OBSERVATIONS OF PRESENT-DAY GULLY ACTIVITY ON MARS. Colin M. Dundas[1], Serina Diniega[2], Alfred S. McEwen[1] and Shane Byrne[1], [1]The University of Arizona, Lunar and Planetary Laboratory, 1541 E. University Blvd., Tucson, AZ 85721 (email: colind@lpl.arizona.edu), [2]Jet Propulsion Laboratory, Pasadena, CA.

Introduction: Recent gullies on Mars, first reported by [1], have been much discussed since most theories of their origin involve liquid water. Theories include groundwater breakouts [1], melting of snow deposited in previous climates at high obliquity [2] and melting of near-surface ground ice [3]. Alternate possibilities include dry granular flow [4] or several CO_2-driven processes [5-8].

With over a decade of high-resolution spacecraft observations, it has been possible to not only analyze gully morphology but also to look for changes in existing gullies. Mars Orbiter Camera (MOC) observations provided two examples of light-toned new deposits associated with gullies, which were suggested as evidence for groundwater release [9]. More recently, additional new deposits have been observed, with a tendency for activity to occur in fall or winter [10-12]. Activity has been observed in association with both classic crater-wall gullies and with dune gullies of similar morphology. Linear gullies in the Russell Crater dune field have also been reported to be active in early spring [13]. In this abstract we report on ongoing observations of gully activity from the High Resolution Imaging Science Experiment (HiRISE) camera, particularly morphological changes in crater-wall gullies.

Observations: Starting during the Martian southern-hemisphere fall and winter of 2010, several recently active gullies were repeatedly imaged to look for new activity. At the time of writing, new changes have been observed at two of the non-dune gully sites. Monitoring of dune gullies is discussed by [14].

Gasa Crater (35.7° S, 129.4° E) is a young impact crater, formed ~1.25 Ma [15]. Previously, two new gully deposits in the crater with topographic changes were reported by [10]. Over the period of observations, dark deposits appeared in shadow in association with two gullies. One appeared between L_s 65-109, and a second between L_s 109-152. A recent well-illuminated image shows little or no albedo contrast over the shadowed deposits; however, substantial topographic changes are seen in one (Fig. 1). Changes include apparent channel widening as well as deposition of multiple large lobate toes suggesting flow of material with yield strength. An additional bright deposit is also seen.

A small crater at 38.9° S, 223.7° E was also monitored. This site showed distinct frost on the gullied slope, and developed dark patches suggestive of CO_2 sublimation activity as well as lineations within frosted gully alcoves. A small dark deposit developed on one gully apron between L_s 136-158. Possible small topographic changes are seen in association with this deposit, including possible channel incision.

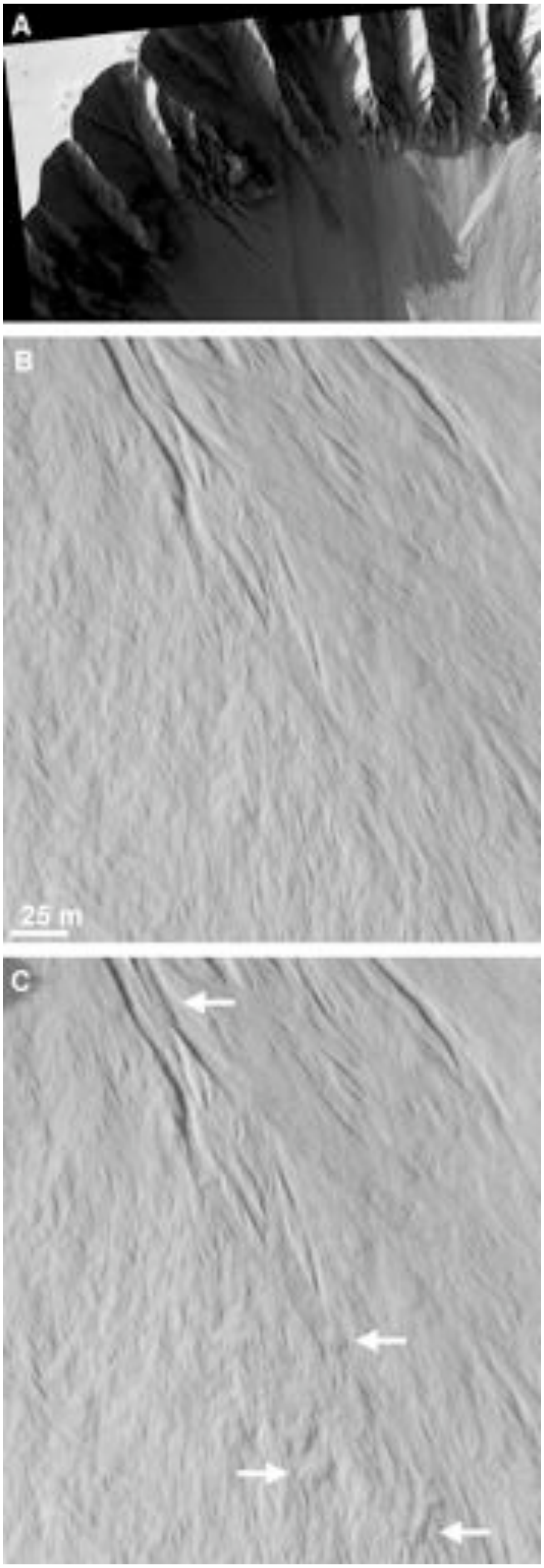
In addition to these systematic monitoring sites, we are also surveying HiRISE gully observations where repeat coverage was acquired with a long time baseline. In our previous work [10] we surveyed distinct bright or dark deposits which were the most readily observed changes; here we also look for changes at sites with no obvious deposit with distinct albedo and use extensive subsequent repeat coverage. Morphological changes have been observed in gullies at two sites. Both are on crater walls (40.8° S, 200.3° E and 41.1° S, 203.5° E) which appear to have a coating of sand and have linear gullies resembling those in the Russell Crater dunes. Both sites show substantial changes such as formation of meters-wide, decameters-long channels and terminal pits (Fig. 2).

Some gully activity involves appearance of multiple dark deposits in shadow, which leave no obvious change in brightness or topography when well-illuminated. It is unclear whether this indicates a different form of activity.

Discussion: Dune gullies observed over the same time period show extensive morphological changes, including formation of new alcoves and large channels [14]. The similar timing of activity in dune and non-dune gullies, and the similar morphology of many of the gullies, suggests that the controlling processes are closely related. Division into dune and non-dune gullies may be a distinction of less importance than morphological variations between gullies. The more extensive morphological changes seen in dune gullies may simply be a result of a non-cohesive sand substrate.

The gully activity reported here and in [14] is consistent with a preference for fall and winter gully activity. Seasonal influence suggests that volatiles play a role in current gully activity and makes it unlikely that current changes are all simply dry mass wasting.

The nature and extent of changes seen in present-day gullies suggests that gully formation is ongoing. Current processes do more than simply degrade existing gullies; not only is material falling from alcoves to aprons, channel incision is occurring in the present climate. Additional processes could contribute to gully activity under different climate regimes at high obliquity, but if present-day processes are sufficient then such variations may be less important.



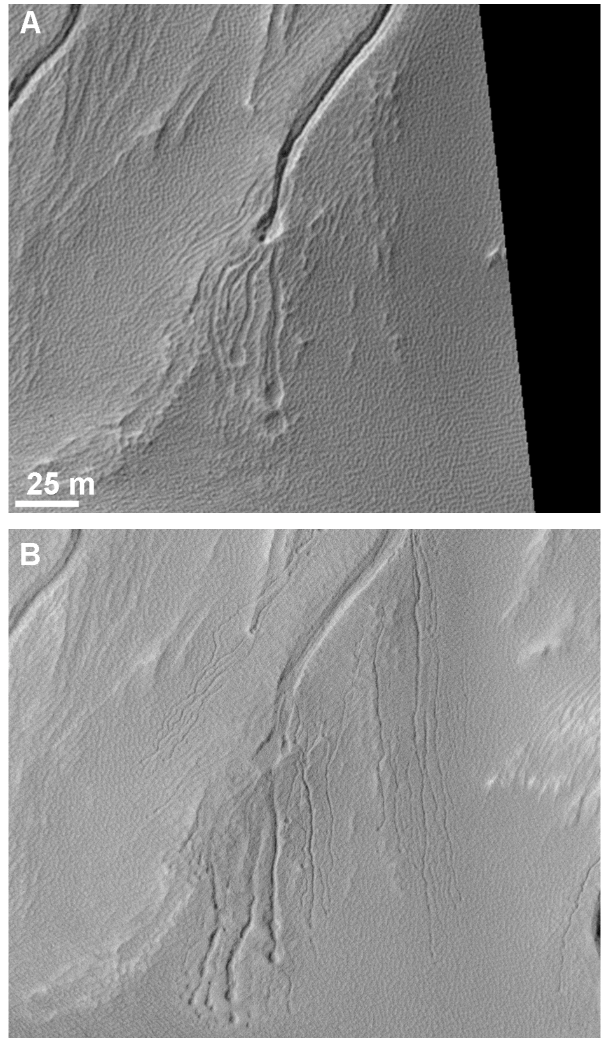


Figure 1 (left): A) New dark deposit visible in shadow, ESP_019461_1440. B) Full resolution near toe of deposit site, ESP_012024_1440. C) Post-deposition, ESP_020661_1440. Arrows indicate largest of many topographic changes.
Figure 2 (above): New channels and pits. A) PSP_001697_1390. B) ESP_012206_1390.

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