moon, the mission has generated a wealth of data, specifically data on the lunar volatiles environment and what future explorers may encounter on the lunar surface.

The objectives of the "Defining a Coordinated Lunar Resource Evaluation Campaign" are co-aligned with what LRO has been doing, and will do, while on lunar orbit. We should not forget that we have one of the most spectacular spacecraft built by NASA ACTUALLY CURRENTLY OPERATING AT THE MOON. Therefore we, as a community, should use that spacecraft, specifically its data, to disentangle the myriad of questions, facing the lunar resource community.

The Lunar Reconnaissance Orbiter (LRO) has been gathering data to address questions regarding the distribution, abundance, and variability of lunar volatiles for 13 years. Despite advances in our understanding, many fundamental questions remain unanswered. To address these questions, the LRO team is focused on new global-scale measurements characterizing diurnal variability and the exosphere and the space environment, as well as focused measurements of regions of high interest in the lunar poles, including polar craters. The transport of volatiles across the surface of the Moon plays a critical role in the distribution of volatiles, both as a function of depth and of location on the surface. After several years of investigations by LRO and other spacecraft, major questions remain about how volatiles are transported and the role of the space environment in volatile production and evolution. Thus, LRO is investigating global volatile processes using a multi-instrument approach. We leverage the evolving orbit of the spacecraft to investigate local regions with a cadence not-before available to LRO, specifically of volatile-rich areas such as Cabeus, the impact target of the LCROSS mission.

Goals of the Workshop and LRO – A union made in a boardroom: One may learn valuable lessons from the LRO, its data, and subsequent data analyses. Here we describe how LRO data can begin to address the goals of the workshop. We will present direct answers to these questions at the workshop, hopefully bounding what is needed by future observations.

Identify the basic information needed to evaluate ice deposits at the lunar poles, including the constraints/ranges required, which would inform measurement methods: LRO and its seven instruments bring to bear several constraints on the distribution and abundance of ice (and other volatiles) at the lunar poles [most recently, 2]. The instrument suite on LRO provides spatial and depth coverage using multiple instruments, from optical to radar measurements, all providing the critical constraints on what *future* measurements can leverage.

Identify the measurement types and characteristics (such as resolution, coverage, etc.) that can be obtained to provide this information and the types of missions that could supply these data, including the areas on the Moon to be evaluated: LRO's seven instruments all provide an initial set of observations that bound lunar ices, prior to any subsequent observations, we must evaluate what LRO's data has taught us about what's needed next.

Identify ways of consolidating and compiling the information into an accessible, usable form (e.g., geostatistical modeling leading to resource favorability maps): A hallmark of LRO's success has been the rapid delivery of data and higher-level products to the lunar and planetary community. These products include derived products to the NASA Planetary Data System (PDS) as well as a method for making an array of lunar data useable by the community via a web platform, Lunar QuickMap. Several special data products, including modeled depth to ice stability, illumination maps, and thermal maps, are readily available for community use. Future products need to ensure both ease-of-use as well as traceability to physics-based models and actual observations made by LRO and other spacecraft.

Conclusions: We are in the beginning stages of another era of lunar exploration, one that we have the benefit of having access to a myriad of data and derived products. To ensure a successful "Coordinated Lunar Resource Evaluation Campaign" one must first take stock in what we currently hold, and then build from there.

References: [1] LRO Objectives/Requirements for 2008 Lunar Reconnaissance Orbiter. [2] Brown et al., (2022) Resource potential of lunar permanently shadowed regions, Icarus, 377, 10.1016/j.icarus.2021.114874.