DELIQUESCENCE-DRIVEN BRINE FORMATION IN THE ATACAMA DESERT, CHILE: IMPLICATIONS FOR LIQUID WATER AT THE MARTIAN SURFACE. H. N. Farris¹, A. Davila²,
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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 in the hyper-arid core of the desert (Fig. 1) has experienced extremely dry conditions, less than 1 mm of rainfall annually; unchanged for upwards of 15 million years [1].

Despite harsh conditions considered near the dry limit of life, the Atacama is teeming with life. Through the process of deliquescence, hygroscopic salts adsorb water vapor from the atmosphere to form liquid brines, allowing colonies of cyanobacteria to thrive deep within these halite nodules.

Mars Analog: Chloride-bearing evaporites in the driest place on Earth can sustain liquid water in quantities large enough to harbor microbial life. As Mars transitioned from relatively wet to extremely dry, it is fair to assume that chloride-bearing evaporite deposits that have been identified and mapped by Mars Odyssey THEMIS, reported by [3], may have been or are the last inhabited substrates on the planet. In addition to chlorides, samples for this study were chosen based on their Mars relevance. Identified by Phoenix; perchlorates, for example, were considered due to their low eutectic temperatures.

Experimental Setup: Preparation of samples was done in the Extremophile Laboratory at the Instituto Antofagasta of the Universidad de Antofagasta. Seven different samples were prepared over the course of two days: 100 wt% magnesium chloride (MgCl₂), 100 wt% magnesium sulfate (MgSO₄), 100 wt% calcium chloride (CaCl₂), 100 wt% calcium sulfate (CaSO₄), 100 wt% sodium chloride (NaCl), 100 wt% calcium perchlorate (Ca(ClO₄)₂), and a 99 wt% calcium perchlorate/1 wt% soil mixture. A kilogram of each compound was heated in an oven at 60 °C for 24 hours to remove any residual moisture. The following day the compounds were added to 10 cm cube Plexiglas boxes (Fig. 3). Two Hygrochron iButtons each were inserted at depths of 3 cm, 6 cm, and 9 cm. iButtons are small, round sensors that work wirelessly to collect temperature (± 5 °C) and relative humidity (± 0.5% RH) at user-determined interval. Due to the data capacity of the iButtons, two were necessary at each location in the box, (one to record data every 30 minutes for the first 6 months and a second to record data every 30 minutes after a 6 month delay) in order to collect a full year worth of data at meaningful intervals.

Finally, a HOBO electric conductivity sensor was inserted to approximately the middle of the sample. Two small metal plates separated by a gap can detect small changes in electrical current across the plates, thus the presence of liquid water over time. All samples started with an electric conductivity, EC, value of 0.
All sensors are easily removed from the sample at the end of the experiment and downloaded via USB connection.

The samples were deployed in a flat region of Yungay ($24^\circ 05'267''S, 069^\circ 59'682''W$) within a few meters of each other. Small nearby rocks were placed around the boxes to ensure security and over wires to improve invisibility (Fig. 4-5).

At the time of deployment, the CaCl$_2$ appeared wet, but had an initial electric conductivity reading of EC = 0. This was noted for future analysis. Five days later, we returned to Yungay to make sure everything was working properly and undisturbed and reported no problems. A return trip is planned in January 2016 to collect the first 6 months of data and again in June 2016 to collect the second 6 months of data for analysis.

**Anticipated Outcome:** Upon data collection in January and June, we hypothesize sinusoidal fluctuations in temperature and relative humidity, diurnally, which will ideally correlate with the presence of brines (electric conductivity readings consistent with liquid water). Measurements of this nature have not been made in situ for Mars-relevant salts. If we can show liquid water formation through deliquescence in the driest place on Earth, we gain traction for isolating conditions under which we could see transient liquid water at the surface of Mars. This has potentially important implications for future human exploration, landing site selection, and astrobiology.


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