THE 2016 #CanMars MARS SAMPLE RETURN ANALOGUE MISSION: A GUIDE FOR Mars 2020 AND ExoMars. Osinski, G. R.[1,2], Battler, M.[1], Caudill, C.[1], Pilles, E.[1], Francis, R.[3], Haltigin, T.[4], Hipkin, V.[4], Kerrigan, M.[1], Picard, M.[4], Sapers, H. M.[3], Tornabene, L.[1] & CanMars Team. [1]Centre for Planetary Science and Exploration / Dept. of Earth Sciences, Univ. of Western Ontario, Canada. [2]Dept. of Physics & Astronomy, Univ. of Western Ontario, Canada. [3]JPL, California Institute of Technology, USA. [4]Canadian Space Agency, Canada (gosinski@uwo.ca)

Introduction: One of the highest priority goals for the Canadian and international planetary science communities is the return of samples from known locations on Mars [1, 2]. Mars Sample Return (MSR) will be one of the most challenging planetary exploration mission campaigns to date and will likely involve substantial international collaboration.

The 2016 CanMars MSR Analogue Mission represents a continuation of an 11-day/sol MSR analogue mission conducted in 2015 [3] and was conducted at the same field site in Utah, USA [4], in the framework of CSA's 2016 Mars Sample Return Analogue Deployment [5] over three weeks in November 2016. The mission control team was located at the University of Western Ontario (Western), London, Canada, and had no direct knowledge of the site. This contribution will provide an overview of the CanMars analogue mission and insights and recommendations for biosignatuire detection for the Mars 2020 and ExoMars missions.

Mission overview: The current scenario for MSR is a series of 3 missions: sample cache, fetch, and retrieval. The NASA Mars 2020 mission represents the first cache mission, which was the focus of the 2016 CanMars mission. High level deployment objectives were established by CSA in co-ordination with Western and other partners [5] and included science, operations, engineering and training. An overarching goal of the CanMars analogue missions is to advance knowledge regarding sample selection for MSR as well as advancing sample science and analysis protocols. The mission used a suite of off-the-shelf "stand-in" and integrated instruments with the aim of reproducing the science payload for the 2020 rover.

The CanMars 2016 cache mission was implemented in two parts. Part 1 was conducted with the CSA Mars Exploration Science Rover (MESR) rover built and supported by MDA. In this scenario, 1 day = 1 sol, as with the 2015 campaign and indeed, the MESR rover started the 2016 campaign at the exact spot it ended the 2015 campaign. During Part 1 of the mission (sols 12–21) 10 command-cycles were planned and executed using MESR. In addition, two Strategic Traverse Days were pre-planned with activities involving long rover traverses and post-drive imaging (see [6] for a description of the objectives and results of the Strategic Traverse Day operations experiment).

Part 2 was implemented without the MESR rover and with hand-carried instruments and sample acquisition equipment. This portion of the mission was conducted as a Fast Motion Field Test (FMFT) with three sols of operations being executed in one day (i.e., 1 day = 3 sols). A single plan was used to execute the 3 sols, such that the same remote science team planning cycle was used in Part 2 as for Part 1. Pilles et al. [7] describe the approach and outcomes of the FMFT.

Science Objectives and Overview: This was a science-driven MSR analogue mission [3,4,8]. The site was chosen based on a lengthy process and was visited by key personnel in order to determine its suitability for this mission from both a scientific and engineering perspective. The Science team was provided with the following highest priority mission goals (see [8]): 1) collect and rank samples for cache and return with highest potential for preservation of ancient biosignatures from organic-rich carbon; and 2) assess paleoenvironmental habitability potential and history of water at the site. Caudill et al. [8] and Pontefract et al. [4] provide a detailed overview of the science objectives and outcomes for this analogue mission and their evolution from pre-mission hypotheses to *in situ* science. The geologic interpretation of the site is a catchment basin for various fluvial regimes, where inverted paleochannels with erosion-resistant cap rock preserved a lacustrine sequence.

Field Data and Sample Validation: Another major component of the overall mission exercise was field validation, as the ability to validate mission results is a major advantage of analogue mission exercises. Further validation of science-decision making during the analogue mission is ongoing through analysis of samples targeted by the remote ops team and 'returned' for laboratory analysis. This, ultimately, will provide feedback on whether the tools available for MSR will return the most scientifically valuable samples, and insight into approaches that might be adapted to enhance MSR mission success. Post-mission data and sample analysis is being conducted at partner labs throughout the US and Canada.

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