SOME INSIGHTS ON GULLY MORPHOLOGY AND FORMATION ON MARS FROM HIRISE . V.C. Gulick[1], A. Davatzes, K. Kolb[2] and the HiRISE team. [1] NASA Ames/SETI Institute, MS 239-20, NASA Ames Research Center, Moffett Field, CA 94035, (email: vgulick@mail.arc.nasa.gov), [2] LPL, University of Arizona, Tucson, AZ.

Introduction: The surface of Mars has been extensively modified at all scales by fluvial processes. The High Resolution Imaging Science Experiment (HiRISE) camera onboard the Mars Reconnaissance Orbiter is extending our understanding of these features to scales more familiar to a terrestrial geologists. Here we briefly summarize some of the fluvial observations of gullies in HiRISE images obtained so far.

Gullies: Some of the most spectacular HiRISE images have been of gullies formed on the interior slopes of impact craters and elsewhere. Additional observations of gully morphology in various locations on Mars has provided insight to formation mechanisms involved. Notable features seen in the images include theater heads in some cases, multiple elevations for source regions (Figure 1), source regions originating from more resistant layers (Figure 2), as well as source regions originating from more nondescript regions (Figure 1). Braiding and anastomosing of middle reaches is common where the slope flattens, and deposition and dissection of overlapping alluvial fans in distal reaches. Stream channel features are detectable, including what appear to be channel bars, stream terraces and erosion into the underlying surfaces.

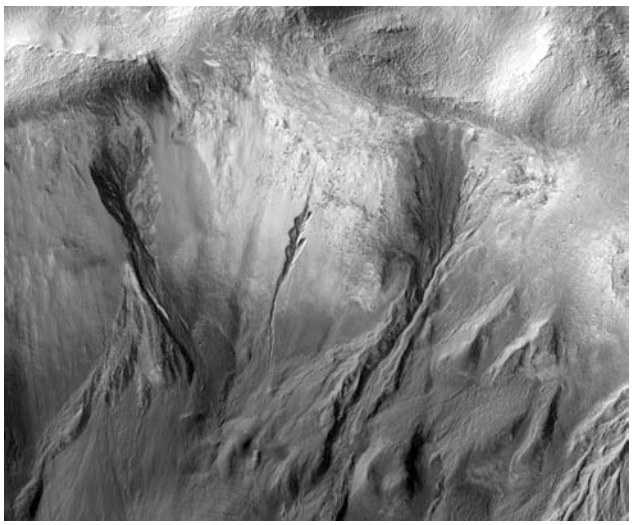

Figure 1 (a) A portion of HiRISE image PSP_1712_1405 showing gullies exhibiting sapping and runoff morphology with sources at various elevations.
(b) Close-up of the gully system in the center of image (a) theater-headed tributaries with inner channels and infalling debris. Bright material is frost.

Figure 1 shows an interesting example of gullies exhibiting both runoff-dominated and sapping-dominated morphology that are physically adjacent to each other in the same geological setting. The gully system on the right exhibits more of a runoff-dominated morphology. The center smaller gully system that sources lower in elevation displays theater-headed tributaries and interior channels within the gully. This morphology suggests that sapping was important in the formation of this particular gully system. Large boulders and debris that have fallen into the gully have partially obscured the interior channel. The gully system on the left appears to have a more mixed runoff and sapping morphology, a combination that is also observed in terrestrial fluvial systems. It is interesting that the source of his gully system is higher than the adjacent sapping-dominated system, but lower than the runoff-dominated system on the right.

HiRISE has also imaged the new bright gully deposits that have appeared within the last few years [1, 2-5,. In addition, HiRISE has also identified several other gully systems with bright fan deposits [2-5]]. In each case so far, we have found that the gully sources seem to contain bright layered deposits. Adjacent areas that do not source in these deposits do not seem to exhibit bright gully deposits. Gullies in the Noachis Terra region provide an example (Figure 2). The source region of the gullies in Figure 2 consists of alternating bright and dark layers. The bright deposits on the fans may arise simply from the redeposition of the bright layered material. The bright deposit may fade in time due to eolian mantling or removal. In addition, small exposures of bright deposits are seen elsewhere upslope suggesting that these bright deposits may also underlie surface materials. Fluid flows may have eroded and transported this bright material and deposited it at the surface. The source region of these gullies in Noachis Terra may also provide additional clues to how they might have formed. Gully heads have undercut and eroded through the alternating bright and dark layered region. Chains of pits and partially collapsed troughs in the mantled unit above suggest that underlying material was removed and trans-

ported through the gully system suggesting that piping was important in the formation of this gully system.

References: [1] Malin, M.C. et al. (2006) Science 314, 1573. **[2]** Kolb et al., LPSC 2007, abstract # 1391. **[3]** Gulick et al., LPSC 2007, [4] Kolb et al., this conf., [5]McEwen et al, submitted to Science.

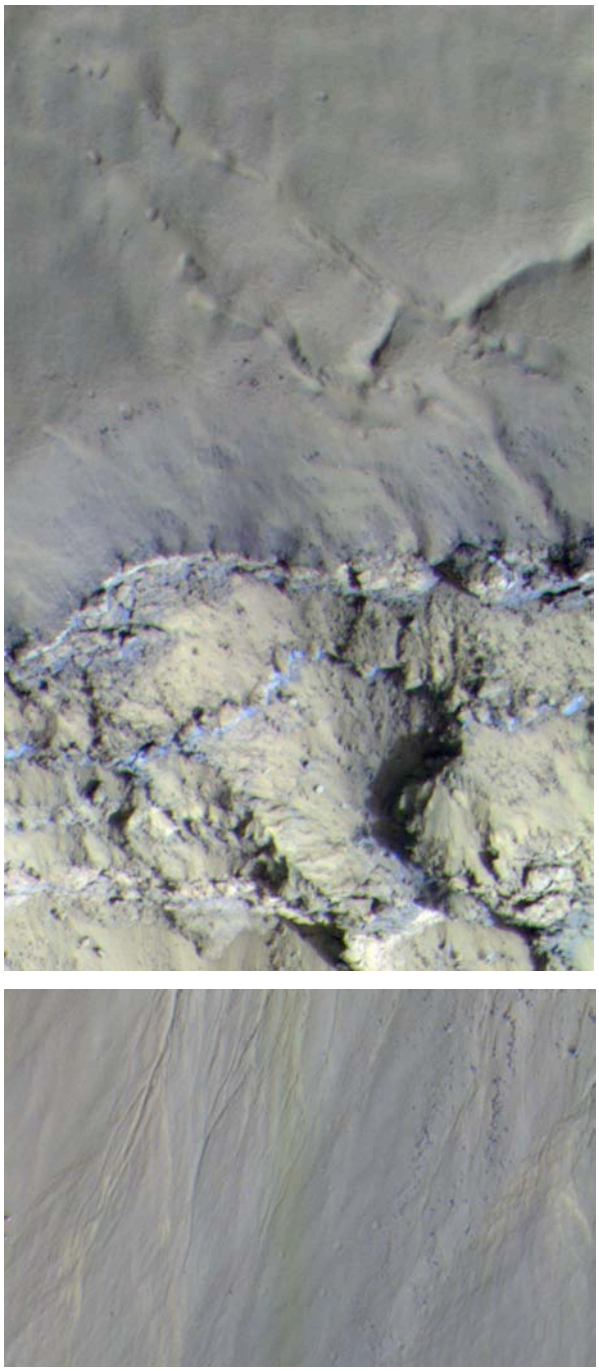

Figure 2: Gully systems in the Noachis Terra region. (a) Piping along mantle and upper-lying units has resulted in small chains of pits along troughs in the mantled unit. This suggests that groundwater flowing in a perched aquifer perhaps from near surface melting along fractures caused piping which likely contributed at least in part to gully formation. (b) Close-up of bright fan deposits in some of the Noachis Terra gullies.