VALIDATING ACCURACY OF ROVER-BASED SAMPLE SELECTION APPROACHES WITH A FIELD VALIDATION TEAM : RETURNED SAMPLE ANALYSIS AND RELEVANCE TO MARS 2020

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Introduction: Validation of mission approaches through simulations using Mars analogues on Earth is especially needed as missions increase in scope and complexity, such as NASA's Mars 2020 mission which augments in situ science: *Characterize the processes that formed and modified the geologic record within a field exploration area on Mars selected for evidence of an astrobiologically relevant ancient environment and geologic diversity,* with sample return activities, *Assemble a returnable cache of samples for possible future return to Earth*, and two other Objectives, all to be achieved within one Mars year of primary science operations [1].

An overview of the 2016 Canadian Mars Sample Return Analogue Deployment and #CanMars Mission and site is described in [2,3]. The focus of this paper is the validation effort related to one of the analogue deployment test objectives:

- *To test the accuracy of selecting samples remotely using the partial context available to mission scientists using rover-based field operations, compared to the full context available to a traditional human field party.*

The design of the test and its implementation is described in [4] and hinged on giving the same basic task to the 2016 #CanMars remote science operations team, based at Western University, Canada, and a Human Field Team using traditional field geology methods: (1) Observe and interpret the geology of the site focussing on a subset of the Mars 2020 objectives to simplify science considerations: *Advance understanding of the habitability potential of an ancient sub-aqueous environment; Advance understanding of the history of water at the site.* (2) Document the process by which #1 above was carried out, and most importantly, the decision-making process. (3) Select for 'Return to Earth' and quantitative analysis the sample hypothesized to contain the most Total Organic Carbon (TOC). The purpose of #3 as a specific challenge objective was to focus team resources on science interpretation rather than acquisition of a certain number of samples.

The Human Field Team validation activity and resulting interpretation of the site is described in [5]. Our highest priority TOC target is shown in **Figure 1 (Bottom Right),** identified as as a dark green siltstone.

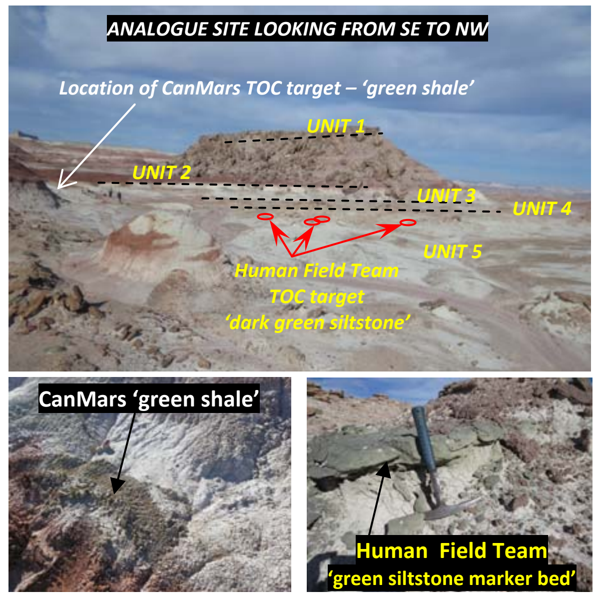

Figure 1: Top: Image of the analogue site working area for 2016, approximately 5km NW of Hanksville, Utah, USA, showing location of TOC targets of 2016 CanMars cache rover team (white annotation) and Human Field Team (yellow annotation). The site is relatively small, approximately 200m x 200 m, and can be easily walked in one day. **Bottom Left:** CanMars 'green shale' TOC target **Bottom Right:** Human field team dark 'green siltstone marker bed' TOC target with rock hammer for scale.

This paper reports on the laboratory analysis of the returned TOC and type samples collected by the Field Validation Team, of units identified in **Figure 1 (Top)** and discusses the relevance of validation results to rover-based investigations of an ancient sub-acqueous terrain.

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References: [1] Mustard J. et al. (2013) Report of the Mars 2020 SDT [2] Hipkin et al. (2017a) LPS XLVIII [3] Osinski G. R. et al (2017) AbSciCon,*This meeting*. [4] Hipkin et al, (2017b) LPS XLVIII [5] Beaty D.W et al. (2017) LPS XLVIII