Geophysical Research Abstracts
Vol. 15, EGU2013-1951, 2013
EGU General Assembly 2013

Initial Observations and Activities of Curiosity's Mars Hand Lens Imager (MAHLI) at the Gale Field Site

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The Mars Hand Lens Imager (MAHLI) is a 2-megapixel focusable macro lens color camera on the turret on the Mars Science Laboratory rover, Curiosity's, robotic arm. The investigation centers on stratigraphy, grain-scale texture, structure, mineralogy, and morphology. MAHLI acquires focused images at working distances of 2.1 cm to infinity; at 2.1 cm the scale is 14 μm/pixel; at 6.9 cm it is 31 μm/pixel, like the Spirit and Opportunity Microscopic Imagers (MI). Most MAHLI use during the first 100 Martian days (sols) was focused on instrument, rover, and robotic arm engineering check-outs and risk reduction, including (1) interrogation of an eolian sand shadow for suitability for scooping, decontamination of the sample collection and processing system (CHIMRA, Collection and Handling for In-Situ Martian Rock Analysis), and first solid sample delivery to the Chemistry and Mineralogy (CheMin) and Sample Analysis at Mars (SAM) instruments; (2) documentation of the nature of this sand; (3) verification that samples were delivered to SAM and passed through a 150 μm mesh and a 2 mm funnel throat in the CheMin inlet; (4) development of methods for future precision robotic arm positioning of MAHLI and the Alpha Particle X-Ray Spectrometer (APXS); and (5) use of MAHLI autofocus for range-finding to determine locations to position the scoop before each scooping event.

Most Sol 0–100 MAHLI images were obtained at scales of 31–110 μm/pixel; some geologic targets were imaged at 21–31 μm/pixel. No opportunities to position the camera close enough to obtain 14–20 μm/pixel images were available during this initial period. Only two rocks, named Jake Matijevic and Bathurst Inlet, were imaged at a resolution higher than MI. Both were dark gray and mantled with dust and fine/very fine sand. In both cases, the highest resolution images of these rocks show no obvious, indisputable grains, suggesting that grain sizes (as expressed at the rock surfaces) are < 80 μm. However, because of the dust and sand obscuration, the observables are unclear —grains 300–500 μm size in the Bathurst Inlet images and 300–500 μm-sized rhombus-shaped crystals in the rock, Jake Matijevic have been observed by some workers. Sand and granules (as well as dust), exhibiting a variety of colors, shapes, and other grain attributes, were deposited on rover hardware during descent. As noted above, sand as well as dust also mantles the rocks observed by MAHLI; in one case the cohesive properties of this material was demonstrated by the presence of a "micro landslide" on a rock named Burwash. At the Rocknest sand shadow, a variety of coarse to very coarse sand grains of differing color, shape, luster, angularity, and roundness were observed, including glassy spheroids and ellipsoids (perhaps formed from impact melt droplets) and clear, translucent grains. The fine to very fine sands sieved ($\leq$ 150 μm) and delivered to the rover's observation tray exhibited at least four distinct grain types, including clear, translucent crystal fragments.