A CANADIAN SCIENCE MATURATION STUDY FOR A LUNAR PRECURSOR ROVER TO SCHRODINGER BASIN. M. Bourassa[1], G. R. Osinski[1], M. Cross[1], P. Hill[1], D. King[1], Z. Morse[1], E. Pilles[1], G. Tolometti[1], L. L. Tornabene[1], and M. Zanetti[1]. [1]Western University (1151 Richmond St, London, ON, Canada). Email: mbouras@uwo.ca.

Introduction: Future robotic exploration of the Moon is necessary as a precursor for human exploration not only for testing critical technologies required for a long-term human presence on the Moon, but also for performing a reconnaissance mission to gain a better understanding of the area of investigation before humans return to the surface. The Human Enabled Robotic Architecture and Capability for Lunar Exploration and Science (HERACLES) is an international mission concept to develop the Precursors to Human and Scientific Rover (PHASR) lunar sample return mission that would fulfill the needs of a robotic precursor. In 2017, the Canadian Space Agency (CSA) awarded a one-year contract to a team at Western University to perform a science maturation study to mature and validate the preliminary science requirements of PHASR for the HERACLES concept and develop a preliminary science scenario.

Mission Concept: PHASR is planned to land in Schrödinger Basin on the lunar far side and cache samples over a 70-day period. The samples are then returned to the ascent vehicle which would rendezvous with the Deep Space Gateway and eventually return to Earth. After the ascent vehicle has left the lunar surface, the rover would continue to explore Schrödinger Basin for another year to perform follow-up science. The purpose of the science maturation study is to define the science goals and objectives for the PHASR mission and define the baseline science investigation. This entails selecting the appropriate payloads needed to achieve the science goals/objectives and developing a traceability matrix to define the relationships between the science objectives and the payloads, and the required measurement parameters needed. The baseline mission also includes the development of a nominal traverse plan for the rover based on mission parameters provided by CSA.

Science Goals: The science goals for PHASR have been divided into four themes each consist of multiple specific objectives. (1) The absolute ages of lunar rocks are constrained based on Apollo and Luna sample studies as well as lunar meteorites. To constrain the early bombardment history of the solar system, and characterize the lunar crust, returning lunar samples to the Earth for age dating is essential. (2) Impact cratering is the most important process on the Moon, affecting its surface, crust, and potentially the mantle [1]. Acquiring samples and in-situ measurements from lunar impactites would provide insight into peak ring basin formation, impact melting, and shock metamorphic processes, as well as help to understand the origin of uplifted and excavated crustal materials. (3) Volcanism is another important geologic process on the Moon [2]. To better understand of the evolution of lunar volcanism, PHASR will acquire samples and in-situ measurements of mare and pyroclastic volcanic deposits from Schrödinger Basin. (4) PHASR is a precursor rover for human activity on lunar surface. As such, it will analyze the topographic, radiation, and temperature environments within Schrödinger Basin.

Proposed Traverse Plan: In order to best address the science goals for the PHASR mission concept, a proposed traverse plan has been created which covers ~85km across the basin floor. This proposed traverse is situated between the prominent pyroclastic vent and the interior wall of the Schrödinger peak ring. The main target of this sample traverse is the pyroclastic deposit on the basin floor. This material was determined to be the highest priority target for a mission to Schrödinger due to the potential inclusion of lunar mantel materials including potential volatile content. This traverse plan also includes stops at locations where peak ring material has clearly fallen to the basin floor, as indicated by distinct boulder trails visible in satellite images. Sampling these fallen boulders would enable the rover to access uplifted peak ring material from different elevations. A detailed map of this traverse plan and included sites of interest (SOI's) will be presented.

Conclusions: The results of this science maturation study will aid Canada in its future contributions to the HERACLES concept as part of an international effect to return humans to the lunar surface.

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References [1] Stöffler, D. et al. (2006) *Reviews in Min. and Geochem.,* 516-596. [2] Hiesinger, H. and Head, J.W. (2006) *New Views of the Moon, 60, Min. Soc. of America,* p. 1-81.