CALCIUM PERCHLORATE BRINE FORMATION IN THE ATACAMA DESERT, CHILE AND IMPLICATIONS FOR LIQUID WATER AT THE SURFACE OF MARS. Holly N. Farris[1], A. Davila[2], [1]Arkansas Center for Space and Planetary Sciences, University of Arkansas, Fayetteville, AR 72701, *hnfarris@uark.edu*, [2]NASA Ames Research Center, Moffett Field, CA 94035.

Introduction: The Atacama Desert is known as one of the driest places on Earth, making it one of the best terrestrial Mars analog sites. Specifically, the Yungay region, located in the hyper-arid core of the desert has experienced extremely dry conditions, receiving less than 1 mm of annual rainfall; unchanged for upwards of 15 million years [1]. The Atacama is characterized by vast expanses of exposed salts, relics of evaporated lakebeds, called "salars". These salars are entirely composed of halite (NaCl), formed into large nodules [2]. Despite harsh conditions near the dry limit of life, halite adsorbs water vapor from the atmosphere through deliquescence to form liquid brines, allowing communities of cyanobacteria to thrive within nodules.

We hypothesize as Mars transitioned from a wet environment to an extremely dry one, evaporite deposits, identified and mapped by Mars Odyssey THEMIS [3] may have been or are the last inhabited substrates on the planet. In addition to chlorides and sulfates, we focus on perchlorates, identified on Mars by Phoenix [4].

Experimental Setup: Preparation of samples was performed in the Extremophile Laboratory at the Instituto Antofagasta at the Universidad de Antofagasta, Chile. Seven different samples including a mixture of Atacama soil (99 wt%) and calcium perchlorate ($Ca(ClO_4)_2$) (1 wt%). A kilogram of sample was heated in an oven at 60°C for 24 hours to remove any residual moisture and placed in a 10 cm^3 Plexiglas box (Fig. 1).

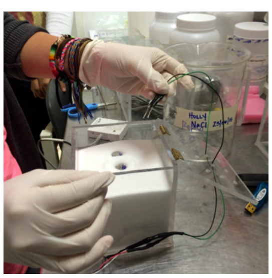

Figure 1. *Installing iButtons and HOBO sensor during sample preparation in the laboratory.*

Six Hygrochron iButtons were placed in each box: two each at the surface, and at 6 cm and 9 cm. iButtons are small, round sensors, housed in stainless steel casings that work wirelessly to collect temperature, *T*, (± 5°C) and relative humidity, *RH*, (± 0.5% RH). There were programmed to collect a data point every 30 minutes. Lastly, a HOBO electric conductivity, *EC*, sensor was inserted to approximately the center of the sample.

Results: The results varied widely and were not always favorable, due to unforeseen problems with hasty weathering of instrumentation. For this abstract, we focus on the mixture of Atacama soil and $Ca(ClO)_2$. The iButtons failed over the period of Oct 2015 - Feb 2016, while the HOBO collected data throughout. The interval of time over which these datasets overlap (approx.. 2 mo., Sept - Oct 2015: S. American Spring) plotted in Figure 5.

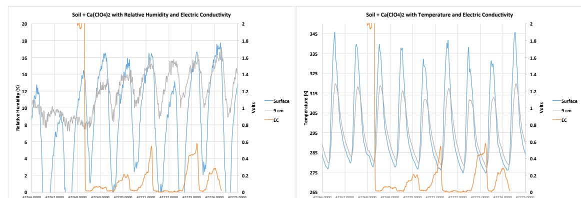

Figure 5. *Relative humidity (left) and temperature (right) at the surface and at 9 cm depth plotted with electric conductivity over the same time interval.*

The data indicates the presence of liquid over short, repeated time intervals; low *T* and high *RH* (night), specifically when the $T_{surface}$ was as low as the T_{9cm} (approx. 280 ± 3 K) and when the RH_{9cm} was as high as the $RH_{surface}$ (approx. 15 ±2 % RH).

Conclusions: We show that a liquid brine of $Ca(ClO_4)_2$ is stable over small periods of time at 277 K $\leq T \leq$ 283 K and 13% $\leq RH \leq$ 17%. This is easily within the range of conditions reported from the surface of Mars. While we suspect the trend continued (and seemed to intensify via the *EC* data), it is impossible to say with confidence without *T* and *RH* data to confirm. We plan to repeat these experiments, but inside of a Mars simulation chamber, in order to increase the relevance to Martian conditions, including a larger temperature range (ie. approaching the eutectic temperature of $Ca(ClO_4)_2$) and simulating a Martian atmosphere of 6 mbar of CO_2.

References and Acknowledgments:
[1] Wierzchos J. et al. (2012) *Biogeosciences Discuss, 9,* 3071-3098. [2] Artieda O. et al. (2015) *ESPL.* [3] Osterloo M. M. et al. (2008) *Science, 319,* 1651-1654. [4] Hecht, M. H. et al. (2009) *Science*, 325, 64-67. Funding for this research was provided by Ark. Space Grant Consortium, the Lewis and Clark Fund for Exploration and Field Research in Astrobio., and Sturgis Intl. Grad. Fellowship.