IN-SITU INVESTIGATION OF DEVONIAN REDBED SEDIMENTS IN BOCKFJORD (SVALBARD, NORWAY) AS A MARTIAN ANALOGUE. P. Sobron[1], H. E. F. Amundsen[2], A. Bauer[3], J. L. Bishop[4], F. Jordan[5], J-L. Josset[5], L. Josset[5], R. Leveille[1], S. M. Pugh[6], N. Schmitz[7], A. Steele[8], A. Wang[9], [1]Space Science and Technology. Canadian Space Agency, St. Hubert, QC (pablo.sobron@asc-csa.gc.ca). [2]Earth and Planetary Exploration Services, Oslo, Norway. [3]Joanneum Research, Graz, Austria. [4]SETI Institute, Mountain View, CA. [5]Space Exploration Institute, Neuchatel, Switzerland. [6]Aberystwyth University, Ceredigion, UK. [7]German Aerospace Center (DLR), Institute of Planetary Research, Berlin, Germany. [8]Carnegie Institution of Washington, DC. [9]Dept. of Earth and Planetary Sciences and McDonnell Center for the Space Sciences, Washington University in St. Louis, MO.

Introduction: The redbeds in Bockfjord, composed of rust-colored fluvial sandstones and mudstones, which contain iron-bearing minerals, e.g. hematite, are reminiscent of aqueous layered deposits seen on Libya Montes, Mars, in images recently taken by CRISM on MRO [1]. During the Arctic Mars Analogue Svalbard Expedition (AMASE) 2011, we performed an exhaustive *in-situ* imaging and spectral analysis of a selected area within the redbeds in Bockfjord using several prototypes of mission instruments. The goal of this investigation was to evaluate synergies between optical and spectroscopic instruments of mission-quality in a relevant Mars-like scenario, and to characterize the red sandstones as a potential terrestrial analogue for Libya Montes in the context of future missions focused on habitability and the search for signs of life.

Instrumentation used during the *in-situ* investigation:

1. Panoramic camera: this instrument is a prototype of the PanCam instrument developed for ExoMars featuring two wide angle cameras for stereo, panoramic and multispectral imaging and one high resolution camera for high-resolution color imaging [2].

2. Close-up imager: this instrument is a prototype of the CLUPI instrument developed for ExoMars, designed to acquire high-resolution micro-scale color and stereo images of rocks [3].

3. An active source miniaturized NIR (1.14-4.76 μm) reflectance spectrometer, WIR, developed for lander/rover deployment that enables *in-situ* identification of water in different forms (liquid, ice, or clathrates, structural H_2O and OH, and water adsorbed on grain surfaces), carbonates, sulfates, hydrated silicates, as well as C-H & N-H bonds in organic species [4].

Results and relevance for interpreting Mars orbital data: Figure 1 shows a panoramic image of the Devonian redbeds in Bockfjord including the location of interest (yellow arrow). This location shows a grey/green layer within the hematite-rich redbed materials. A panoramic investigation of the site was first performed with PanCam, including a full multispectral stereo panorama along with high resolution images of selected targets of interest. PanCam's High Resolution Camera (HRC) was used for stereo imaging of selected targets (stereo fusion of images from two vantage points). A PanCam panorama of the set of rocks we investigated is shown in Figure 2. Figure 3 shows a HRC stereo mosaic of a selected target. HRC images were primarily used to select the specific targets for further spectral analysis. Figure 4 shows a collection of CLUPI images acquired targets selected based on the color information and the hypothesis about mineral diversity derived from PanCam imagery. The latest stage in the data acquisition sequence was the collection of WIR spectra in the mentioned targets. The WIR spectra of the ten targets labeled in Figure 4 are shown in Figures 5 and 6. The mineral identification is shown in Table 1.

The interpretation of the WIR spectra relies on a search-match procedure performed against a database of reference materials. The spectra show relatively high SNR and distinct spectral features in the 1.14-4.76 μm spectral range that, in principle, can be associated with unique minerals or mineral mixtures. In practice, one of the difficulties associated with the interpretation of NIR reflectance spectra of H_2O and OH-bearing minerals is that O-H bonds are very intense absorbers thus the strong band from fundamental vibration modes (2.5-3.3 μm) (deep and broad bands in the spectra) often mask the M-OH band near 2.4 μm (where M represents a metallic cation). For this reason, the identification of the reflectance NIR spectral features associated to most of the minerals present in the redbeds is less specific. To improve the accuracy of the *in-situ* measurements, samples were collected at the spots analyzed in the field, and detailed analysis using laboraory laser Raman spectroscopy and X-ray diffraction are underway.

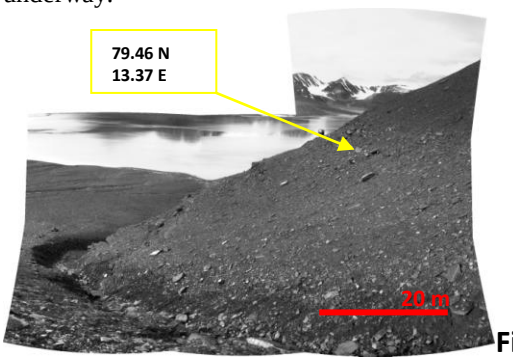

Figure 1

Figure 2

Mineral deposits similar to those found in the redbeds of Bockfjord have been observed in the Libya Montes region on Mars [1]. The deposits in Libya Montes contain carbonates, Fe/Mg clays, and olivine, suggesting abundant aqueous activity. Similarly, the red sanstones in Bockfjord are thought to have sedimentatry origin, although the presence of smectites and other minerals (chlorites within igneous matrix) suggests volcanic input. An unambiguous characterization of the mineralogy in the redbeds of Bockfjord will provide a reference framework to the resolution-limited orbital remote sensing at Libya Montes. Further, elucidating the processes by which minerals formed in Bockfjord (sedimentary, volcanic, transport, and combinations thereof) will help develop a hypothesis for the mineral deposition sequence in Libya Montes and therefore constrain the geochemistry and timeline of the forming processes in this region.

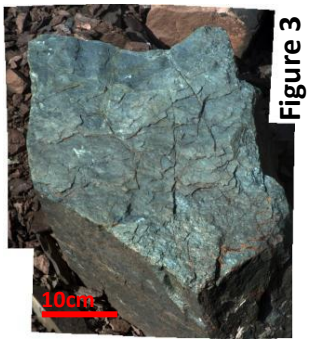

Figure 3

Table 1. Mineral identification of targets shown in Figure 4 based on WIR spectra.

Target #	*Color*	*Mineral ID*
1	red/brown	calcite, organics
2	green	smectite
3	red/brown	illite
4	red/brown	illite
5	dark red	illite
6	white	illite + unID
7	red/brown	illite, organics
8	yellow/tan	illite, calcite
9	white	calcite
10	yellow/tan	illite, calcite, oxides

Conclusions: The combination of imaging and spectroscopic techniques in geo-field provides a means to characterize the mineralogy of Mars analogue terrains such as the redbeds in Bockfjord. Understanding the processes that drive the formation of certain mineral deposits in the redbeds of Bockfjord has implications for the interpretation of the orbital remote sensing data from Libya Montes.

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Figure 4