# GEOSPATIAL CLASSIFICATION OF TRANSVERSE AEOLIAN RIDGES ON MARS [#1137]

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## Introduction

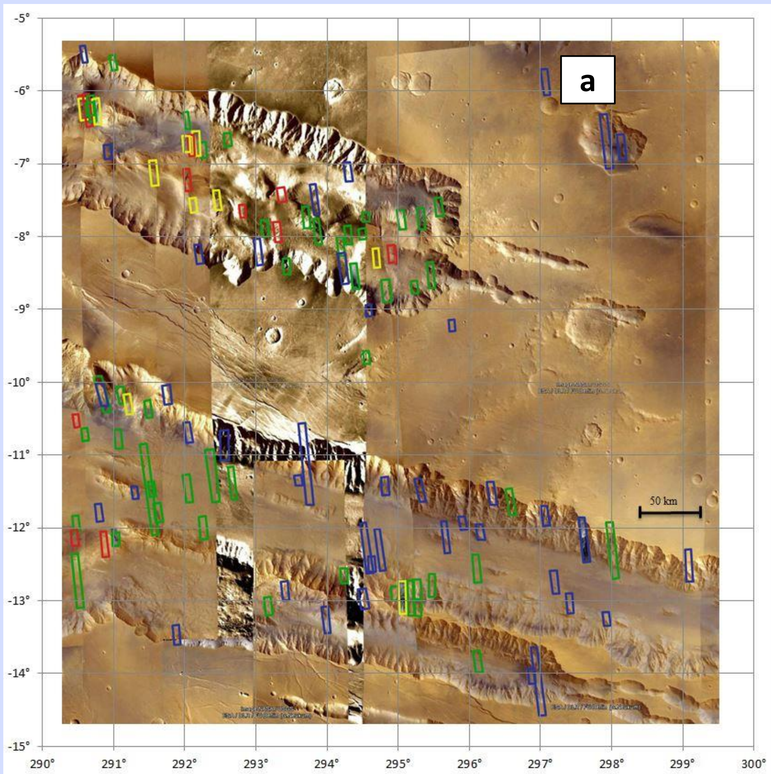
Small ripple-like aeolian bedforms, known as Transverse Aeolian Ridges (TARs) are widespread on the martain surface. It is unknown whether the features are large ripples or small dunes [1,2]. Our analysis of HiRISE images at two longitudes leads us to propose that TARs are not homogenously distributed on Mars

We have geospatially mapped TARs within two pole-to-pole swaths and come to the conclusion that TARs are controlled by local geology, elevation, and latitude.

## Methodology

Two pole-to-pole swaths – 290°E-300°E and 240°E-250°E – were chosen for examination:

- Swaths included parts of Valles Marineris and the Tharsis region
- Nearly 1000 HiRISE images examined in HiView , local TAR coverage per image was estimated and recorded
- TARs identified and classified using the classification scheme of Balme et al. (2008) (classification by morphology and topographical influence)
- All examined images were then mapped according to their center latitude and longitude (Figure 1).



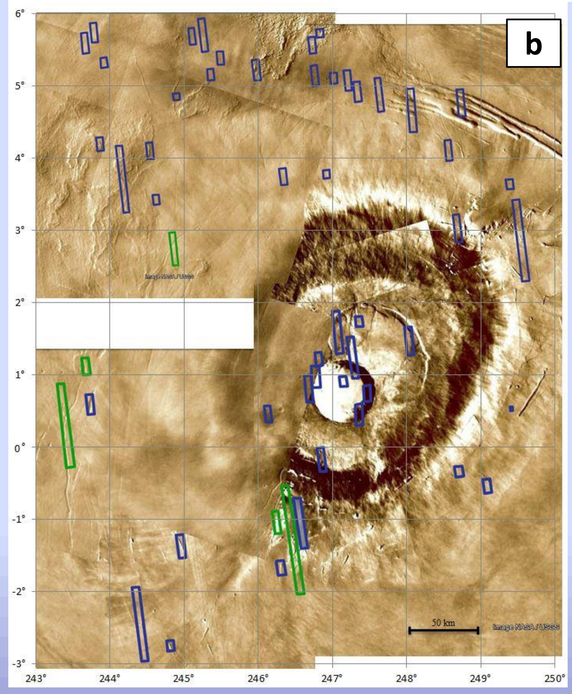




**Figure 3:** Distribution of HiRISE images included in study from a portion of **a)** Valles Marineris and **b)** Pavonis Mons, with backgrounds from Google Mars. Percent areal TAR coverage designated by color of rectangle:

% TAR coverage:
0-4 = blue
5-25 = green
26-50 = yellow,
51-100 = red

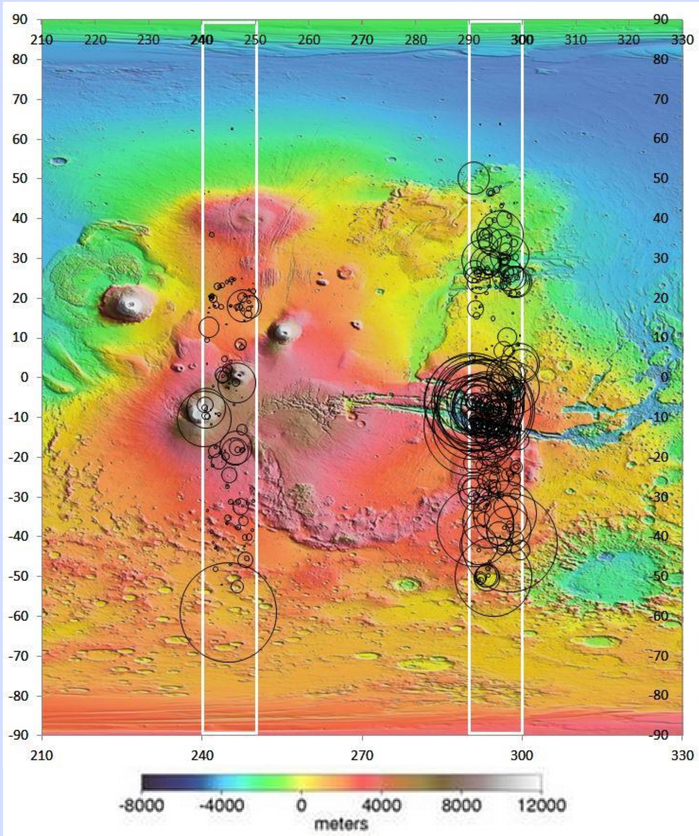



**Figure 1:** Distribution of HiRISE images surveyed with percent TAR coverage indicated by size of circle (larger = greater coverage) with MOLA background and swaths outlined in white.

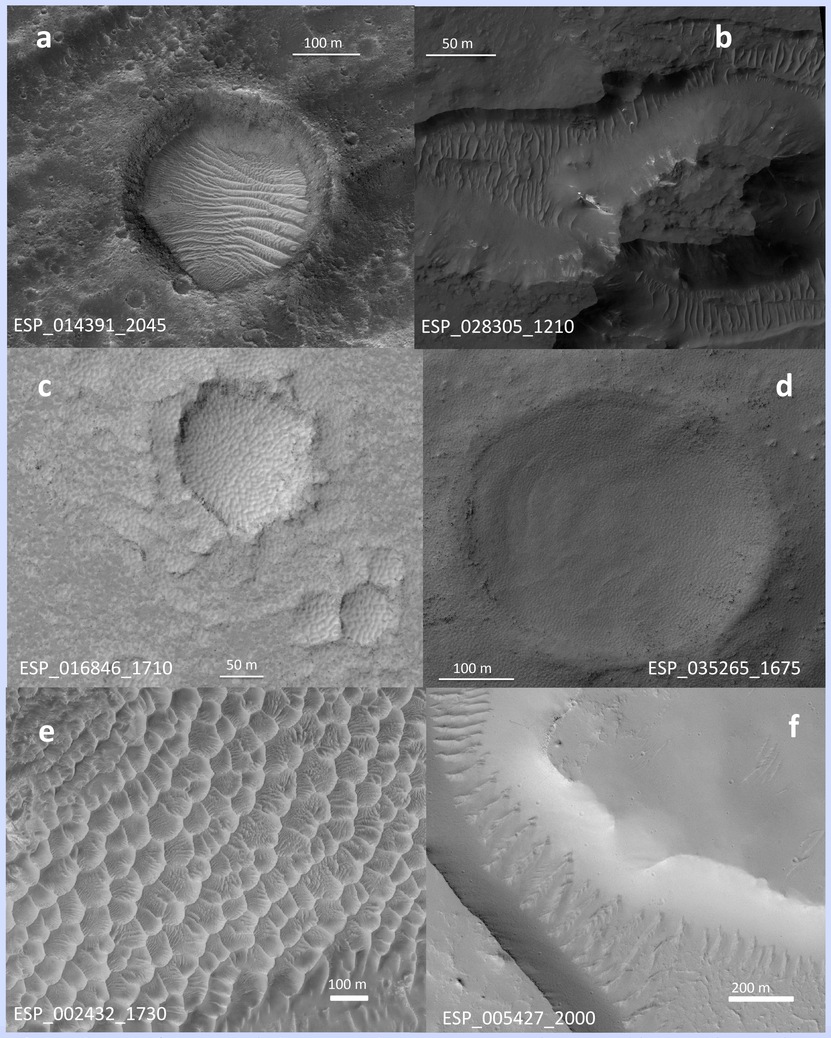



**Figure 2:** TARs form mostly in depressions near steep slopes and layered bedrock, as seen in **a)** Kasei Valles and **b)** Coprates Chasma. However, **c)** on Tharsis ripples form within craters rather than TARs, and **d)** in the Southern Highlands mantled terrain and ground ice hinder TAR formation. TARs also range in shape, from **e)** networked and independent TARs to **f)** simple and controlled TARs.

## Findings

The 290°E-300°E swath:

- Mean areal TAR coverage is 8% (4% in the Northern Hemisphere and 12% in the Southern Hemisphere)
- 42% of the surveyed images contained at least 5% coverage by TARs
- 25% contained no TARs at all

The 240°E-250°E swath:

- Mean areal TAR coverage is 1% (0.6% in the Northern Hemisphere and 1.8% in the Southern Hemisphere)
- 6% of the surveyed images contained at least 5% coverage by TARs
- 70% contained no TARs at all.

Both swaths:

- Mean areal TAR coverage is 5%
- No TARs found poleward of 64N nor 59S

Based on these data, we propose that TARs are controlled by local geology, which is influenced by elevation and latitude.

### Local Geology

The composition and formation of TARs is still unclear. We hypothesize that TARs consist of coarse-grained sediment that traps sand and silt [1,3], similar to gravel-mantled megaripples of the Argentinian Puna [4]

The sediment source is likely locally derived [1,2] from weathering, wind abrasion, and mass wasting

- Regions with steep slopes and local exposures of layered bedrock have more extensive TAR fields due to increased local sediment supply
- TARs are most commonly found in this confined and controlled areas (Figure 2a, 2b) → sediment trapped in topographic lows such as craters, valleys, channels, and troughs

Regions with less sand are assumed to have fewer TARs (i.e. the dusty surface of Pavonis Mons)

- If TARs formed in Tharsis millions of years ago they may have since been buried in thick layers of dust
- If TARs are currently active, there may not be enough sand at high altitudes to sustain TARs – the low pressures are unfavorable for saltation and creep of the coarse-grained material assumed to compose TARs [5] (Figure 2c)

### Elevation

Local elevation:

- TARs were not found on steep slopes or mountains
- TARs found almost exclusively in topographic lows

Global elevation:

- Greater abundance of TARs at lower elevations across the planet (Figure 1)
- TAR fields within Tharsis are sparce and mostly isolated, but plentiful within Valles Marineris and Kasei Valles (Figure 3)

This disjunction is likely a result of differences in local geology and air pressure:

- The lows of Valles Marineris and Kasei Valles are favorable for accumulation of sediment that sources TARs
- The high dusty surfaces of Tharsis do not favor the formation of TARs

### Latitude

TARs are not ubiquitous, heavily concentrated at low latitudes:

- TAR concentrations almost exclusively restricted to between 45N and 50S
- TARs are almost absent within the Northern Plains, and almost none poleward of 50S

The lack of TARs at high latitudes is likely due to the presence of mantling terrain:

- Could be preventing aeolian transportation of the materials that compose TARs and/or burying previously formed TARs (Figure 2d) [2]

## References

[1] Balme M.R. et al. (2008) *Geomorphology 101, 703-720*. [2] Berman D.C. et al. (2011) *Icarus 213, 116-130.* [3] Zimbelman J.R. (2010) Geomorphology 121, 22-29. [4] de Silva S.L. et al. (2013) *GSA Bulletin 125, 1912-1929*. [5] Bridges N.T. et al. (2010) *Icarus 205, 165-182*.