THE VARIABILITY OF TRANSVERSE AEOLIAN RIDGES IN TROUGHS ON MARS.
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Introduction: A precursory glance at MGS images of the surface of Mars show an abundance of aeolian transverse ridges [1]. These ridges are located in a variety of geological terrains. Zimbelman and Wilson [2] have separated the small-scale aeolian features of Syrtis Major into six categories: ripples associated with obstacles, ripple bands, ripple fields, ripple patches, isolated ripple patches and ripples associated with dunes. This paper focuses on one of these categories, that of ripple bands which tend to accumulate within linear troughs. As the origin of these features is still being studied (i.e. ripples versus dunes), we refer to them simply as transverse aeolian ridges.

These ridges lie perpendicular to the trough orientation and often cover the entire trough floor. On Earth, transverse aeolian ridges develop in wind environments which display the least directional variability [3]. On Mars, transverse aeolian ridges have variable forms, chord length and wavelength. An understanding of the controls on this variability may help our understanding of trough wind patterns, sediment supply and landform genesis. This paper presents the results of a preliminary investigation into the controls on ridge variability. In particular, we are interested in variations of ridge form, wavelength and length. To this end we present a preliminary classification of ridge form and initial results on ridge wavelength and length.

Methodology: We have focused our efforts on the Phaethontis quadrant (Mars Chart 24). To date over 3,400 Mars Orbital Camera (MOC) images have been examined for candidate sites. From these, 14 images have been selected and data from 27 sample sites collected. These locations fall into three geological type sites: grabens, troughs and valleys.

Data has been collected on the transverse ridges (form, chord length, wavelength, orientation) over a mean sample distance of 800 m. Additionally, data has been collected on the form and dimension of the trough (width, depth, sinuosity, junction angle, channel floor morphology and trough orientation to prevailing wind).

The classification of ridge types: We follow the approach of Bullard *et al.*, [4] who classified linear dunes in the Kalahari Desert from aerial photographs. Their principal criteria was ridge planform.

Planimetric variability: At the time of writing, a five-fold classification has been constructed. This is based on the planform of transverse ridges visible on high resolution MOC images. The following are the main categories:

Simple: Simple transverse ridges tend to have variable length, with most common examples measuring <100 m. They are most frequently located between or at the end of larger ridges. However, the examples in Figure 1 measure approximately 700 m long and illustrate the potential chord length of these ridge types (Fig. 1a).

Sinuous: These are one of the most common transverse forms detected. Similar to the straight ridges, they may exceed 700 m in length. The ridge crest may be gently or tightly sinuous. The examples in Figure 1 are gently sinuous (Fig. 1b).

Forked: Forked or ‘y’ junction ridges are also common in trough systems. They tend to be preferentially located at trough margins or adjacent to obstacles. The may be attached to the end point of simple or sinuous ridges including where trains of transverse ridges merge (Fig. 1c).

Feathered: Feathered ridges have small secondary ridges intersecting with or extending from the larger ridge (Fig. 1d). These compound forms have also been reported for linear dunes on Earth [5, 6].

Network: Networked ridges in troughs on Mars tend to form in local topographic lows and areas of secondary flow circulation. They are closely spaced and appear to be smaller than the other ridge types (Fig. 1e).

Mapping from MOC images indicate that ridge planform varies both along a ridge and down trough. A common example of the former is the tendency for sinuous ridges to become forked close to the trough wall. This may reflect a change in slope, a coarser grain texture or the influence of higher wind frictional resistance at the trough boundary. Down trough variability in ridge form appears to be influenced by trough width and by floor morphology. Where troughs widen (either symmetrically or asymmetrically) dune form becomes increasingly complex. A similar adjustment in ripple form is noted at trough junctions.

Ridge wavelength and length: Ridge wavelength and chord length appear to be influenced by large-scale trough properties. Measurements taken along Auqakuh Vallis show that ridge wavelength increases in locations where trough width increases and decreases in locations where the trough narrows. However, this observation may not be applicable to all troughs on Mars. When both chord length and ridge wavelength were correlated with trough width from 8 locations in the sample quadrant (MC24), the results indicate, a very weak but, negative correlation. More data points will clarify the nature of this trend or perhaps highlight how local trough floor variability may be an important control on ridge wavelength and length.

Conclusion: Transverse aeolian ridges display variable planforms. This variability has been categorized into five planimetric sub classes: straight, sinuous, forked, feathered and network. The controls on this variability are being investigated.

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References:

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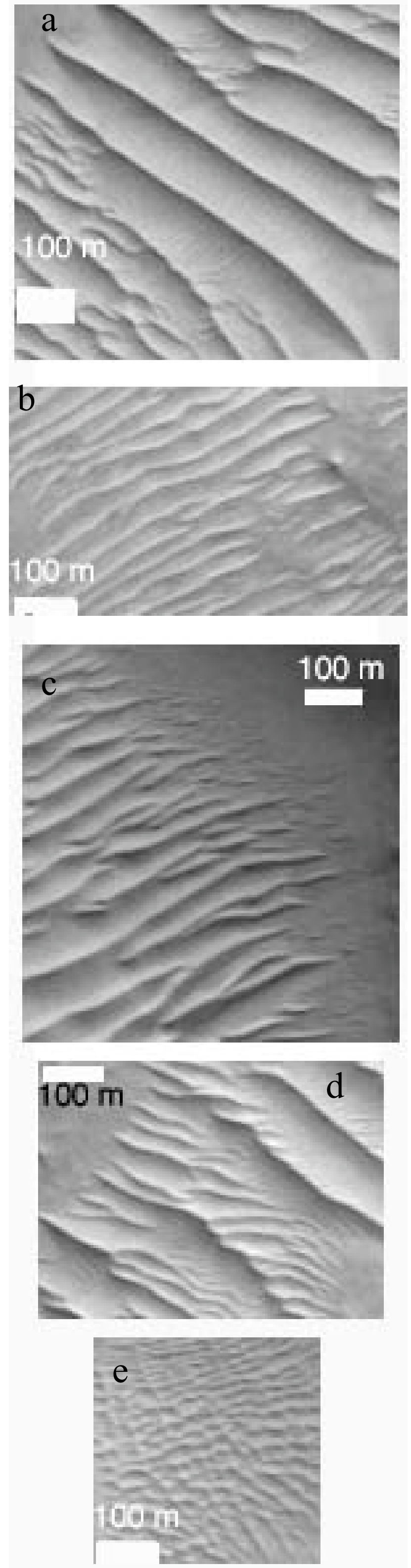

Figure 1. Examples of variability in transverse ridge form in troughs on Mars. Sub-scenes from MOC image M12-00911 of Auqakuh Vallis.

a) Simple
b) Sinuous
c) Forked
d) Feathered
e) Networked