THE PILOT VALLEY BASIN, UTAH: A MODEL SYSTEM FOR STUDYING SUBSURFACE LIFE ON EARLY EARTH, MARS AND BEYOND. K. L. Lynch[1] [1]Georgia Institute of Technology, School of Earth and Atmospheric Sciences and School of Biological Sciences, Atlanta GA 30332 (klynch31@gatech.edu)

Introduction: One of the key recommendations from the recent National Academies study on the state of astrobiology science is that "NASA's programs and missions should reflect a dedicated focus on research and exploration of subsurface habitability…" and in particular the focused study of saline/hypersaline subsurface habitats. On Earth, one such environment that could serve as an excellent model for the study of subsurface life on early earth, Mars, and beyond is the Pilot Valley Basin in Northwest Utah.

Pilot Valley is a closed basin paleolake that consists of hypersaline fluvial and lacustrine deposits. It hosts a shallow brine aquifer that encompasses the upper 6 m of basin fill and is maintained through subsurface groundwater flow by mountain-front recharge from the adjacent Silver Island Mountain Range (Figure 1). The only loss mechanism from the basin is capillary wicking and evaporation from the playa surface. Pilot Valley is being studied as a geochemical and mineralogical Mars analog environment due to the presence of aqueous minerals similar to those found in multiple Martian paleolake basins; it can also serve as a sedimentological analog to Martian paleolake environments as it contains the full sequences of 28 lake cycles going back over 800,000 years [1].

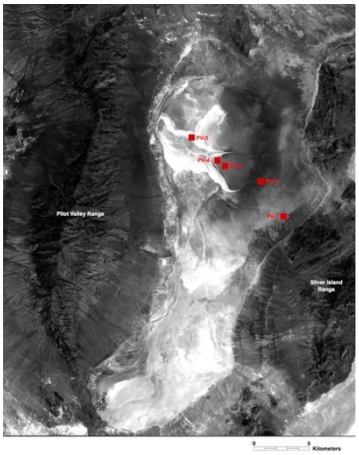

Figure 1. Pilot Valley Basin, Utah. *Image Credit: NASA Land Processes Distributed Active Archive Center (LP DAAC). ASTER L1B. USGS/Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota. 2000*

Pilot Valley is also being studied as a habitability analog for both ancient and modern Martian habitable zones due to the presence of an extensive microbial ecology throughout the 6 m expanse of the basin shallow aquifer.

Microbial Ecology: Continuing research shows that the ecosystem present in Pilot Valley is organized into three distinct community groups. This discrete assembly is most likely influenced by grain size among other lithological factors. Because lithology is a factor that seems to influence community structure, this variable could impact how, where, and what type of biosignatures get preserved within this type of subsurface environment [2].

Perchlorate-influenced Ecosystem: Recent experimental results show that perchlorate reducing bacteria co-exist with the naturally-occurring perchlorate (NOP) present in the basin. Research results also indicate strong evidence of active microbial reduction of the NOP throughout the basin. This is the first potential finding of in situ perchlorate metabolism in hypersaline environment and could serve as a model for possible extant ecosystems in the Martian subsurface [3]. Further, an ancient origin for perchlorate metabolism has been suggested, hence perchlorate and other oxyanion salts may be significant aspects of Earths early biosphere [4].

References: [1] Lynch, K.L et al. (2015), JGR Planets, [2] Lynch, KL et al. (2016), LPI Contributions 1912, [3] Lynch, K. L. et al (2019), Astrobiology. [4] Melnyk and Coates (2015), BMC Genomics.