THE NEW MARS OF MGS MOC: CRATERING AND EOLIAN HISTORY OF A SMALL INTERCRATER PLAIN IN WESTERN TERRA SIRENUM. M. C. Malin and K. S. Edgett, Malin Space Science Systems, P.O. Box 910148, San Diego, CA 92191-0148, USA.

Introduction: Typically, Mars is considered to have had a short, early history of impact cratering and vigorous surface modification, followed by a longer, more quiescent history of minor eolian modification of surface materials. Increasing the spatial resolution of images obtained from another planet can often lead to an increased sense of temporal resolution, as well. This paper describes an example in which Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) results illustrate the nature of an otherwise unknown "middle history" of a portion of the Terra Sirenum region.

Orbit 4 Image: The story begins with one of the very first high spatial resolution images obtained by the MGS MOC. The picture, shown in Figure 1, was acquired during the spacecraft's fourth orbit on 17 September 1997—just a few days after the successful orbit insertion burn. Figure 1a shows MOC image AB1-00406 (Aerobraking Phase 1, orbit 4, image 6) as it appeared upon receipt from the spacecraft. Figure 1b shows the image in an approximated orthographic projection. The picture covers a cratered, mare-ridged plain in Terra Sirenum near 30.8°S, 172.8°W. What is most striking about the image is the appearance of the impact craters—some of them cast long, late-afternoon shadows across their floors, but others do not. Which craters cast big shadows and which do not appears to be uncorrelated with size: craters of all sizes fall into both categories. In the size range illustrated here (the largest crater has a diameter of about 3.2 km), craters without shadows are clearly shallower than those with big shadows. The largest of the shallow craters in Figure 1 exhibit small bedforms on their floors (*e.g.,* Figure 1d). The fact that some of the craters are deeper and do not have such bedforms (*e.g.,* Figure 1c) must indicate that the process by which certain craters became shallow (a) predates the formation of the deeper craters, and (b) involved a material that can create bedforms. It is a reasonable supposition, based upon the scale and relationships of these forms, that these materials were wind-transported.

Eolian bedforms result from subaerial transport of granular material via saltation and traction [1], which on Mars (as on Earth) typically requires sand-sized grains [2, 3]. The interpretations that emerge from the geomorphic relationships seen in image AB1-00406 are as follows: (1) Some impact craters of diameters up to and including the largest seen in the image formed on a pre-existing ridged plain surface. (2) The formation of the initial crater population was followed by a period in which sand-sized sediment was introduced to the area, presumably by wind. (3) As windblown sand passed across the ridged plain surface, some of this material became trapped within the craters, making these craters shallower. (4) Sand that was not trapped within craters eventually passed through (and left) the area shown in image AB1-00406. (5) Meteorite impacts that post-date the passage of the windblown sand formed craters that have remained deep (*i.e.,* those with long shadows). The sand transport period occurred roughly half-way back in this area's cratering history—about as many craters are deep as are shallow.

Mapping Phase Image: The story continues with the acquisition of a subsequent, higher-resolution image of a portion of the plain seen in AB1-00406 on 17 July 1999 during the Mapping Phase of the MGS mission. Two sub-frames of MOC image M03-03172 are shown in Figure 2. The first, Figure 2a, includes a portion of one of the deep craters on the Terra Sirenum plain, whereas Figure 2b shows one of the craters with a floor partly covered by eolian bedforms. The new image confirms the interpretation that the partly-filled craters have ripple and dune patterns that are characteristic of eolian bedforms. But the image also reveals limited occurrences of bedforms on the surrounding plains, and bedforms that are banked up against the margins of the deeper crater in Figure 2a. Thus, this image suggests that after the second period in which the deep craters formed, additional wind activity created bedforms on the surrounding plains—however, since the time that the deep craters formed, sediment supply has been so low that the younger craters do not have bedforms within them.

Conclusions: Ever since it arrived in orbit, the MGS MOC has been revolutionizing our view of Mars and its past. One of the very first MOC narrow angle camera images revealed a relatively complex history involving impact cratering and ancient transport of eolian sediment across a portion of the Terra Sirenum region. Subsequent, higher-resolution imaging during the Mapping Phase has provided additional details about the post-cratering history of this location.

References: [1] Bagnold, R. A. (1941) *The Physics of Blown Sand and Desert Dunes*, Methuen, London. [2] Iversen, J. D. and B. R. White (1982) *Sedimentology, 29*, 111–119. [3] Edgett, K. S. and P. R. Christensen (1991) *JGR, 96*, 22765–22776.

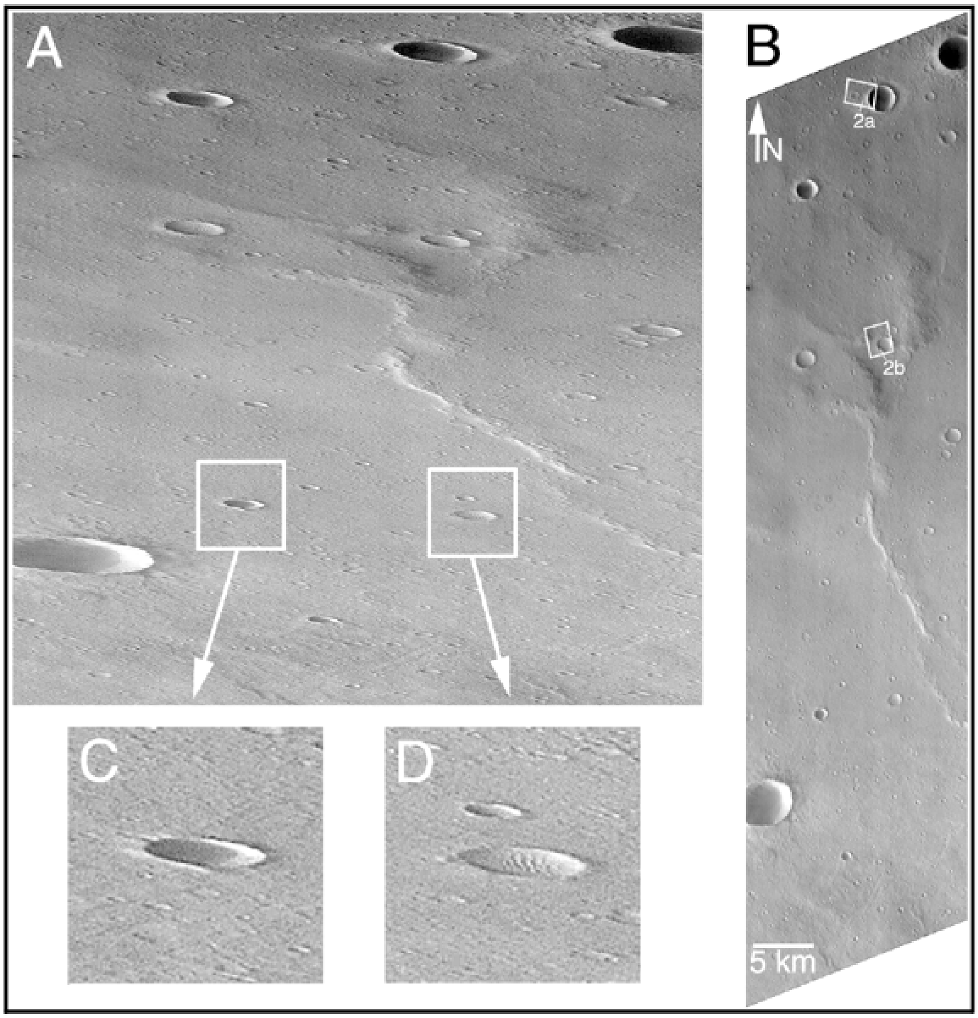

Figure 1. MOC image AB1-00406. See text for description. Boxes 2a and 2b on right indicate the location of pictures in Figure 2, below. Illumination is from the left.

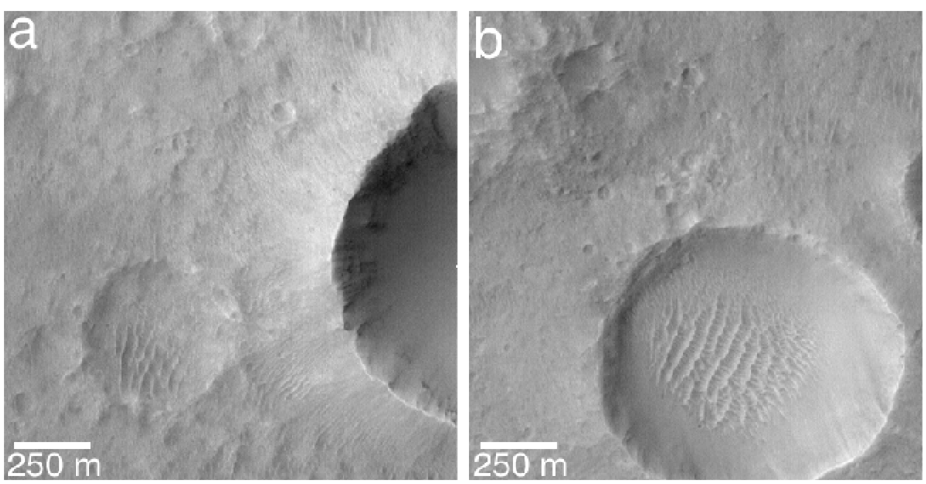

Figure 2. Two sub-frames of MOC image M03-3172, providing higher-resolution views of the craters, bedforms, and plains seen in AB1-00406. Illumination is from the left.