

MAPPING THE DISTRIBUTION OF PERCHLORATES ON THE MARTIAN SURFACE AT THE PHOENIX LANDING SITE. A. S. Clark and S. C. Cull, Bryn Mawr College Department of Geology, Bryn Mawr, PA. aclark@haverford.edu

Introduction: On May 25, 2008, NASA's Phoenix lander arrived successfully on the northern plains of Mars. Its main scientific goal was to study the Martian arctic, where the existence of water ice might shed better light on the water cycle of Mars. A noteworthy and unanticipated accomplishment of Phoenix's mission to Mars was the detection of perchlorate salts (ClO_4) by the Wet Chemistry Lab (WCL) instrument at significant concentrations between 0.4 and 0.6 wt% [Hecht et al., 2009].

Perchlorates at the landing site are likely hexahydrate magnesium perchlorate, which has a relatively low eutectic temperature compared with other perchlorates, in the range of -70°C [Chevrier et al. 2009]. Cumping and subsequent drying of soil sampled by Phoenix's robotic arm was observed and is another indication of the presence of perchlorate [Arvidson et al. 2009]. This soil cohesion occurs because perchlorates act to drastically lower the freezing point of water on Mars and enhance binding between grains when liquid water is present [Arvidson et al., 2009].

Due to the properties of magnesium perchlorate, and its effects on Martian soil and water, it is important to gain a detailed understanding of the distribution of perchlorates in the soil column. Evidence suggests that perchlorates at the landing site are concentrated in subsurface salt patches, and that these may be an indication that its affinity for water and ability to maintain water in a liquid solution for periods of time may have caused this brine to be translocated to the subsurface [Cull et al., 2010]. Here, we present results from mapping of the distribution of these subsurface patches in order to gain a more complete picture of the depth and geological horizon in which these perchlorates are concentrated.

Methods: Mapping the distribution of perchlorates near the Phoenix landing site is accomplished using the Phoenix's Surface Stereo Imager (SSI). The SSI was the primary imager for the duration of the 5-month mission and captured many hundreds of images. This instrument is designed to image the landscape using 15 filters over a wavelength range from 445nm to 1001nm [Morris et al., 2008]. Hydrated perchlorate salts have a spectral absorption at 967 nm, which can be used to identify these salts in SSI data [Cull et al., 2010].

Using spectral information from the SSI, images of the landing site are mapped for distribution patterns of perchlorate salts. Absorption depths are mapped across the images taken from the SSI, and a photomosaic produced. The development of a more complete map of perchlorate distribution at the Phoenix landing site is important to the continued

study of Martian water cycles and specifically, the role of liquid water on Mars.



Figure 1. Dodo-Goldilocks trench, sol 14 showing exposed water-ice table. Excavated by Phoenix's Robotic Arm.

Mapping: Images were chosen for analysis based on the trenching activity of the Phoenix's Robotic Arm (RA, Figure 1, Figure 3). All SSI 15F images corresponding with RA activity were selected.

This constituted a set of 169 images, spanning 149 in the following trenches: Snow White, Dodo-Goldilocks, Stone Soup, Pet Donkey, Upper Cupboard, Lower Cupboard, La Mancha, Headless, Burn Alive, Neverland, and Runaway.

Hydrated magnesium perchlorate is identified in these images by a smooth absorption feature at 967 nm (Figure 2). This feature is distinct from both undisturbed soil and water ice, and can be ruled out as instrument noise [Cull et al. 2009, Morris et al. 2008].

To date, perchlorate has only been found in concentrated subsurface patches. There is no evidence of a homogeneous distribution through the soil column.

References:

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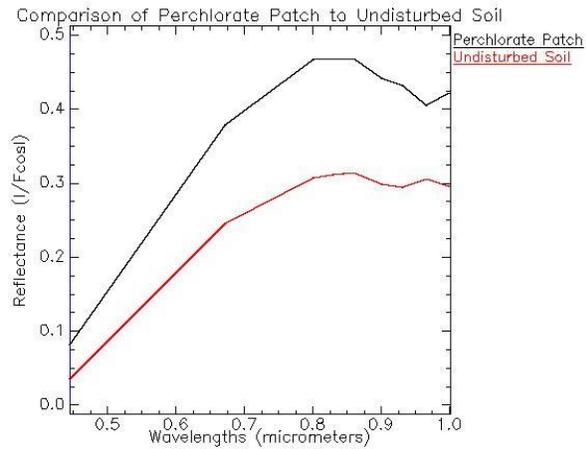


Figure 2. Dodo-Goldilocks trench, spectrum comparison between a known perchlorate patch (black line) and a patch of undisturbed soil (red line).

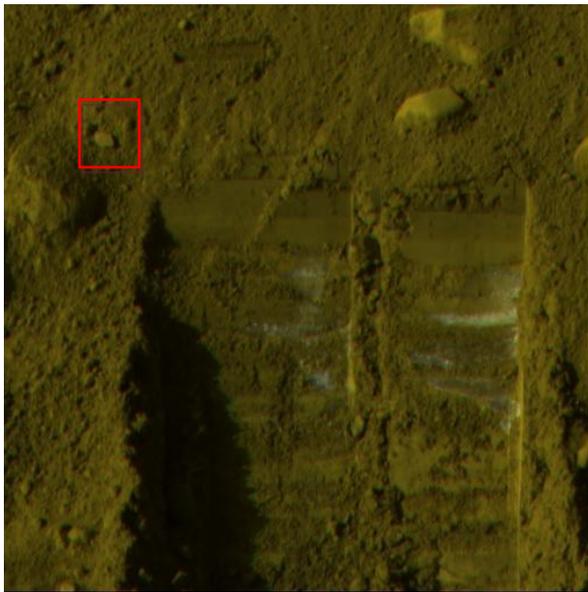


Figure 3. Dodo-Goldilocks trench showing location of analyzed perchlorate patch.