SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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UNIFYING SCIENCE-DRIVEN AND RESOURCE EXPLOITATION STRATEGIES FOR LUNAR MISSIONS: APPLYING LESSONS LEARNED FROM TERRESTRIAL GEOLOGICAL EXPLORATION AND CANADIAN PLANETARY ANALOGUE MISSIONS

Abstract

The international community is motivated to continue lunar exploration to advance scientific knowledge of the Moon, and to learn how to live and work on the lunar surface sustainably via in situ lunar resource utilization (ISRU), as outlined in the Lunar Exploration Roadmap created by the Lunar Exploration Analysis Group (LEAG) (http://www.lpi.usra.edu/leag/LER-Version-1-1.pdf). These activities mirror geological exploration on Earth for 1) understanding the geological history of an area, and 2) resource exploration and extraction. On Earth, these exploration paradigms tend to have different styles of traverse planning and field work activities. However, an aspect of the Lunar Exploration Roadmap that is often overlooked is that these activities will likely happen concurrently. Understanding how to merge these activities for future lunar missions will help the Canadian space and terrestrial communities apply their expertise in mineral exploration, geological mapping, and planetary analogue missions.

Our study will outline:

1) Potential hybrid geological field approaches for lunar exploration where objectives from both science-discovery and ISRU frameworks will be used during the same mission (either robotic precursor or human-robotic missions).

2) The possible evolution of hybrid approaches over the lifespan of lunar exploration from early (robotic precursor), middle (robotic and/or human short duration stays – build up an outpost), to late (long duration stays at established outpost); and suggestions for appropriate analogue missions to be tested on Earth.

This study reviews and identifies:

1) Terrestrial geological field approaches outlining typical science-driven geological field work and resource exploration and extraction on Earth.

2) Planetary analogue activities that have adapted terrestrial field approaches.

3) Key overlaps and gaps between 1) and 2), and comparison with the Lunar Exploration Roadmap.

Initial results reveal a clear division of geological tasks between an executional-style approach, in which tasks are fairly repetitive and data is not necessarily processed in real-time, and an exploratory-style approach, where real-time analysis is needed for further exploration. Executional tasks, such as

geostatistical sampling and grid-style geophysical surveys, are well suited for autonomous or teleoperated robotic operations. Exploratory approaches, such as reconnaissance and contact mapping, require an understanding of regional geological context and are best carried out by teleoperation of a rover or by an astronaut with 'boots on the ground'. A critical aspect of the hybrid approach is the coordination of these elements and the identification of how robotic and human elements can help each other accomplish their tasks.