IN-SITU EXPLORATION OF HABITABLE ENVIRONMENTS AND BIOSIGNATURES IN ARCTIC COLD SPRINGS AND ANTARCTIC PALEOLAKES.

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Introduction: The scientific motivation for this investigation is the need to add *flight-instrument signatures of life* data from high priority analogs to the spectral libraries of laser-based spectroscopy instruments on the ESA ExoMars 2018 (RLS) and NASA Mars 2020 (SHERLOC and SuperCam) missions.

Our work maps to the SETI Institute *Signatures of Life* NAI team's goal of characterizing Earth analogs of high-priority environments for identifying traces of ancient life in changing planetary environments.

Our results are: a) furthering our scientific understanding of cold springs and paleolakes as high-fidelity analogues to putative inhabited/habitable environments on Mars, b) advancing our technological readiness for their exploration, and c) yielding new scientific data of relevant Arctic and Antarctic analogs.

Results: In July 2015 we carried out *in-situ* Raman investigations at three perennial springs and one paleospring site located at Axel Heiberg Island in the Canadian High Arctic (Fig. 1). At nearly 80° N, these springs are located in a region of thick, continuous permafrost. From the springs we collected samples of well-developed travertine, icing pastes and nearby salt deposits resulting from efflorescence. Concurrent with sample collection, we deployed a Raman spectrometer and an IR reflectance spectrometer for *in-situ* measurements at the four sites. We recorded 100+ Raman spectra and 50+ IR reflectance spectra on those sites. We identified gypsum, iron sulfates, kerogens, elemental sulfur, organics, halite, hydrated, iron sulfates, and thenardite. These results are helping us evaluate the role of spring deposits as high-priority targets for the search for life on Mars.

In November 2015 we travelled to Lake Untersee in the mountains of Queen Maud Land, Antarctica (Fig. 2) to continue a series of studies aimed at understanding the lake ecosystem, its sedimentary history, local climate, and to begin detailed investigations of a paleo-basin located to the east of the lake. At these sites we deployed a Raman spectrometer, IR reflectance spectrometer, and an X-ray diffraction/fluorescence (XRD/XRF) spectrometer for *in-situ* measurements. Our investigations include studies of the physical and biogeochemical characteristics of the lake, deposition and preservation of biomarkers, and the use of *in-situ* analytical techniques to identify organic signatures within a mineralogical context while developing synergistic operational concepts for *in-situ* analyses in paleolakes analog to early or present Mars.

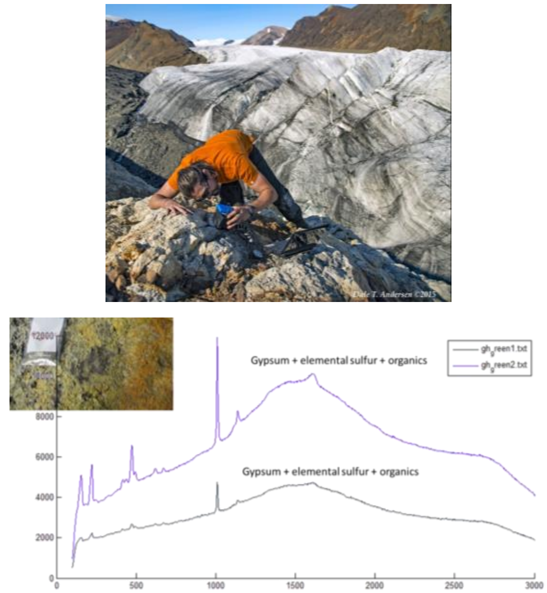

Figure 1. *In-situ* analyses and Raman spectra of Axel Heiberg paleosprings.

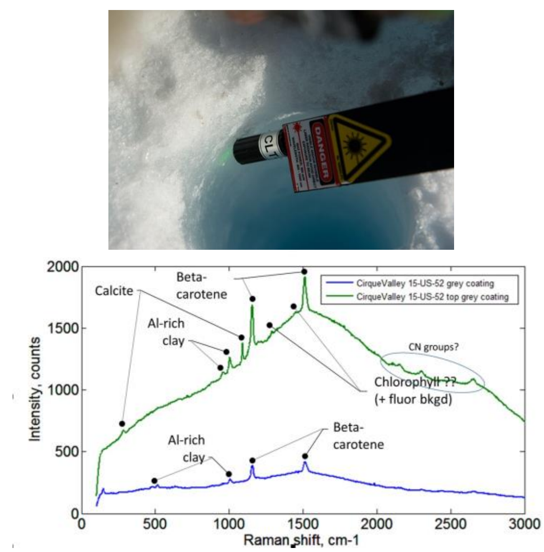

Figure 2. *In-situ* analyses and Raman spectra of Untersee glacier ice and paleolake deposits.

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