RECENT SPIRIT RESULTS: MICROSCOPIC IMAGER ANALYSIS OF PARTICLE PROPERTIES IN SCAMANDER CRATER, WEST OF HOME PLATE. Kirsten Siebach,[1] Raymond Arvidson[1], Nathalie Cabrol[2], and The Athena Science Team, [1]Washington University in St. Louis (klsiebac@ wustl.edu, Campus Box 1169, 1 Brookings Dr., St. Louis, MO 63130), [2]NASA Ames/SETI CSC, Space Science Division, Moffett Field, CA.

Introduction: The Mars Exploration Rover Spirit has completed an extensive set of soil observations in its current location, perched on the edge of Scamander Crater, a shallow 8m-diameter crater to the west of Home Plate. The rover's left wheels are inside the crater, whereas the right wheels are sitting on a plateau to the east. Light-toned subsurface soil ("Ulysses") was excavated by the left front wheel during initial attempts to extricate the rover. Observations on this soil include images taken by the Panoramic Camera as well as measurements by the Alpha-Particle X-Ray and Möessbauer spectrometers [1]. These data were supplemented with images taken by the Microscopic Imager (MI), a fixed focus lens camera with a pixel scale of 31 µm/ pixel. The series of MI images taken during the campaign at Ulysses allow analysis of the physical properties of the soil and, when combined with spectroscopic data, help constrain the morphology of specific compositional features. Results indicate that the soils are angular, poorly sorted sulfate-rich sands.

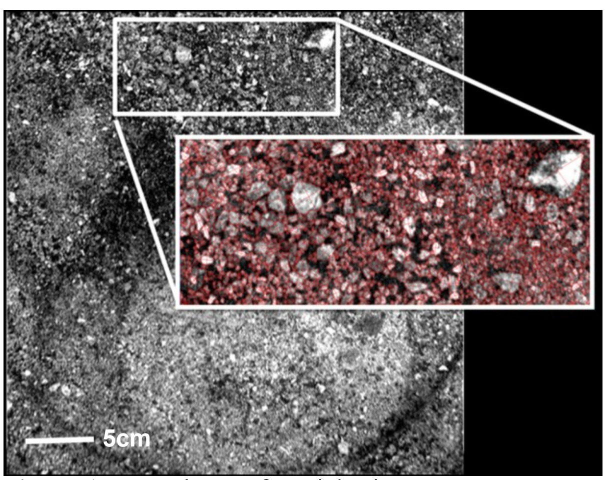

Figure 1 Example set of particle size measurements on "Olive Branch" target, MI image, sol 1929.

Analysis Methods: Within Ulysses, three preliminary spectroscopic endmembers were identified from Panoramic Camera images, and targets for in-situ analyses selected. Each of the targets was then analyzed with the full set of analytical instruments and imaged with the MI. Particle sizes were determined from MI images by selecting a subset of the image with a representative particle size distribution and then measuring the long and intermediate axes of each identifiable particle, as shown in Fig. 1. This necessarily does not include particles under 100 µm, or the limit of resolution of the camera, and is not statistically dependable for particles under 150 µm based on derivations from Nyquist's sampling frequency. Additional processing was done on some of the images to compare the measured particle perimeters to the perimeter of an ellipse with the same axes and determine the apparent roundness of the particles.

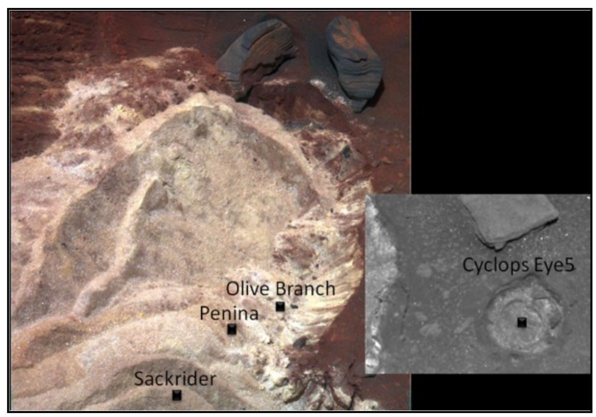

Figure 2 Locations of MI images for context

Spatial Differentiation: Three targets selected from within Ulysses, "Sackrider", "Penina", and "Olive Branch", showed very similar particle size distributions. Olive Branch was just under the interface between the light-toned soil and the sandy red surface soil, and Penina and Sackrider were located more centrally within Ulysses, on a mound of soil kicked up by the wheel.

All three soils are dominated by light-toned, angular, silt to fine sand-sized grains (150 µm - 300 µm), with a few agglomerates, mostly between 500 and 700 µm. The deeper soils tend to be more poorly sorted. Compositionally, these materials are similarly enriched in sulfates, with a slight trend to higher calcium enrichment in the shallower layers.

The basaltic surface layer was imaged and analyzed at "Cyclops Eye," an undisturbed surface location to the right of Ulysses. The MI analysis revealed well-sorted, round, fine sand particles with an average size of 220 µm. This matches the predicted particle size and shape for aeolian distribution on Mars, as the peak grain size for saltation is ~150 µm.

In the interest of viewing the soil layers in an undisturbed environment, the Cyclops Eye surface soil was brushed with the Rock Abrasion Tool (RAT). The subsurface layers revealed by brushing were identified with numbers following the name, and the final surface was called "Cyclops Eye5." MI analysis of this site indicated that the brushed surface was more similar to shallower Cyclops Eye targets than to the Ulysses areas, but represented a mixture of the two sets of particle properties. The particles were centered around 210 µm and had a fairly sharp size distribution similar to what was found for Cyclops_eye_1, but also exhibited more angular particles and agglomerates. This analysis correlates well with compositional trends, which showed Cyclops Eye5 to be in between the surface and subsurface values.

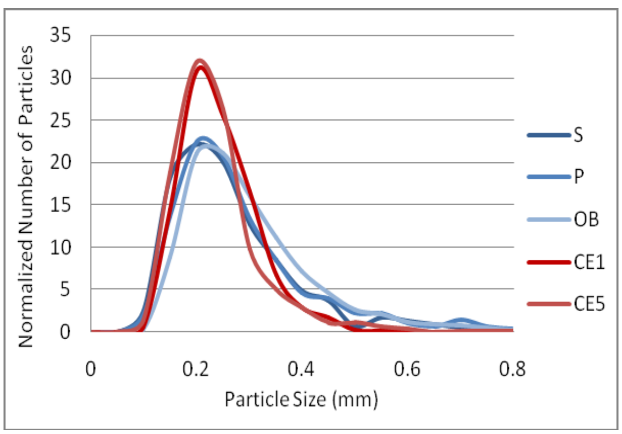

Figure 3 Particle size distributions for described samples: Sackrider, Penina, Olive Branch, Cyclops Eye1, and Cyclops Eye5

In summary, the surface layer is composed of eolian basaltic sand, covering a subsurface sulfate-rich crust composed of agglomerated angular silt-sand sized particles. The angularity of these particles indicates that they did not travel far before collecting in the crater, and the agglomeration and crustal appearance indicate that this soil was processed post-deposition, likely by hydrothermal processes or later translocation of water during wet periods, e.g., under modest snow cover.

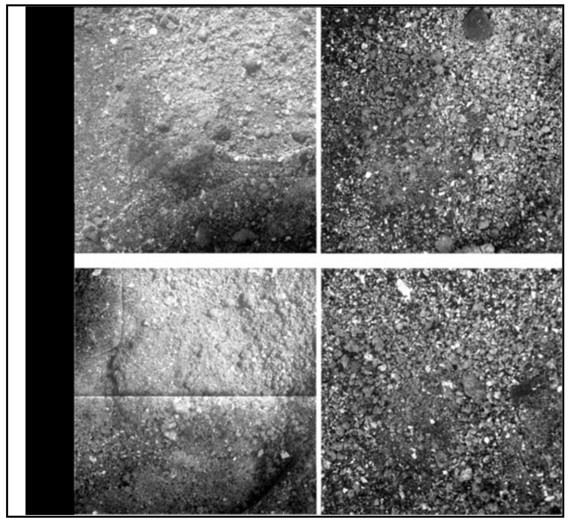

Figure 4 (A) Shows Penina1 on sols 1936 and 2024, respectively, (B) Penina2 on sols 1940 and 1986, respectively.

Temporal Differentiation: The set of MI images taken at the Penina location within Ulysses were repeated a few months after the initial images to analyze the temporal change in soil properties and composition since the initial exposure of the soil. The later images show a marked decrease in fines and agglomerated particles, leaving a mixture of larger, subangular sand particles. This physical change was accompanied by a compositional shift to more basaltic, less sulfate-enriched sand. The change likely represents a breaking of agglomerates and loss of fines due to the several wind events in the West Valley region.

References: [1] Arvidson, R. et. al. (2009), this volume.