FIELD VALIDATION FOR THE 2016 CANMARS ANALOGUE MISSION D.W. Beaty[1], R. Hansen[2], E.M.. Hausrath[3], V. J. Hipkin[4], C. Maggiori[5], R. McCoubrey[6], J. Parrish[1], and S.J. Ralston[3]. [1]Jet Propulsion Laboratory/Caltech, Pasadena, CA, USA (dwbeaty@jpl.nasa.gov), [2]Natural History Museum, London, UK, [3]Universitiy of Nevada, Las Vegas, NV, USA, [4]Canadian Space Agency, 6767 Route de l'Aeroport, St Hubert, J3Y8Y9, QC, Canada, [5] McGill University, Montreal, QC, Canada, [6] MDA, Toronto, ON, Canada.

Introduction: In 2016, the Canadian Space Agency, along with several partners, carried out the 2016 Canadian Mars Sample Return Analogue Deployment, a major rover-based operation at an analogue test site near Hanksville, UT (Fig. 1). Deployment objectives are described in [1] and include test of the accuracy of selecting samples remotely using the partial geological context available to mission scientists using rover-based field operations, compared to the fuller context available to a traditional human field party. To address this objective, parallel investigations of the geology/astrobiology of the site were implemented. Results of the rover-based investigation by the 'CanMars 2016' remote team at the University of Western Ontario are provided in [2,3]. The purpose of this abstract is to report on the parallel human field team investigation of the site. Results of the comparison are given in [4].

As an important constraint for the test, CanMars and human field teams were given the simple goal of selecting a sample hypothesized to contain the most Total Organic Carbon (TOC).

Figure 1: Location of the field area for the 2016 CanMars Analogue Mission campaign. *The site is located approximately 5km NW of Hanksville, Utah. The north-trending belt of gray rocks west of the field site are the Cretaceous Mancos Formation, and the pink-white rocks in the center of the map area are the Jurassic Morrison Fm.*

Mechanics: The field team consisted of the 8 authors of this report, one of whom (VJH) was designated as the documentarian. The team met at 7 AM on Nov. 15 for breakfast, and carried out a map review/discussion using 1m resolution colour satellite imagery of the field site. In this conversation we agreed on a conceptual traverse strategy (see below), to be modified in the field as needed. We got to the site by about 9 AM. The field team was equipped only with rock hammers, hand lenses, acid bottles, and a GPS unit--by prior agreement, no analytical instrumentation was allowed. Additionally, one of the rules of the exercise was to keep the field team together, rather than splitting up into sub-teams. In recognition of the greater efficiency of the human team, in order to keep things on par, the human team was asked to do its work in one day (the rover team had about three weeks). The field site is relatively small (around 200m x 200m), so we were able walk the site and visit all of the outcrops by lunch. Our lunch-time conversation resulted in agreement on a single follow-up activity, which was to investigate our stratigraphic unit of highest priority - a dark green siltstone - in more detail. For the following 2 hours we investigated several outcrops of this unit, and identified the specific place where we wanted our sample of hypothesised highest TOC to be taken. By 3 PM, we felt we had completed our objectives, and released two members of the field party to begin driving home. The remaining six members of the group sampled the target using aseptic sampling methods, taking a single sample of dark green siltstone (Sample MSR-FV-16-2D).

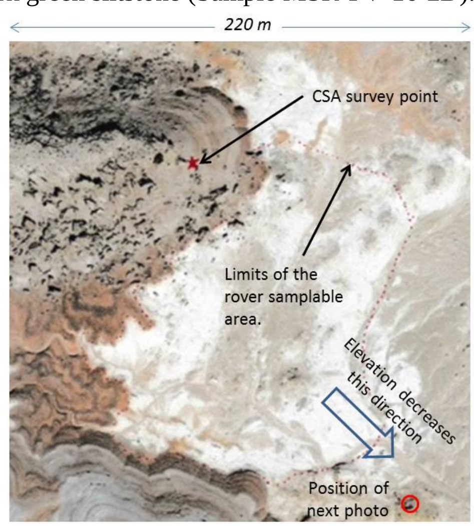

Figure 2: Detailed image of the field area for the 2016 CanMars Analogue Mission campaign

Traverse strategy: We decided to begin with a broad circle around the area, starting from the point where the rover began its traverse (which had happened prior to our arrival at the site) with clockwise movement (i.e. beginning towards the east). The rationale was to get a feel for the whole site and by going clockwise it ensured we got into the more complex areas (initially believed to be on the southern and western edges of the basin) later in the survey. Once in the field we recognized that this strategy would take us to the lowest stratigraphic position, and that we could investigate the stratigraphy from the bottom up—a classically preferred approach. Therefore we were happy with our initial decisions based on the satellite imagery.

Geology of the Field Site. The field site consists of nearly flat-lying sedimentary rocks which are part of the Brushy Basin Member of the Jurassic Morrison Formation. The rocks dip very shallowly (1-2 degrees) to the SE. Within the area evaluated, the topography is such that there are hills at the NW and SW corners, and the main part of the field area consists of a shallow basin that drains to the SE. Thus, the lowest parts of the stratigraphy are exposed in the SE corner of the map area (Fig. 2), and the highest parts are on the hills to SW and NW. The relationship between topography and bedding is shown in Figure 3.

Figure 3: View of the stratigraphy of the field site. *This photograph was taken from the red circle on Fig. 2, and looking to the NW. The stratigraphic units are nearly flat-lying, and therefore the lowest parts of the section are exposed in the lowest topography, which is at the SE corner of the map area.*

Overall Stratigraphy (younger to older): Within the map area, several beds that are part of the Jurassic Morrison Formation are exposed. In our relatively quick survey, we defined a rough stratigraphic section consisting of five primary units (Fig. 4). These Jurassic sedimentary rocks are overlain by small amounts of Quaternary alluvium in the drainage channels. The alluvium is typically tan-colored (e.g. see lower right corner of Fig. 3). Also of note, there is locally a lag deposit that includes fragments of petrified wood that presumably eroded out of the Morrison Formation above the level of the present erosional surface.

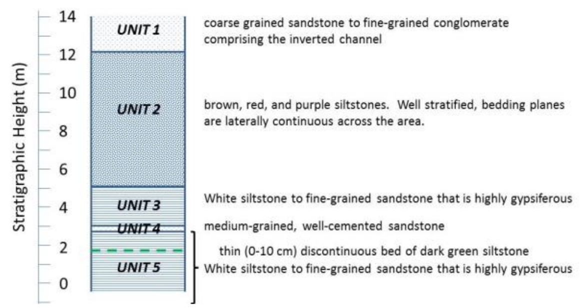

Figure 4: Recon stratigraphic section of the Jurassic rocks exposed in the field area.

Sampling: In our judgement, the samples most likely to contain elevated TOC from within the defined field area are those from the thin layer of dark green siltstone which outcrops discontinuously within Unit 5, and especially those from the dark unweathered interiors of the outcrops. We know from experience that this dark green color typically originates from reduced iron minerals, and therefore reflects a reducing environment during deposition—there is a good possibility that this environment could have preserved organic carbon. This conclusion was reached by geologic inferrence, since we were equipped only with rock hammers and hand lenses. We spent some time tracing the limits of the exposures of this unit, and to identifying its thickest and darkest places. These were our highest priorities for sampling.

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References: [1] Hipkin V.J. et al. (2017a) *LPS XLVIII*, *This Meeting* [2] Osinski G. R. et al (2017) *LPS XLVIII*, *This meeting* [3] Caudill et al.(2017a) *This meeting* [4] Hipkin et al. (2017b) *LPS XLVIII This meeting*