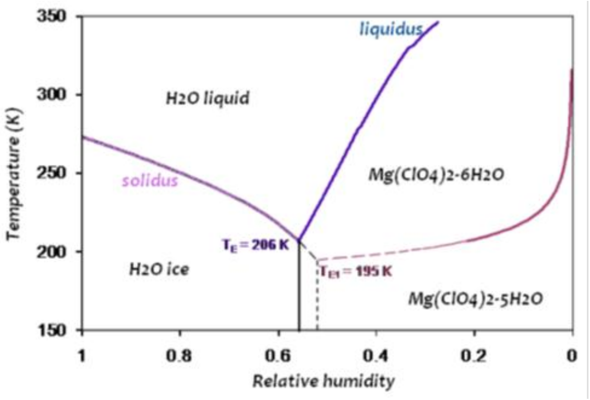
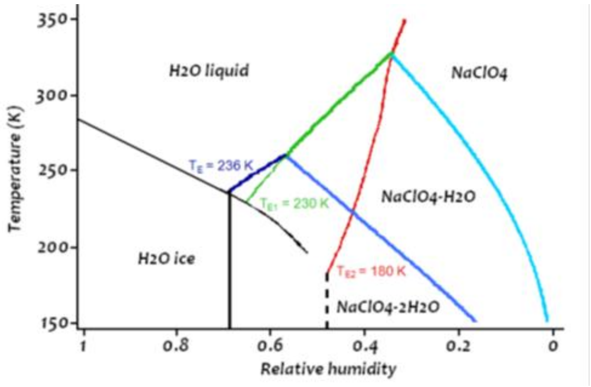
Soil Conductivity of Perchlorate Brines on Mars. Kayla Love[1], Vincent Chevrier[1,2], Laura Fernandez [2] Langston University, Langston, OK, (Kaylalove8300@yahoo.com), [2] Department of Space and Planetary Science, University of Arkansas, Fayetteville AR

Introduction: The Phoenix lander perform chemical analysis and detected perchlorates on Mars which are most likely to exists as $Mg(ClO_4)^2$. An important property is that they are readily soluble in water and they act as anti-freeze. Therefore the deliquescent property (A substance that transforms from a crystalline solid to a liquid) of perchlorate may play a role in controlling soil and the atmospheres water content. The more that we can learn about the behaviors of perchlorates in a Martian environment would be beneficial to researchers.

The Phoenix Mars Lander used The Wet Chemistry Laboratory (WCL) instrument to conduct the chemical analysis of Martian regolith. After analyzing two samples one from the Martian surface and one at 5 cm depth, about 0.6 wt. % of perchlorate was detected (Hecht et al. 2009). Perchlorates (ClO_4-) are salts derived from perchloric acid ($HClO_4$). An important property is that they are readily soluble in water and they act as "antifreeze". The deliquescence of perchlorates is dependent on both relative humidity as well as temperature. Figure 4 represents a deliquescence graph of $Mg(ClO_4)^2$ and Figure 5 is a deliquescence graph of $NaClO_4$ .On the right side of both figures perchlorate has different hydration degrees. On the left side there are two water phases. (Fernandez 2011). This experiment focused on the liquidus phase in where both liquid water and perchlorate are stable which indicates the deliquescence limit.

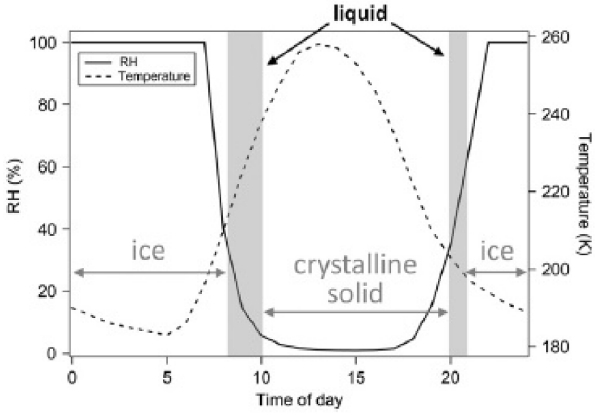


(Figure1) Deliquescence of Magnesium Perchlorate $Mg(ClO_4)^2$



(Figure 2) Deliquescence of Sodium Perchlorate $NaClO_4$

When perchlorate is in equilibrium with the Martian atmosphere it will form a liquid solution. The solubility of perchlorate is dependent on relative humidity and temperature. Figure 3 demonstrates the phase changes that perchlorate undergoes. As surface temperature on Mars increases in the morning the ice begins to melt which allows perchlorates to exist in the aqueous phase temporarily throughout the day. When the temperature began to increase throughout the course of the da a crystalline salt is formed. Later into the evening ice will form again.(RV Gough 2011)



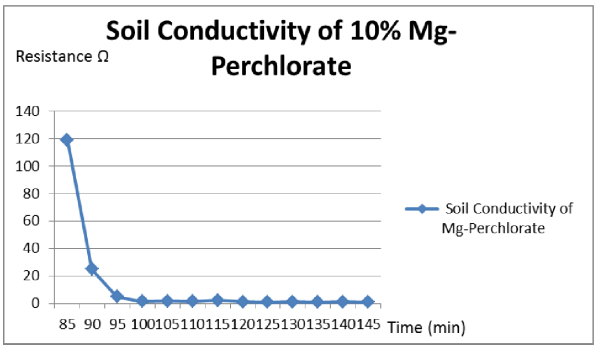
(Figure 3) RV Gough 2011

The drastic change in relative humidity on Mars helps us to understand capability of liquid brine formation. It is known that the deliquescence and efflorescence of either $Mg(ClO_4)^2$ or $NaClO_4$ present in Mars regolith is dependent on relative humidity. The conductivity of mars regolith can be used as an indicator to detect perchlorate brines on mars. This will help researchers

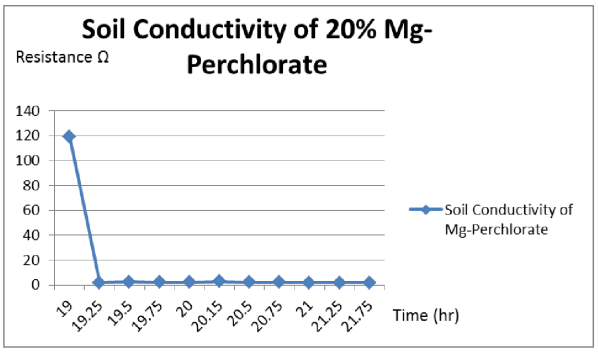
understand the history and current environment of Mars and the potential for biological activity.

Methods: 100 grams of Palaganite Soil (JSC Mars 1) was used which is most similar to regolith found on mars. 1%, 10% and 20% of $Mg(ClO_4)^2$ was added to three separate JSC Mars 1 samples two copper electrodes were inserted into the sample. The copper electrodes were connected to wires that were attached to a micrometer. The sample was kept in a closed environments surrounded with water to ensure one hundred percent relative humidity then placed on a hot plate at approximately 73°C.

Results And Discussion. When concentration of $(MgClO_4)^2$ increased the speed at which conductivity occurred increased as well (figure 4 and figure 5). In addition as the temperature increased conductivity occurred faster. This technique of identifying the amount of time required to detect conductivity produced by a sample can be used as an indicator for perchlorate brine formation on Mars. In future studies we intend to use a Mars Simulation Chamber to vary the relative humidity and conduct experiments at lower temperatures with a CO_2 atmosphere. This will allow us to investigate the capability of conductivity in a Martian environment and provide further evidence to confirm that perchlorate salt is capable of brine formation in Mars current conditions.



(Figure 4) Soil Conductivity of 10% $(MgClO_4)^2$: amount of H2O 850 ml, water temp 73°C, soil initial temperature 28°C, experiment start time 11:37 a.m. , conductivity time 3:02 p.m.



(Figure 5) Soil Conductivity of 20% $(MgClO_4)^2$: amount of H2O 850 ml, water temp 73°C, soil initial temperature 28°C, experiment start time 11:37 a.m. , conductivity time 3:02 p.m.

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