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PROPOSED HUMAN-ASSISTED ROBOTIC TRAVERSES IN THE NORTHWEST PEAK RING OF THE SCHRÖDINGER BASIN.

Abstract

The development of the international Lunar Orbital Platform-Gateway (aka Lunar Gateway) opens doors for human-assisted robotic exploration on the lunar far side. Here we propose three rover traverses using the Human-Enhanced Robotic Architecture and Capability for Lunar Exploration and Science (HERACLES) concept. HERACLES is a robotic transport system developed by ESA, CSA, and JAXA using crew stationed on the Lunar Gateway to dispatch and tele-operate robotic missions. It contains elements to land and operate a rover on the lunar far side, and to collect samples for return to Earth. Using the HERACLES concept, we propose a 14-day robotic traverse in Schrödinger basin in the south polar region.

The Schrödinger basin has been identified as a high-priority target for exploration. Spectral mapping of the peak ring reveals noritic, anorthositic, pyroxene-bearing anorthositic, and troctolitic lithologies. These rocks are plutonic, forming either as cumulates in a lunar magmatic ocean, or intrusively deep below the lunar surface. Returning samples of each lithology from source outcrops (as opposed to impact-ejected material) will provide much-needed testing of the lunar magma ocean hypothesis and absolute

chronology of the crustal growth. In terms of future resource utilization, Apollo samples of lunar norite and troctolite contain minor abundances of fluorapatite, titanium dioxide, chromite, zinc dioxide, iron sulphide, Fe-Ni-Co alloy, pyrochlore ((Na,Ca)2Nb2O6(OH,F)), and K-Ba feldspar. Further, the Schödinger basin contains permanently shadowed regions which may contain lunar volatiles for establishing sustained human presence.

Three options for a traverse were designed to return samples of all four lithologies. They are optimized to complete a circuit within a lunar day using solar energy. While each traverse shares the same landing site in the southwest region of the peak ring, the traverses have different secondary objectives. Traverse A prioritizes geomorphology, providing opportunities to image the inside of a graben and visit a small, relatively well-preserved crater. Traverse B prioritizes in situ analysis, devoting more time and energy using on-board instruments to analyse regolith and boulders. Traverse C prioritizes finding geological relationships between rock types, stopping in locations where different lithologies are likely to be in contact with each other. Our study is high-fidelity, targeting specific boulders that are traceable to outcrops of known composition, while also accessible within conservative engineering trafficability constraints. Sample return will greatly improve our scientific understanding and resource potential of the Moon.