MICROSCOPY ANALYSIS OF THE SALT CONTENT OF SOIL AND DUST AT THE PHOENIX LANDING SITE. H. Sykulska[1], W.T. Pike[1], S. Vijendran[1] and Phoenix Microscope Team. [1]Department of Electrical and Electronic Engineering, Imperial College London, SW7 2BT, UK (hanna.sykulska@ic.ac.uk)

Introduction: The Phoenix Spacecraft landed successfully on 25th May 2008. On the deck of the lander is a microscopy payload comprising an Atomic Force Microscope (AFM) and an Optical Microscope (OM) to which samples from the surface and below are delivered by a robot arm. The setup allows imaging of individual dust and soil particles at a higher spatial resolution than any previous in-situ instrument. The OM images have a 3.9um per pixel resolution with images up to 256 x 512 pixels and 1 x 2mm in size [1]. Colour images are obtained by illuminating the material in turn with red, blue and green LEDs, acquiring the images with the monochrome CCD and creating composites.

We present here a predictive analysis which indicates the salt content of the soil using the OM images by combining colour and spatial information to analyze the salt material in the soil.

Salt Analysis: The study assumes the “white” particle population to be representative of the salt content within the soil. However, identifying this population is not trivial as salt particles may be off-white due to surface coating with finer material or contamination, making them difficult to distinguish from the lighter particles or glints in the bulk material as shown in Fig. 1.

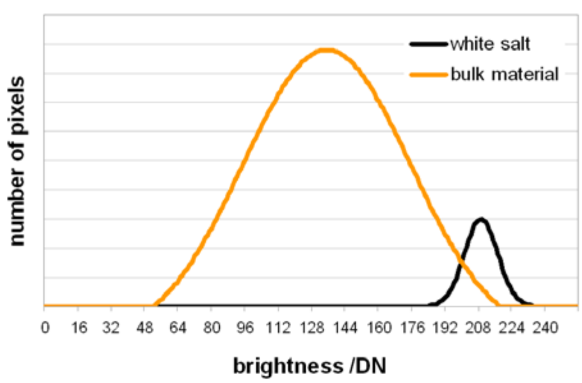

Fig. 1 A schematic plot of the pixel numbers where brightness is the grey level segmentation threshold. The distributions are modelled at normal distributions truncated at the first standard deviation.

Observing the number of particles, rather than pixels, above a brightness threshold allows the identification of the point at which the lighter material in the bulk begins to contribute to the white material, a point clearly visible in the cumulative plot in Fig. 2. Above this threshold white particles can be defined as salt particles rather than lighter particles from the bulk material.

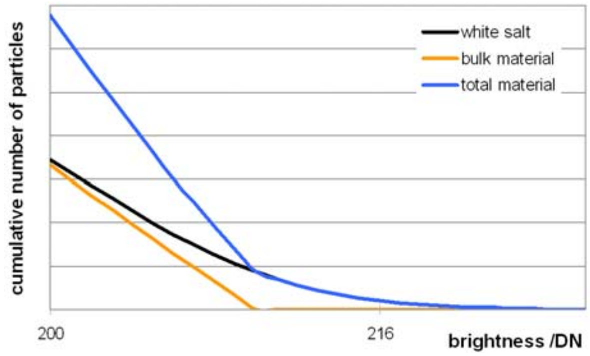

Fig. 2 A schematic plot showing salt particles evident as an excess number above a certain threshold. The break in the blue line (representing the overall material) provides a threshold above which all the particles are white salt particles.

Fig. 3 shows a colour composite image of the surface sample ‘Rosey Red’ with white salt particles evident, as have been indicated in the image to the right. The number of particles produced by segmentation at all the threshold values was determined as can be seen in Fig. 4. The threshold to which white particles are attributed to salt alone is found at 163 DN, clearly visible as the break in the graph. This threshold corresponds to 0.54 ± 0.05% aerial proportion.

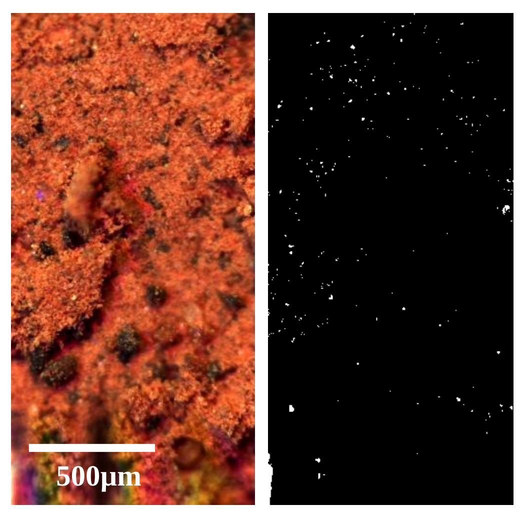

Fig. 3 Left: OM colour composite image of the sample Rosey Red acquired on sol 033. Image size 256 x 512

pixels at 6-bits per pixel. Right: Image showing pixels above a threshold of 163 DN.

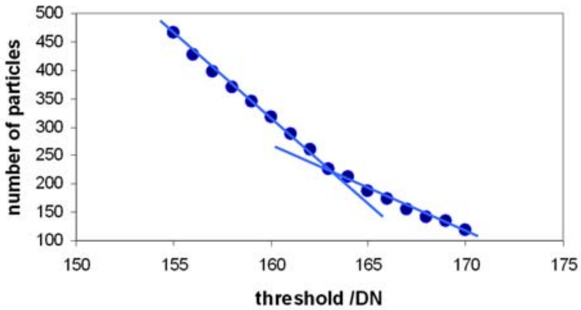

Fig. 4 Count of the number of particles above each threshold for the surface sample Rosey Red.

For the surface sample 'Mamma Bear', acquired on sol 031 at the dig trench 'Dodo-Goldilocks', an aerial density of 0.14 ± 0.05% of white particles was found at the threshold of 178 DN. Analysis of a lag deposit sample 'Golden Key', acquired on sol 103 at the same site but at a different depth, gave a 0.33 ± 0.05% aerial density, showing that the lag deposit is enriched by over 100% in white particles.

Conclusions: Combining both the aerial density of white particles in the field of view with colour information gives a measure of the salt concentration in the sample. Samples show a distinct excess white particle population of aerial density less than 1%. Comparison of samples allows lateral and vertical comparison of salt content of the soil.

References: [1] Hecht M.H. et al. (2008) JGR, 113, E00A22.