MRO's HiRISE COVERAGE OF FLUVIAL LANDFORMS ON MARS DURING ITS PRIMARY SCIENCE PHASE. V.C. Gulick [1] and A.E.K. Davatzes [2]. [1]NASA Ames/SETI Institute, NASA Ames Research Center, MS 239-20, Moffett Field, CA 94035, [2] Temple University Department of Earth and Environmental Science, Beury 315A; 1901 N. 13th St., Philadelphia, PA 19122 .

Introduction: The Mars Reconnaissance Orbiter's High-Resolution Imaging Science Experiment completed its primary science phase (lasting one Mars year) in November 2008. By the end of the primary science phase, the HiRISE camera completed 9549 observations for a total of approximately 8 Terabytes of data. These observations cover an area close to 938,000 km^2 or approximately 0.6% of the surface of Mars. This area is nearly as large as the area of Egypt or the combined areas of California, Oregeon and Nevada. During this time HiRISE targeted suggestions from 16 different science themes in addition to suggestions for future landing sites, and student suggestions. Of the completed observations, approximately 840 observations of valleys (e.g., large valley systems, valley networks, longitudinal valleys and slope valleys) approximately 424 observations of channels, and approximately 644 observations of gullies have been obtained (Figure 1).

Outflow Channels: Several hundred images of the outflow channels on Mars have been collected to date from HiRISE, as well as coordinated images with CTX and CRISM. Depositional features, such as slackwater deposits and small bedforms that are expected to be visible at the resolution of HiRISE have not yet been observed, largely due to post-fluvial modification of the channels. Many of the channels have been subsequently covered by a thin layer of lava, ash, dust, or lineated valley fill.

Although altered slightly by later aeolian modification, Ares Valles and Kasei Valles preserve much of the original fluvial erosional forms, particularly cataracts and longitudinal grooves that can be used to infer the mechanics of the flow. Cataracts, steep knickpoints in the large outflow channels, were once large waterfalls on the Martian surface. These have been observed in all of the larger outflow systems, including Kasai, Athabasca, Mangala, and Reull Valles.

High resolution imaging shows that most of the cataract systems that we have imaged so far appear to have multiple generations of erosion, with smaller subchannels within the cataract system [1]. Based on the length of the recession and the morphological evidence most of the large channels experienced multiple flooding events or pulses. Other erosional landforms are present as well in the outflow channels including flute casts, potholes, scour marks, scour pits and small, interior channels within the main channel system. The tectonically sourced outflow channels, such as Athabasca and Mangala Valles, show sourcing at regions of complex fault geometries, specifically at fault relays. In terrestrial systems, relays tend to be regions of concentrated stress that can produce dilation manifested as high joint density, as well as point sources for hydrothermal outflow on Earth. Athabasca and Mangala Valles, sourced proximal to large volcanic centers, may have been regions of major hydrothermal activity in the past.

Valley networks: Like the ouflow channels, the parts of the valley systems imaged to date have largely been modified by post-fluvial processes including infill by volcanic, aeolian, mass wasting, colluvial, and periglacial and probably glacial processes. As with the outflow channels, erosional features are present in some, channel bedforms and deposits are largely absent. Many valleys (as well as surrounding impact craters) are filled by aeolian transported material, as indicated by the formation of dunes along the floors of these fluvial landforms. The valley networks and channels themselves may have provided an additional source material for the fine-grained infill material. Dunes are frequently found on the floors of valleys and channels, but often not on the adjacent surrounding plains. One possibility is that fine-grained material forming these dunes may be a combination of aeolian infill and reworked fluvial deposits.

Gully systems: Another high priority target for HiRISE has been the intriguing, relatively young gully features. HiRISE has sampled a variety of gully types around the planet at all latitudes. Gullies are located in a variety of locales in both North and South hemispheres including the slopes and central peaks of some impact craters, valley walls, and in some mid to high latitude dune fields. However, they appear to be most developed in the mid to higher latitude regions.

Some of our imaging has focused on a few study areas to systematically understand gully formation in a single environment. One of these study areas is the Noachis ring trough (or eroded pit crater) in the southern highlands (47S, 5E). Gullies are located around much of the perimeter of the ring-shaped depression as well as along the interior walls of the central plateau and within the innermost central pit. Debris aprons from those gullies found along the walls of the central pit overlap and coalesce on the floor. Channel forms are located on the debris aprons.

We have also begun to focus on the occasional occurrence of apparent frost in the vicinity of some very pristine gullies. In some cases frost blankets entire gully forming regions and does not appear to be specifically associated with gullies. However in other cases frost preferentially seems to be associated with gullies, their deposits, and their immediate vicinities. In at least one case in Noachis (Figure 2) simultaneous CRISM observations confirm the presence of water and/or carbon dioxide frosts or ice. In this locale nearby, less pristine appearing gullies are not blanketed with frost (Figure 3). One possible interpretation for the wispy frosts found adjacent to the pristine gully (Figure 2) is that water flowing though an active gully system has evaporated and then been cold trapped onto the surface in the immediate vicinity of the gully. Another possibility is that gully formation depends upon the local appearance of frosts which in turn are controlled by specific local conditions, such as illumination, ground albedo, thermal inertia, or other conditions. It is also possible that gully formation itself is unrelated to frost but the gullies produce local conditions favorable for frost formation. We will discuss these and other possible implications of the frost associations with gully forms. One of our emphasis in the extended science phase will be to obtain repeat and seasonal coverage of several promising gully sites.

References: [1] Davatzes and Gulick (2008), *Eos Trans. AGU, 89*(53), Fall Meet. Suppl., Abstract P34A-06. [2] Gulick and Davatzes (2008), *Eos Trans. AGU, 89*(53), Fall Meet. Suppl., Abstract P34A-01.

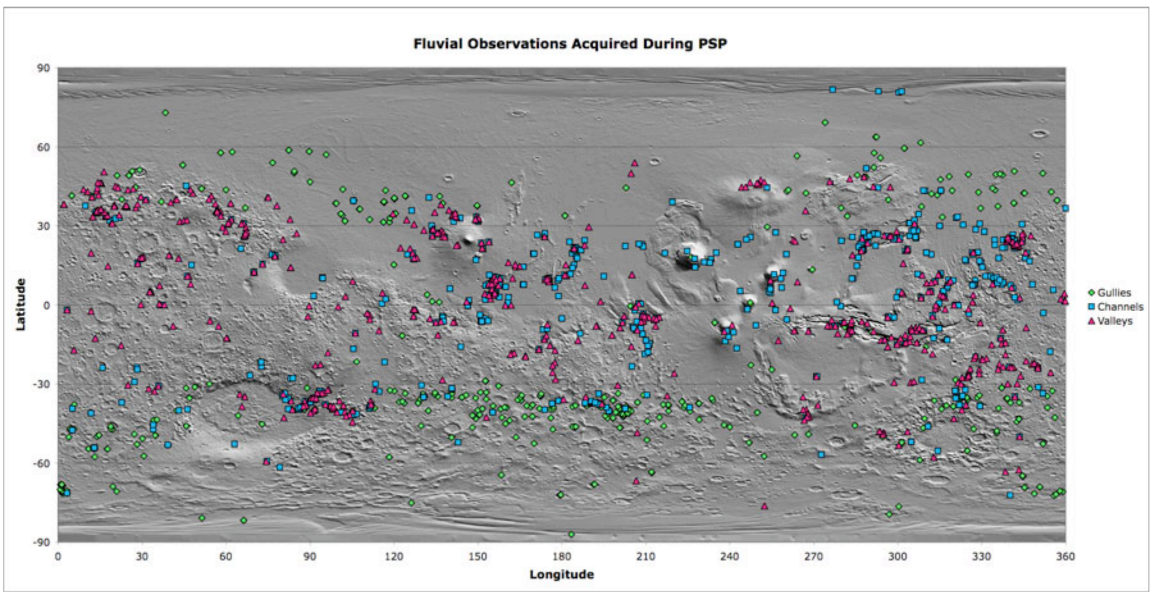

Figure 1: HiRISE Observations of Fluvial Landforms.

Figure 2: Southwestern slope of Noachis ring trough. Dark floored gully with wispy frost deposits along margins.

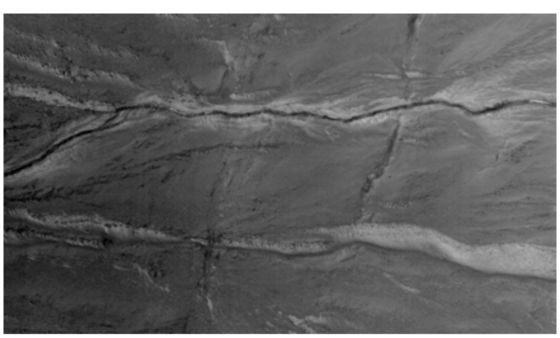

Figure 3: Gullies just to the south of wispy gully in figure 2 with no frost.