DESICCATION OF ALGAL MATS FROM ANALOGUE SITES WHEN EXPOSED TO MARS-LIKE CONDITIONS G.M. Berard[1], J.M. Stromberg[1], E.A. Cloutis[1], P.Mann[1], B. Horgan[2], and M. Rice[3]. [1]Department of Geography, University of Winnipeg, 515 Portage Avenue, Winnipeg, Manitoba, Canada R3B 2E9, [2] School of Earth and Space Exploration, Arizona State University, Tempe, AZ, USA 85287-1404, [3] Department of Astronomy, Cornell University, Ithaca, NY, USA 14853-6801.

Introduction: The East German Creek Mars analogue site in central Manitoba, Canada consists of a series of hypersaline springs that bear some similarities to features identified on Mars [1]. They have also been identified as reasonable analogues for "last refuges" of surficial-groundwater on Mars [2]. As part of a comprehensive study of this site, we collected samples of extensive algal-gypsum-halite mats that exist at the site and subjected them to low atmospheric pressures and UV irradiation (designed to simulate some aspects of the Martian surface) in order to determine how their reflectance spectra are affected by such exposure.

The types of algal mats that were used in these experiments included "black brains" (reasonably fresh algal mats), "white brains" (desiccated and gypsum-halite encrusted algal mats), algal stringers (algal mats present in the springs), and iron-stained mineral sediments from the periphery of the springs.

Experimental Procedure: Samples were collected into hard-sided plastic containers and covered with spring water to maintain moisture until transport to the University of Winnipeg. The samples were then kept in an environmental chamber with an alternating dark-light cycle to maintain in situ conditions until spectral analysis. Baseline reflectance spectra (i=30°, e=0°) were taken for each sample with an ASD spectrometer (0.35-2.5 μm) using a 50 watt QTH light source; 1000 spectra were collected and averaged to improve SNR.

The samples were then placed in a vacuum chamber with a beaker of Dryerite desiccant and exposed to a 25 W deuterium lamp and 100 mb pressure for 44 days. At the end of this time spectral data were collected.

Results- "Black Brains": The reflectance spectra of the as-collected "black brains" (Figure 1) exhibited prominent OH/H_2O absorption bands at 1.45 μm and 1.9 μm, which were intense enough to cause an overall decrease in reflectance longward of ~1.3 μm. After 44 days in the environment chamber, OH/H_2O bands were still present but were much less pronounced. After desiccation, an absorption feature indicative of carbonates became more apparent at 2.35 μm. Another shallow absorption band appeared at 2.1 μm, indicative of the presence of gypsum. A chlorophyll band at 0.67 μm, that was present in the undesiccated sample spectrum, is more prominent in the spectrum after desiccation. An absorption feature at 1.75 μm may indicate the presence of organic molecules (C-H bonds) in the desiccated "black brains".

Results- "White Brains": Before desiccation, the spectrum of the "white brains" (Figure 2) had a low overall reflectance due to the OH/H_2O bands at 1.45 μm and 1.9 μm. There was also a very prominent absorption feature at 0.67 μm indicative of chlorophyll before desiccation; after 44 days in the chamber this absorption feature is still present but less apparent. In the desiccated sample, carbonates are indicated by a 2.35 μm absorption, and gypsum is indicated by a 2.1 μm absorption, as in the "black brains". The 1.75 μm absorption feature indicative of organic molecules (C-H bonds) is also present in the desiccated "white brains".

Results- Pool Sediments from Main Spring ("Big Cauldron"): Before desiccation, the overall spectrum has low overall reflectance due to the prominent OH/H_2O absorption bands at 1.45 μm and 1.9 μm, similar to the "black brains" spectra. There is a strong chlorophyll absorption feature at 0.67 μm. After desiccation, the OH/H_2O bands become less prominent and absolute reflectance generally increases. The chlorophyll absorption feature is essentially absent in the desiccated spectrum. Mineral absorption bands in the desiccated sediments spectrum are weaker than in the "black brains" spectra, with no gypsum absorption feature being present, and a very weak carbonate band is present at 2.35 μm. In the desiccated sample spectrum, the presence of Fe^{3+} is indicated by an absorption feature at ~0.9 μm, and by a decrease in reflectance in the visible range.

Results- Algal Stringers: At all East German Creek sample stations where algal samples were collected (Station 1- "Big Cauldron", 5, 6, 8, 10, and 12), the same general trends were seen upon desiccation of the samples (Figures 3 and 4). Overall absolute reflectance of the spectrum increased as OH/H_2O absorption features became weaker. The chlorophyll absorption feature at 0.67 μm remained even after desiccation; this is especially prominent in the desiccated samples of stations 5, 6, 8, and 12. Finally, an absorption feature indicative of carbonates at 2.35 μm is evident in the dried algal samples from all stations.

Discussion: Several spectral features develop when samples containing biotic elements (cyanobacteria and algae) from the East German Creek springs analogue site are subjected to low atmospheric pressure and UV irradiation. Minerals, such as carbonates and some gypsum, that had precipitated onto the "brains" and

algal stringers, become more apparent in the spectra when these biotic materials are desiccated. A feature indicative of the C-H bond in organics also can be noted when the "brains" are desiccated, but is much less prominent or absent in the other biotic samples analyzed. It is also possible that additional carbonates and gypsum precipitated as the samples desiccated.

The most interesting spectral feature of the desiccated samples is the presence of the 0.67 µm absorption feature. The presence of this biosignature in samples from our Martian spring analogue site, even after exposure to UV radiation and low pressure, indicates that a chlorophyll absorption feature could potentially be detected on Mars in the 0.67 µm region if photosynthesizing life ever did evolve on that planet.

Pancam on the Spirit and Opportunity (MER) rovers currently on Mars may be able to pick up a chlorophyll absorption feature. There are 6 filters on the MER rovers that detect wavelengths below 0.8 µm, and if it is possible to detect the chlorophyll absorption using PanCam it would be with the L3 geology filter on the left camera which "sees" at a wavelength of 0.673 µm, but this must be investigated further [3].

References: [1] Grasby, S. and Londry, K. (2007) *Astrobiology*, *7*, 662-683. [2] Oehler, D.Z., and C.C. Allen (2008) *LPSC*, *39*, Abstract # 1949. [3] Bell III J.F et al. (2003) *J. Geophys. Res.*, *108 (E12)*, 8063.

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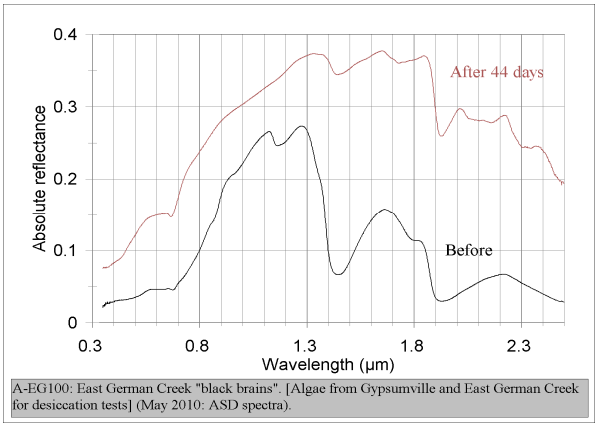

Fig. 1. "Black brains" algal mat after 44 days of exposure to UV irradiation and low atmospheric pressures.

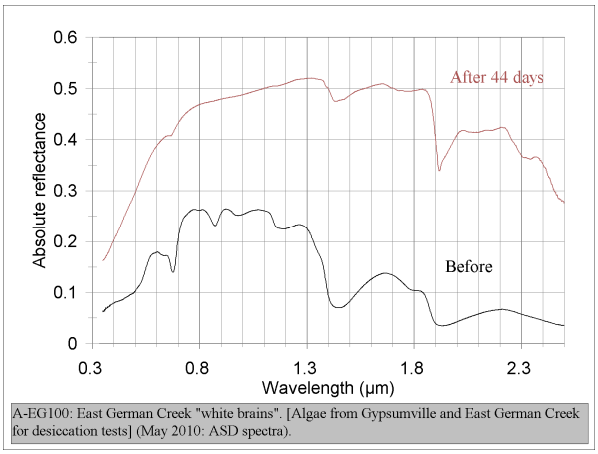

Fig.2 . "White brains" algal mats after 44 days of exposure to UV irradiation and low atmospheric pressure.

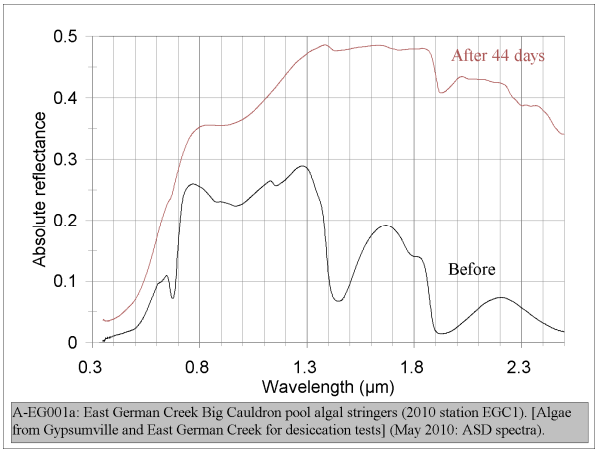

Fig. 3. Algal stringers from station 1 after 44 days of exposure to UV irradiation and low atmospheric pressure.

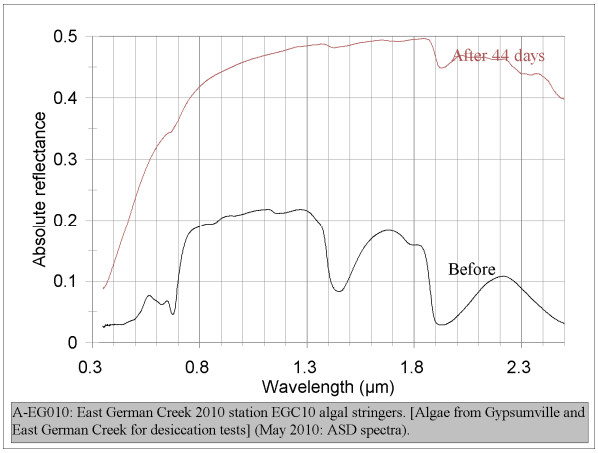

Fig. 4. Algal stringers from station 10 after 44 days of exposure to UV irradiation and low atmospheric pressure.