CRATER MODIFICATION PROCESSES IN THE AEOLIS REGION OF MARS. Robert A. Craddock[1], Veronique Ansan[2], Alan D. Howard[3], and Nicolas Mangold[2], [1]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, DC 20560-0315 (craddockb@si.edu), [2]Lab. IDES-CNRS, bât. 509, CNRS and Université Paris-Sud, 91405 ORSAY, France (veronique.ansan@u-psud.fr, nicolas.mangold@u-psud.fr), [3]Department of Environmental Sciences, University of Virginia, P.O. Box 400123, Charlottesville, VA 22904-4123 (ah6p@virginia.edu).

Introduction: Results from the early Mariner missions indicated that there is a population of modified impact craters on Mars that is morphologically distinct from "fresh craters" possessing a sharp, raised rim, obvious ejecta deposits, and central peak or pit [1]. Although some early investigators suggested that aggradational processes, such as eolian blanketing or lava inundation, were involved [e.g., 2, 3], erosional processes best explain the morphology of modified impact craters, their temporal and spatial relationships with valley networks, and the size range of affected craters [4, 5, 6, 7]. Impact craters have fairly simple, geometric shapes that easily lend themselves to both qualitative and quantitative analyses. Impact craters have also formed throughout the entire history of Mars. By carefully analyzing the geology and physical structure of fresh and modified impact craters in the highlands, our goal is to deconvolve the types and intensity of geologic processes that have operated through time on Mars. While similar analyses have been undertaken from Mariner and Viking orbiter data, our understanding of the geologic history contained in the record of modified impact craters is, at best, crude. High-resolution imagery from Mars Global Surveyor (MGS), Mars Odyssey (MO), and Mars Express (MEX) provide unprecedented details of not only the fluvial processes that extensively modified impact craters early in martian history [e.g., 6], but also information about the subsequent processes that have operated on Mars since the mid-Hesperian. Mars Orbiter Laser Altimetry (MOLA) and High-Resolution Stereo Camera (HRSC) topographic data also provide detailed morphometric information about modified crater shape, which is necessary for estimating the amount of erosion that has occurred. Such information can provide important information for determining erosion rates as well as an assessment of how intense these processes operated.

Aeolis Region: We have begun a study to explore where modifications processes operated on Mars, how the importance of these processes changed by location and geologic unit, and how the intensity of highland modification changed through time. Our pilot study focuses on the Aeolis region, which has a distinct population of modified impact craters that are flat-floored with steep interior walls (Fig. 1). Typically the intercrater plains are etched or contain dense concentrations of valley networks (Fig. 2). Released HRSC data also provide stereo coverage for portions of this region, and using techniques described in [8] we can create a high-resolution digital elevation model (DEM) to support our quantitative analyses.

General Observations: Imagery and topographic data indicate that most of the craters in the Aeolis region lack an appreciable rim regardless of the crater diameter (Fig. 1). This suggests that most of the craters are in the terminal stage of erosion [6, 7], which indicates that modification processes operated very intensely or that, perhaps, the surface material is more friable or easily weathered and eroded. Because the efficiency of many erosional processes should decrease with increasing crater diameters (i.e., scale), the preservation of smaller craters also suggests that the modification processes were long-lived within this region. Basically, smaller craters should erode more quickly, so they must be constantly added to the population before they are completely eradicated, and this requires time. Generally the morphometry of all the modified craters we observed so far shows that the interior walls dip fairly steeply (~20°) and terminate at a sharp angle with the crater floor (Fig. 1). These observations are consistent with craters modified extensively by surface runoff [6, 7].

Subsequent processes: Interestingly many modified craters within the same area have comparable depths (crater profiles in Fig. 1). Such elevational controls may in part pre-date crater modification suggesting that surface lithology initially controlled the general crater shape. However, fresh impact craters that formed after modification ceased show a depth/diameter relationship that is consistent with the rest of the planet [9]. Alternatively, the craters may have been infilled to a common elevation, which might be possible by eolian deposition or lava infilling similar to the formation of the lunar maria [10]. High resolution images show that while eolian infilling is common, it appears not to be very deep. Rather, there is evidence for light-toned materials within some craters, which may be indicative of lacustrine infilling.

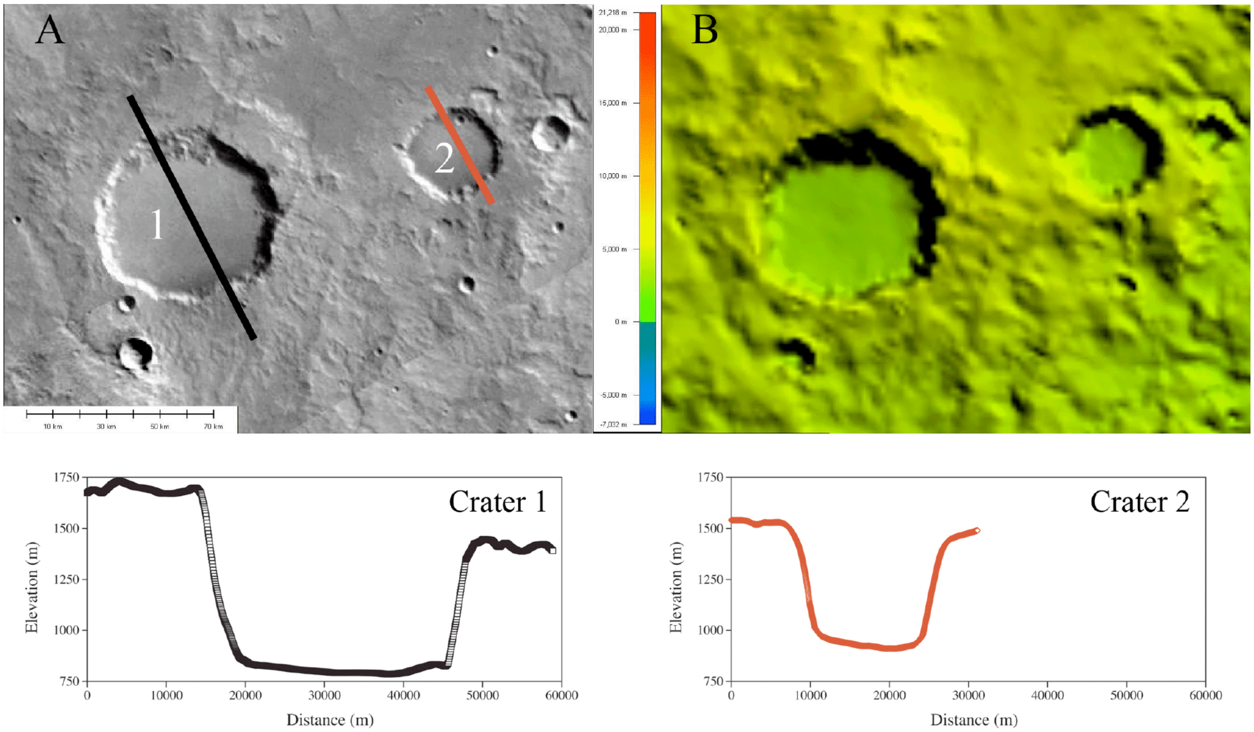

Figure 1. Examples of modified impact craters in the Aeolis region. (A) Two craters of different sizes are at the same general stage of modification centered at roughly 21° S., 157° E. Note the lack of an appreciable rim, a flat floor, and the steep interior slopes. The scale bar to the bottom left is 70 km across. The numbers refere to the crater profiles presented at the bottom of the figure. (B) The 1/64 degree/pixel MOLA data used to generate the crater profiles. Note the rugged intercrater plains that are apparent even in the topographic data. The elevation values for the Aeolis region range from a low of -7.032 m to a maximum of 21,218 m. Most elevation values center around 1,000-2,000 m in the small area presented here. Also note that despite being nearly half as large crater 2 is almost as deep as crater 1.

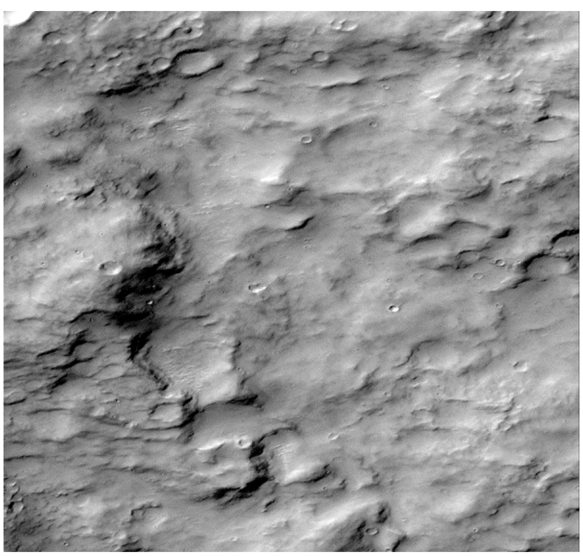

Figure 2. Intercrater plains are typical rough throughout most of the Aeolis region suggesting that the area has been subjected to intense weathering and erosion. This image is 2.91 km across with a resolution of 1.42 m/pixel. (*MOC image M0100107.*)

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