14th HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)
Joint session on Human and Robotic Partnerships to Realize Space Exploration Goals (3.-B3.6)

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CANADIAN-LED ANALOGUE MISSIONS IN PREPARATION FOR LUNAR AND MARTIAN SAMPLE RETURN.

Abstract

Sample return from the Moon and Mars is a high priority for the international scientific community, in order to ground truth theories of planetary formation and surface processes. We can prepare for future sample return missions by conducting analogue missions on Earth – essentially integrated, interdisciplinary field experiments conducted at terrestrial sites that have similar characteristics to a planetary surface (e.g., topography, geology).

Two separate Canadian analogue missions, led by the University of Western Ontario (UWO) and by MDA Corporation, tested the following scenarios, respectively: 1) Precursor robotic mission to a human sortie mission at the Mistastin Lake impact structure, Labrador, Canada (2010); and 2) Robotic sample return mission at the SP Crater, Arizona, USA (2010). Key geology-focussed objectives for these deployments included:

- Developing mapping, sample site selection and analysis protocols;
- Characterizing the scientific decision making processes for outcrop mapping and sample site selection;
- Determining science requirements and limitations of existing off-the-shelf-instrumentation.

We examined the best strategies for identifying and targeting specific rocks by testing combinations and effectiveness of the following instruments: light detection and ranging (LIDAR), 3D stereo camera, ground penetrating radar, digital camera, and X-ray fluorescence spectrometer. Each deployment comprised two

distinct groups: the mission control team and the field team (i.e. the rover). The mission control team was based at a remote site and communicated by satellite terminal. They made all science decisions for the deployment based on returned data from the field. None of the mission control team members had ever been to the field sites.

Initial lessons learned apply to any mission which involves a remote mission control team (including human sortie missions). Decreased situational awareness was experienced for scientists using returned data – as compared to a geologist in the field – largely due to difficulties in visualizing scale, relief, and geological details. These challenges, in part, reflect current limitations of the field instruments. Recommendations emphasize the need to optimize the resolution required for vision system data products and to improve visualization software that would allow seamless data integration of different data sets. Data management is an additional challenge – the amount of data generated was immense, more than what can be sent with current bandwidth allowances. Furthermore, there is a limit to how much data can be 'digested' by mission control and used in real-time. Thus, data collection and products sent back to mission control need to be prioritized.