A NEXT-GENERATION LUNAR ORBITER TO SUPPORT LUNAR SCIENCE AND EXPLORATION. T. D. Glotch[1], [1]Department of Geosciences, Stony Brook University, Stony Brook, NY, timothy.glotch@stonybrook.edu

Introduction: Over the last decades the lunar science community has used orbital data to make significant progress in addressing key lunar science and exploration goals, while defining many new high-priority scientific questions regarding the formation and evolution of the Moon. At the same time NASA's key lunar orbital asset, the Lunar Reconnaissance Orbiter (LRO) is aging. NASA and the lunar science community should consider post-LRO lunar remote sensing strategies.

A large (Flagship or New Frontiers class) Next Generation Lunar Orbiter (NGLO) mission would address the last Planetary Decadal Survey objective of understanding the origin and diversity of terrestrial planets by studying the geochemistry and geology of the Moon at an unparalleled resolution compared to other lunar mission datasets. Also, NGLO would address the objective of studying the evolution of life on terrestrial planets by furthering knowledge about the composition and distribution of volatile elements on the lunar surface and better characterizing the past and present-day impact rates in the inner Solar System to better understand the original delivery of water to Earth. Key exploration goals, including identifying the nature and distribution of lunar volatiles (i.e., water, ice), mapping and characterizing potentially valuable lunar resources, and establishing a human presence on the Moon, also would be addressed by NGLO.

Notional Payload to Address Science Goals: The National Research Council Scientific Context for Exploration of the Moon (SCEM) report [1], Next Steps-Specific Action Team (SAT), and Advancing Science of the Moon SAT (ASM-SAT) developed scientific goals explicit to the study of the Moon. An advanced lunar orbiter such as the NGLO, with a payload consisting of imaging spectrometers spanning the ultraviolet (UV), visible/near-infrared (VNIR) and thermal infrared (TIR), a P-band radar sounder, and color stereo high resolution imagers would address many of these science goals, as shown in Table 1.

In addition to evaluating the progress made in achieving the eight scientific concepts of the SCEM report (and finding that none of the original SCEM goals were completed), the ASM-SAT [2] also added three new concepts with additional science goals related to understanding (1) the lunar water cycle, (2) the origin of the Moon, and (3) lunar tectonism and seismicity, all of which would be addressed by NGLO.

Need for a Large Lunar Orbiter: NASA has recently invested in cubesat and small satellite development for lunar and planetary applications. These missions will provide valuable insights into the lunar volatile cycle and lunar geology but will generally have

Table 1. Scientific questions addressed by instrumentation on an advanced lunar orbiter mission

		VNIR Imager	TIR Imager	UV Mapper	Radar Sounder	Stereo Imagers
Decadal Survery Inner Planets Objectives	Diversity & Evolution	●	●	●	●	●
	Origin & Evolution of Life	●	○			
	Climate Processes					
SCEM Themes	S1: Bombardment	●	●		●	●
	S2: Interior	○	○			
	S3: Crust	●	●	●	●	●
	S4: Volatile Flux	●	○	●	○	
	S5: Volcanism	●	●	○	○	●
	S6: Impacts	●	●	○	●	●
	S7: Regolith	●	●		●	●
	S8: Exosphere	○		●		
ASM Themes	A1: Water Cycle	●	○	●	○	
	A2: Origins	●	●		○	○
	A3: Tectonics	○				●

● Indicates instrument would be a primary contributor to answering question
○ Indicates instrument would be a secondary contributor to answering question

short timescales to end-of-mission. Further, power and mass requirements for cubesat and smallsat missions necessarily exclude certain classes of instruments, often preventing the acquisition of the highest possible precision, accuracy, and spatial resolution measurements. The NGLO notional mission includes instruments with large mass or power requirements to enable high precision and accuracy measurements of the lunar surface at spatial scales up to an order of magnitude better than those available from LRO and international lunar orbiters. The resulting unprecedented, foundational data set would advance consensus lunar scientific priorities and support landed missions over the next decade or more. NGLO would enable long-term landing site scientific and hazard characterization, act as a communications relay for landed assets, and could provide quick-response, high-resolution imaging of human and robotic activity on the lunar surface. Finally, NGLO would broaden participation in lunar and planetary science and train the next generation of leaders in extraterrestrial science and exploration.

Recommendation: The development of a large lunar orbiter with a potential lifetime of a decade or more would provide support and information that is essential to achieving near-future lunar exploration and science research goals. In the immediate term, NASA should fund a mission concept study to analyze trades between instrument suites, capabilities and observational modes, including the costs and benefits of different orbits and data acquisition plans.

References: [1] National Research Council (2007), The scientific context for exploration of the Moon, https://doi.org/10.17226/11954. [2] Lunar Exploration Analysis Group LEAG (2017), Advancing science of the Moon: Report of the specific action team,