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GEOLOGICAL EXPLORATION OF OTHER PLANETS: INSIGHTS FROM TERRESTRIAL DESERT, SEA, AND POLAR FIELD CAMPAIGNS.

Abstract

Planetary analog missions – i.e., simulated missions conducted in challenging environments on Earth – test hardware and techniques for the human exploration of extraterrestrial rocky bodies. Planetary geological exploration focuses on deciphering the geological history of an area and conducting resource exploration and extraction. Two main geological approaches used, often in combination, to accomplish these goals include: a *fixed-executional* approach, in which tasks are fairly repetitive and are carried out by non-expert surface agents, and 2) an *adaptive-exploratory* approach, where a skilled agent makes observations and interpretations and the field plan can be adapted to these findings as the agent progresses.

Analog tests and field studies can provide specific guidance for future geological work on the Moon, Mars, and asteroids. Our study reviews 5 key programs, including the NASA Extreme Environment Mission Operations (NEEMO), NASA Desert Research and Technology Studies (DRATS), NASA and CSA funded Pavilion Lake Research Project (PLRP), CSA-funded Impacts: Lunar Sample Return (ILSR), and the NASA and NSF-funded Antarctic Search for Meteorites (ANSMET).

Noteworthy science-related operational considerations in these analogs include:

• extensive pre-mission planning for operations and logistics;

• selecting sites identified with remote sensing data but permitting detours for new field discoveries;

• allowing time for the field crew's basic life functions and for operating and maintaining critical equipment and vehicles;

• defining flexible plans and priorities to respond to changing conditions;

• using precious field time to record data and collect samples for later analysis in safer environments;

• including mutually cross-trained scientists and engineers on the field team;

• choosing reliable field gear to reduce time lost to failures with limited resupply; and

• making best use of limited bandwidth for communication between the field team and colleagues at home.

In thus study, we compare the scientific goals, science operations, and geological approaches of each campaign; identify key operational commonalities and lessons learned; and highlight existing gaps that could be addressed in future analog studies.