

HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Joint session on Human and Robotic Partnerships to Realize Human Spaceflight Goals (3-B3.6)

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OPTIMIZING SCIENTIFIC RETURN FOR ROBOTIC-HUMAN LUNAR EXPLORATION: CASE
STUDY IMPACTS LUNAR SAMPLE RETURN (ILSR) ANALOGUE MISSION PROGRAM

Abstract

Geological exploration of Earth's moon is a key priority as outlined in the Global Exploration Roadmap created by 12 space agencies. Robotic missions followed by human exploration missions have been proposed as an effective strategy for lunar surface exploration. Successive Apollo missions demonstrated that the only constant factor is change. There is a need to design-in the expectation and ability for constant capability upgrades during and between missions; a long sequence of steps involving hardware, procedure, and operational testing and verification is needed before "normal operations" is obtained. Analogue mission simulations provide testing grounds on Earth and provide a means to safely prepare and advance lunar scientific instruments, enabling technologies, exploration strategies, system designs, and mission concepts.

To prepare and test protocols for future lunar sample return missions, our team carried out two analogue missions at the Mistastin Lake impact structure, Canada, as part of a campaign entitled Impacts: Lunar Sample Return (ILSR) funded by the Canadian Space Agency – Mistastin is an exceptional geological lunar analogue with anorthosite and preserved impact ejecta deposits. The first analogue mission involved a simulated robotic surveying of selected "landing sites" at the Mistastin Lake impact structure. A second included simulated astronaut surface operations. A mission control team, based at the University of Western Ontario, 1900 km from the field site, oversaw operations.

Our study focuses on two broad technical and operational objectives that are expected to affect scientific return, based on best practices from terrestrial geological fieldwork, including:

- to develop mapping, sampling, and analytical protocols for human lunar exploration;
- to develop geological prospecting tools and data management considerations for future human lunar missions.

A comprehensive evaluation plan was developed that linked activities with necessary observations to be made which would address these objectives. Analogue mission data products that were collected and reviewed included, daily reports by analogue mission leads, feedback from team meetings, and notes collected by embedded observers, referred to as Documentarians. The Documentarians did not participate in other aspects of the mission. By implementing a rigorous evaluation plan, lessons learned could be supported from multiple perspectives.

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