THE GREAT SALT LAKE DESERT: EXPLORING THE HABITABILITY OF PALEOLAKES ON EARTH AND MARS. K. L. Lynch[1], K. M. McGuire[2], S. M. Ritter[2], R. J Schneider[1], J. Munakata Marr[1]. [1]Colorado School of Mines, 1500 Illinois Street, Golden, CO 80305, (klynch@mines.edu), [2]Dept. of Geosciences, Brigham Young University, Provo, Utah 84602.

Introduction: The identification of numerous hydrous mineral-bearing deposits on the martian surface lends strength to the general understanding that Mars had an abundance of liquid water interacting with the basaltic crust during its early history [1-6]. Further, the geological context of some of these deposits suggest the existence of substantial surface water interaction in the form of valley networks, outflow channels and, most significantly, deep-water paleolakes. Wray et al. provide an extensive analysis of the mineralogy of the inferred paleolake at Columbus Crater in which aluminum phyllosilicates consistent with kaolinite and montmorillonite clays, gypsum, Fe/Mg-bearing polyhydrated sulfates and several other hydrated mineral assemblages were identified [7].

The majority of terrestrial paleolakes transition to modern day evaporite basins with significant clay, sulfate and chloride deposits similar to the mineralogy identified in the Columbus Crater [8]. These terrestrial deposits are generally known to harbor a diverse array of microbial life and enhance the preservation of organic matter and fossils [9-12]. Further, these systems also tend to be a reservoir for authigenic carbonate deposition [13]. Finally, life on Earth may have originated in Hadean oceans or deep lakes where redox energy from chemical gradients would have been available. Hence, it stands to reason that developing a comprehensive understanding of the characteristics of habitability and biosignature preservation in these terrestrial systems will prove useful for future *in situ* astrobiological investigations on the martian surface as well as sample selection for Mars sample return.

The goal of this study is to assess three geobiological characteristics (1-microbial diversity; 2-energy resources; 3-biomarker preservation) of the understudied terrestrial paleolake environment of the Great Salt Lake Desert to determine the relevance of this environment for long-term, detailed astrobiological studies. Here we present some of the preliminary results from this on-going study.

Field Site Characterization: Lake Bonneville is one of several known paleolakes from the Pleistocene Epoch (~32,00 to 16,200 B.P.); the Great Salt Lake Desert is one of two remnant features, the other being the Great Salt Lake. Bonneville covered about 20,000 square miles of western Utah and smaller sections of eastern Nevada and southern Idaho and reached a depth of ~1000 feet. It formed as a freshwater lake from rivers inflow, direct precipitation and glacial melt and was sustained at various levels until about 14,000 B. P. when it started a sharp decline to the modern day GSLD basin features and the Great Salt Lake as shown in figure 1. The mineralogy of the Lake Bonneville sediments varies spatially in abundance, but the composition is primarily a mix of smectite and kaolinite clays, authigenic carbonates, and sulfates & chlorides.

The modern-day GSLD is an extensive playa situated over a shallow sub-surface brine aquifer. The GSLD is bifurcated by interstate 80 and encompasses three enclosed sub-basins: the Bonneville Salt Flats, Pilot Valley and the Newfoundland Basin. The Bonneville Salt Flats and Pilot Valley basins are the focus of this study.

Figure 1. Satellite Image of the Great Salt Lake Desert &key Sub-basins: Bonneville Salt Flats & Pilot Valley. *Image courtesy of Google Earth.*

Bonneville Salt Flats. The Bonneville Salt Flats (BSF) occupies an enclosed basin area of approximately 150 square miles and is considered an economically important province in the GSLD due to the high concentration of dissolved sylvite (KCl) in the subsurface aquifer. The salt crust is dominated by halite with traces of sylvite and the thickness ranges from millimeters to 2 meters. These near-surface sediments underlying the salt layer are dominated by clay and silt sized particles that are comprised of primarily aragonite and quartz with smaller abundances of gypsum, stilbite and smectite clays. These sediments are verti-

cally stratified into distinct layers that vary in elemental abundances. The sediments also show lateral variability as black, organic-rich anoxic muds are interspersed between the predominant sediments. The shallow brine aquifer rises each winter and floods the basin, then slowly evaporates off through the spring and summer and reaches full dryness by the start of the fall.

Figure 2. Bonneville Salt Flats & Sediment Core

Pilot Valley. Pilot Valley (figure 3) is also a closed topographic basin that lies west of the Bonneville Salt Flats and the Silver Island mountain range. The mineralogy of this basin is not as well characterized as Bonneville; however it is known to have distinct sulfate, chloride and carbonate dominated zones within the playa and the majority of the near surface sediments are dominated by clay-sized particles. Pilot Valley also experiences temporal variability throughout the year, but not to the extent of the BSF.

Figure 3. Pilot Valley & Sediment Core

Microbial Diversity & Energy Resources: The microbial diversity of the GLSD has not been previously recorded. Initial geochemical analysis of sediments in both basins indicates that predominant potential redox species are nitrate, sulfate, organic matter and iron. Preliminary analysis of DNA extracted from BSF and Pilot Valley sediments indicate the presence of methanogens.

Biomarker Preservation: The potential biomarkers of interest for this study are the microconcretionary structures known as ooids. Ooids are spherical to semispherical carbonate grains composed of concentric layers surrounding a nucleus that could be composed of anything from mineral grains to organic matter. Microbial activity has been suggested as a likely mechanism of formation. Three ooid bearing horizons have recently been discovered in the Pilot Valley sediments. Samples have been extracted from these horizons and analysis of the ooid structures is in progress to determine presence/absence of microbial influence.

Continuing Work: Additional field expeditions are scheduled for the 2012 and 2013 seasons. Core samples will be taken down to a depth of 6 meters, which will allow access to the shallow aquifer fluids. Analysis of subsurface fluids and petrological analysis of the sediments will allow further constraint of the mineralogy and geochemistry. High throughput sequencing of additional DNA extracts will allow for further definition of the microbial diversity present in the BSF and Pilot Valley Basins.

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