PRESERVATION OF BIOSIGNATURES IN THE TEN MILE GRABEN COLD SPRINGS, UTAH. J. M. Knuth[1] and S. L. Potter-McIntyre[1], [1]Southern Illinois University Carbondale, 1259 Lincoln Road Mailcode 4324, Carbondale Illinois, 62901, USA (jordan.knuth@siu.edu)

Introduction: Biosignatures have been extensively studied at hot springs sites, such as Yellowstone, because liquid water is fundamental to the existence of life but also owing to the influx of mineral nutrients in these environments [1,2]. However, some hot springs have upper temperatures exceeding the boundaries capable of sustaining life in all the spring facies, particularly those nearest the vent [3]. Cold springs provide the same nutrient rich environment with more ambient temperatures capable of sustaining a diverse consortium of microorganisms across the entirety of the system [4,5]. When considering the search for past life on Mars, environments must be chosen that have a high potential for life (i.e., the least "extreme" by Earth standards). Early Mars is theorized to be much like early Earth and it is possible that cold springs did exist [6,7]. This thought is supported by spring vent-like structures found at Vernal Crater and topographically low areas in Vallas Marineras, Mars [8, 9]. However, little is known about biosignature detection and preservation in cold spring deposits. This study investigates the biogeochemistry and preservation of microorganisms found at an active cold spring deposit.

Ten Mile Graben Springs: Ten Mile Graben fault system extends southeast from Green River, Utah, and hosts a series of modern cold spring deposits that have been emanating for 400ka years [10, 11] The springs are CO_2- and hydrocarbon charged with a pH that is circumneutral [12]. The water is supersaturated with respect to calcite and undersaturated in respect to iron (oxyhydr)oxide [13]. Three springs with four vents were selected for sampling: Big Bubbling Spring, Little Bubbling Spring East and West vent systems, and Torrey's Spring. These were selected for their low anthropogenic influences, preserving the native biota and undisturbed (by humans) precipitation patterns.

Methods of Study: Partially lithified samples, measuring 6cm x 6cm x 6cm, were taken from each facies in each vent system: vent, channel, pond, proximal slope, and distal slope facies. An additional sample was taken from a fossilized vent found north of Little Bubbling Spring East for observation of long term biosignature preservation. A sample from each spring vent system facies was chosen for X-ray Diffraction analysis, random oriented powder mount method, using the Rigaku Ultima IV X-ray diffractometer at Southern Illinois University, IL. Jade 9.1 software was then used for XRD data analysis. The presence of microorganisms and mineral habits was documented via scanning electron microscope (SEM) analysis which was performed using FEI Quanta FEG 450 SEM with an EDS detector at the Southern Illinois University Image Center. Five samples were selected for analysis: Three samples from Little Bubbling Spring East (fossilized vent, pond, and proximal slope facies), One sample from Big Bubbling Spring vent facies, and Torrey's spring pond facies. These samples were selected due to the presence of biofilm development, downstream of an active biofilm, or high potential to measure biotic preservation (i.e. the fossil vent).

Results: Preliminary results show that the three Ten Mile Graben Springs are dominantly composed of aragonite and calcite with minor quartz. Some halite, and calcite, with minor gypsum does occur at the driest sampling locations: the dry distal slope of Little Bubbling Spring West and the fossilized vent of Little Bubbling Spring East. Scanning electron microscope analysis showed the samples containing biofilms (pond samples from both Little Bubbling Spring East and Torrey's Spring) are communities of diatoms (Figure 1). The proximal slope sample from Little Bubbling Spring East, directly downstream from the spring's corresponding pond sample, contained decayed and broken forms of these diatoms (Figure 2).

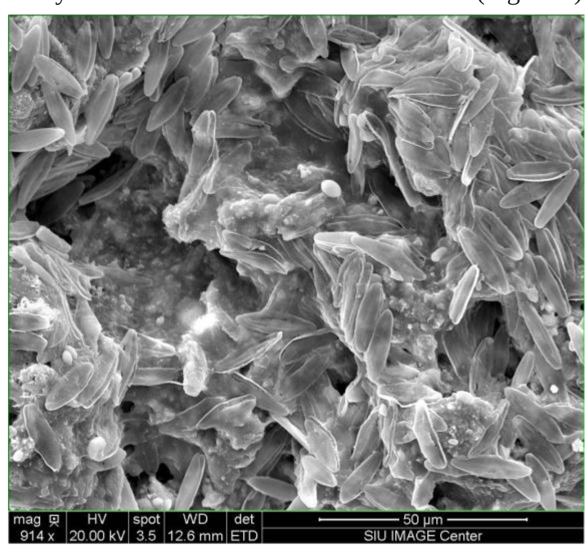

Figure 1: *SEM imagery of a diatom mat from Little Bubbling Spring East pond sample.*

Figure 2*: SEM imagery of decayed diatoms from Little Bubbling Spring East proximal slope sample. About 10 m downstream of the diatom mat pictured in Fig. 1.*

Discussion: Aragonite is the dominant mineral in all three of the Ten Mile Graben springs, across all facies. This mineral, coupled with the abundance of micro-organisms, could suggest a biologic origin; although rapid degassing of the CO_2-charged fluid could easily cause abiotic precipitation of aragonite. However, aragonite is recrystallizing to calcite on geologically short time scales (100's of years) because the fossilized vent is composed of halite and calcite.

Diatoms are rapidly decaying on similar time scales (Figure 2). This site is only 10 m from where the pond sample (Figure 1) was taken, and shows that these diatoms may not be well preserved outside of their colonies. The fossilized vent supports this because diatoms are lacking in that sample.

Understanding the relationship between the diatoms and the presence of aragonite is needed to further understand how these modern biosignatures may be preserved over time. Further chemical analysis is ongoing to understand the link between the microorganisms (diatoms) and the mineralogy. If cold spring environments are to be an acceptable target for future Mars astrobiology missions, then we must understand how modern biosignatures transform and are preserved through time.

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