**FIRST RESULTS OF THE ATHENA MICROSCOPIC IMAGER INVESTIGATION.**

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**Introduction:** The Athena science payload on the Mars Exploration Rovers (MER) includes the Microscopic Imager (MI). The MI is a fixed-focus camera mounted on an extendable arm, the Instrument Deployment Device (IDD). The MI acquires images at a spatial resolution of 30 microns/pixel over a broad spectral range (400 - 700 nm). The MI uses the same electronics design as the other MER cameras but its optics yield a field of view of 31 × 31 mm across a 1024 × 1024 pixel CCD image. The MI acquires images using only solar or skylight illumination of the target surface. A contact sensor is used to place the MI slightly closer to the target surface than its best focus distance (about 69 mm), allowing concave surfaces to be imaged in good focus. Coarse focusing (~ 2 mm precision) is achieved by moving the IDD away from a rock target after contact is sensed. The MI optics are protected from the Martian environment by a retractable dust cover. This cover includes a Kapton window that is tinted orange to restrict the spectral bandpass to 500 – 700 nm, allowing crude color information to be obtained by acquiring images with the cover open and closed. The MI science objectives, instrument design and calibration, operation, and data processing were described by Herkenhoff *et al*. [1]. Initial results of the MI experiment on both MER rovers ("Spirit" and "Opportunity") are described below.

**Spirit (MER-A) results:** Spirit landed in Gusev crater on January 4, 2004 (UTC) and drove onto the Martian surface on the 12th Mars day (Sol) of the landed mission. On Sol 13 the IDD was deployed and MI data were acquired for the first time. The target was a patch of soil between several pebbles and cobbles (Fig. 1). The soil in this MI image appears to consist of agglomerates of dust based on the observed texture. Grains smaller than 60 microns in diameter cannot be resolved by the MI, so dust grains cannot be measured directly.

After the initial MI imaging, the Mössbauer spectrometer was placed in the same location using its contact plate. The MI images taken after Mössbauer [2] contact (1 Newton) showed insignificant changes in surface morphology (Fig 2), indicating either that the soil is cemented or that the Mössbauer contacted nearby rocks before it contacted the soil patch observed by the MI.

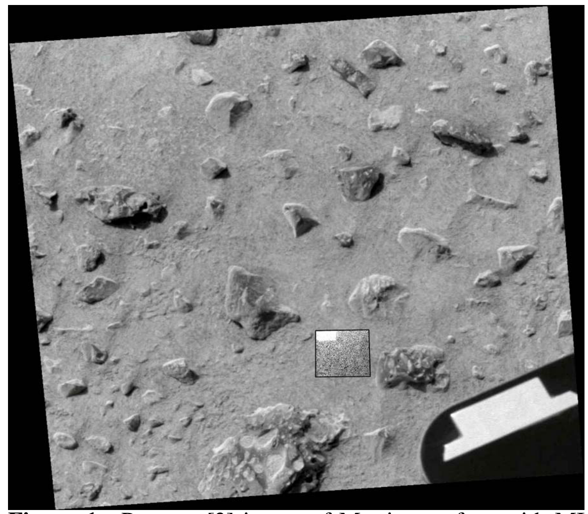

**Figure 1.** Pancam [3] image of Martian surface with MI image superposed (lower center). Pancam image resolution = 0.4 mm/pixel, frame is 0.4 m across, illumination from upper left. Edge of Spirit solar panel at lower right. Only upper left corner of MI image is illuminated directly by sunlight.

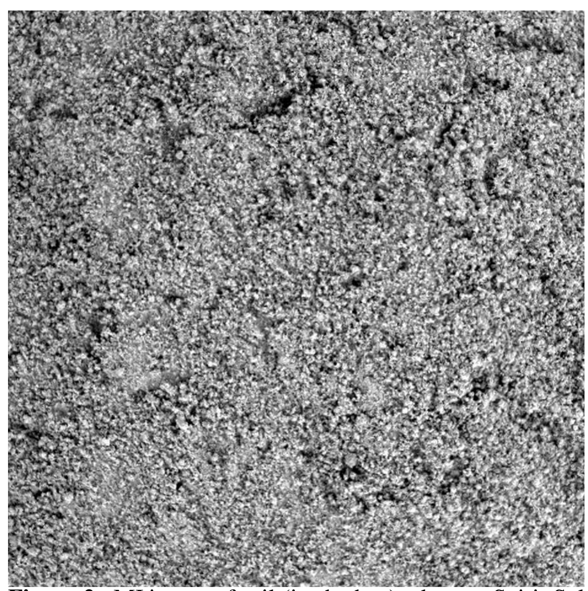

**Figure 2.** MI image of soil (in shadow) taken on Spirit Sol 15, after Mössbauer contact. Target fully shadowed by IDD during image acquisition. Field of view 3 x 3 cm.

On Sol 17, MI images were acquired of the rock dubbed "Adirondack" (Fig. 3). These images show a surface that appears to have been coated or weathered. MI data taken after RAT brushing on Sol 33 (to be presented at the meeting) show that the surface in Fig. 3 is indeed coated by a thin layer of dust.

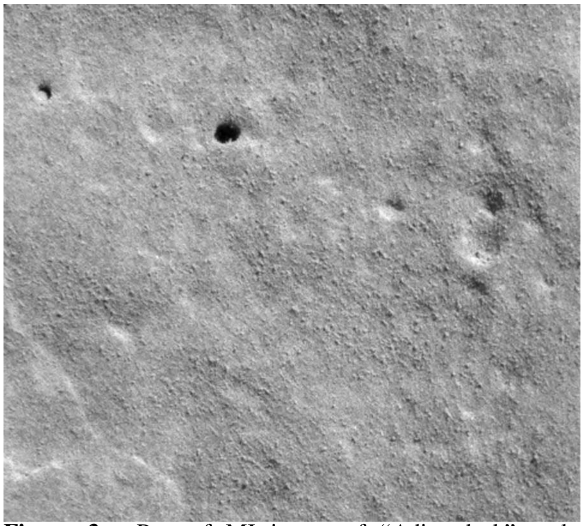

**Figure 3.** Part of MI image of "Adirondack" rock, illuminated from upper right by direct sunlight. Image is approximately 1.4 cm across.

**Opportunity (MER-B) results:** Opportunity successfully landed on Meridiani Planum on January 15, 2004 (UTC) and drove off the lander on Sol 7. The IDD was deployed for the first time onto soil on Sol 10, and MI images were acquired with the dust cover closed and open, allowing generation of the color composite in Fig. 4. The larger grains show variations in color, texture, and shape, indicating a variety of sources. The particles range in shape from spherical to subangular; the most spherical particles may be glass formed by impact or volcanism, or perhaps other types of volcanic material such as accretionary lapilli. Some grains have holes that appear to be vesicles in volcanic rock fragments or impact ejecta.

After measurements of the same soil target by the APXS and Mössbauer spectrometer, the MI observed the target again to determine how the surface was affected by the Mössbauer contact plate. As shown in Fig. 5, the plate pushed several of the larger grains into the subsurface, then the resulting voids were backfilled by the smaller grains. The larger grains do not appear to have been crushed; rather, the soil beneath them appears to be much weaker than the soil at Gusev. This observation is consistent with the apparent disappearance of granules where the Opportunity airbags contacted the surface before the lander came to rest. The smallest particles resolved in the soil images are very fine sand grains (100-250 microns), and smaller grains may be present but unresolved.

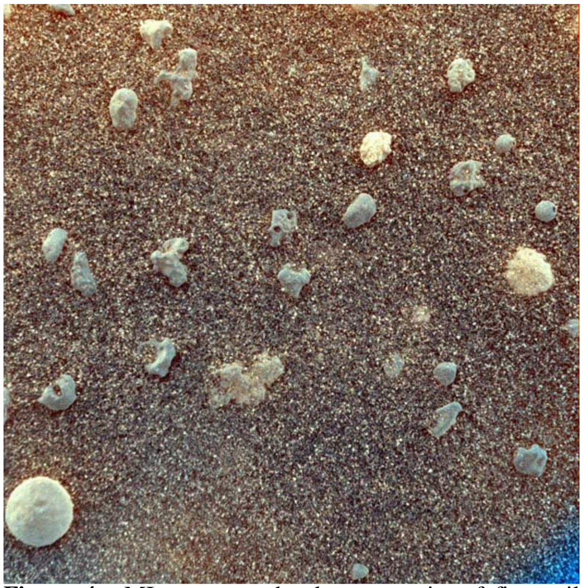

**Figure 4.** MI exaggerated color composite of first soil target at Opportunity landing site. Target in full shadow; blue tint at bottom right is processing artifact. Field of view 3 x 3 cm.

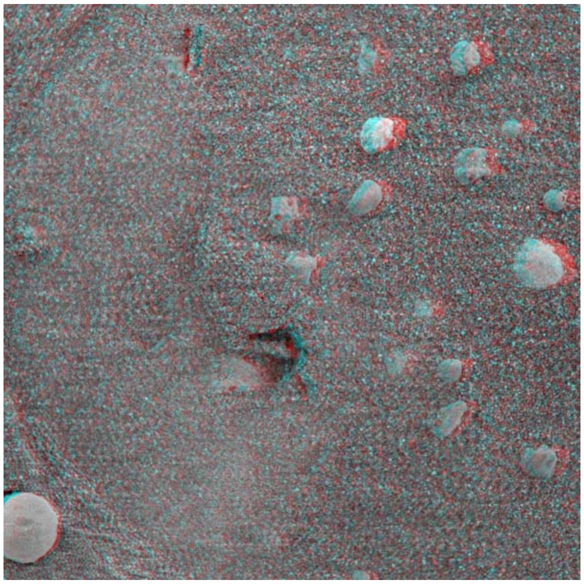

**Figure 5.** Stereo anaglyph of MI images taken multiple positions over soil target after Mössbauer contact. Images taken in full shadow. Field of view 3 x 3 cm; largest grain about 3 mm across.

**References:**

[1] Herkenhoff *et al*. (2003) *JGR, 108,* 8065, 6-1. [2] Klingelhöfer G. *et al*. (2003) *JGR 108*, 8067, 8-1. [3] Bell, J. *et al.* (2003) *JGR, 108*, 8066, 4-1.