AN UPDATE ON ORIENTATION ASSESSMENT FOR SOUTHERN HEMISPHERE GULLIES.

R. M. E. Williams[1], [1]Planetary Science Institute, 1700 E. Fort Lowell, Suite 106, Tucson, AZ 85719, williams@psi.edu.

Introduction: The purpose of this study is to use decameter-scale resolution THEMIS VIS data to characterize the orientation of martian gullies. This abstract provides an update on results reported in [1] based on new sum 1 THEMIS VIS data collected in the last year of known locations of gullies in southern hemisphere craters.

Gully Orientation: Small-scale features resembling terrestrial water-carved gullies first observed in Mars Orbiter Camera (MOC) narrow-angle images at middle and high latitudes were originally reported to have preferentially pole-facing orientations within craters [2]. This observation is fundamental to certain gully formation hypotheses (notably snow melt, e.g. [3-8]), but is based on data that sampled only a portion of the crater. One objective of this investigation is to re-assess gully orientation using data that surveys >75% of the crater to eliminate sample bias. The presence or absence of gullies is recorded for eight 45° sectors. Gullies located on the northwest, north, or northeast wall are classified as pole-facing; gullies on the southwest, south, or southeast walls are termed equator-facing.

THEMIS VIS sum 1 (18 m/pix) images are a dataset that can address this goal as the resolution is sufficient to observe gullies and the footprint size (width of 18 km, variable downtrack length) can cover many craters with gullies in 1 or 2 images. Due to the orbit of Odyssey, THEMIS images of middle latitude gullies are only possible during spring, summer and fall seasons. Prior work concentrated on existing THEMIS VIS sum 1 images that covered >75% of mid-latitude craters with gullies [1]. In addition, 128 region of interest (ROI) sites were identified where new THEMIS VIS images would provide near complete or total coverage of southern hemisphere craters with gullies. As of December 2006, the majority (>70%) of these ROI's have yielded new data. Sixty-seven new southern hemisphere gully sites now have sufficient THEMIS VIS coverage to include in the survey of gully orientation. When this data is combined with prior results [1], the gully orientation database has entries for over one third of southern hemisphere crater gully sites (152/407).

The new data reinforces the trends reported in [1] (Figure 1). Overall, gullies in southern hemisphere craters were observed nearly three times more often on northern crater walls (pole-facing) than on their southern, equator-facing counterparts. The data was subdivided into latitude bins [lower (30-40° S), central (40-50° S) and higher (50-65° S) mid-latitudes] to further explore the relationship between latitude and gully orientation. Gully orientation varied in these latitude bins. In the lower mid-latitudes, pole-facing slope orientation is dominant with a seven-fold increase in the occurrence of gullies on northern crater walls relative to the southern crater walls. The center latitude bin shows a similar effect, but to a lesser degree with pole-facing orientations occurring twice as often as equator-facing orientations. However, at the high mid-latitudes, the occurrence of gullies on the northern and southern crater walls occurs with the same frequency and no preference in orientation is observed.

The data was also categorized on a per-site basis to assess if the trends observed overall were representative. At each location, gully occurrence was classified in one of the following categories: a) present on both north (NE, N, and NW) and south (SE, S, and SW) crater walls, b) only pole-facing orientations, c) only equator-facing orientations, or d) present only on east and/or west crater walls. In this analysis, the latitudinal dependence of gully orientation is very evident (Figure 2). In the lower mid-latitudes, pole-facing orientations dominate. However, in the central mid-latitudes pole-facing orientations occur at a comparable frequency to those that occur on both north and south crater walls. At the highest latitudes, multiple orientations for gullies (i.e. present on northern and southern crater walls) are most common.

Discussion: Examination of THEMIS VIS images of gully sites shows that the frequency of pole-facing orientations varies with latitude and that this orientation is most commonly observed in the lower mid-latitudes. At high mid-latitudes (>50 degrees south) and in the northern mid-latitudes (30-50 degrees), there is no observed preference to gully orientation.

These observations suggest that the formation of gullies is dependent on a number of factors and these factors may vary by location. For example, solar insolation, dust content in snow, and attributes of the geologic setting (i.e. rock permeability, aquifer geometry, etc.) are all variables that can influence gully orientation. Gullies are likely polygenetic landforms with different formation scenarios yielding an array of similar landforms. This hypothesis can be investigated by distinguishing gully types based on morphology.

References: [1] Williams, R. M. E. (2007) *LPSC XXXVIII*, Abstract No. 1739. [2] Malin M. C. and Edgett K. S. (2000) *Science*, *288*, 2330-2335. [3] Christensen P. R. (2003) *Nature*, *422*, 45– 48. [4] Costard F. F. et al. (2002) *Science*, *295*, 110-113. [5] Hartmann W. K. et al. (2003) *Icarus*, *162*, 259-277. [6] Gilmore M. S. and Phillips E. L. (2002) *Geology*, *30*, 1107-1110. [7] Lee P. et al. (2002) *LPS XXXIII*, Abstract #2050. [8] Berman D. C. et al. (2005) *Icarus*, 178, 465-486. [9] Malin M. C. and Edgett K. S. (2000) *Science*, *288*, 2330-2335. [10] McEwen, A. S., et al., (2007) *Science*, *317*, 1706-1709.

Acknowledgement: This work supported by the National Aeronautics and Space Administration 2001 Mars Odyssey Participating Scientist program under JPL contract #1282362 awarded to R. Williams.

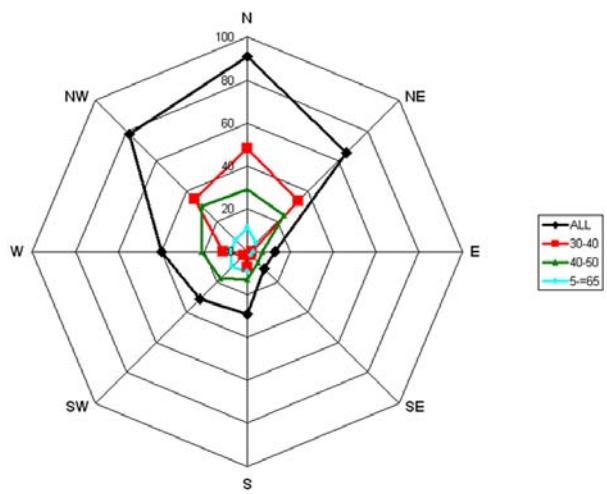

Figure 1: Orientation of gullies in southern middle latitude craters reported as the number of cases of gullies observed in each azimuth bin. Number of observations for each case is denoted in parentheses. All (152), 30 – 40° S (68), 40 – 50° S (58), 50 - 65° S (26).

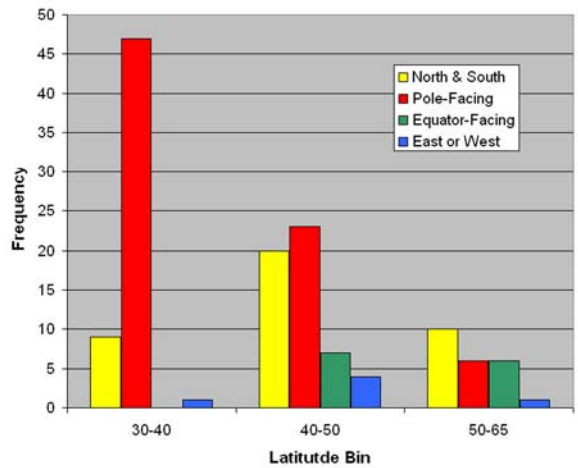

Figure 2: Histogram of gully locations categorized for each crater site.