ORIGIN OF RIDGES SEEN IN TEMPE TERRA, MARS. L. Manfredi[1], R. Greeley[1*],
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Introduction: Tempe Terra is a plateau approximately 1800 km across and is the northeast extent of the Tharsis rise along the dichotomy boundary. Tharsis is a volcanic province dominated by large (100s km in diameter) shield volcanoes as well as several fields of smaller (10s km in diameter) shield volcanoes. Tempe Terra can be broadly divided into two types of terrain: 1) older, fractured, highland material, and 2) younger, mantling and embaying volcanic material. Unique to a small area (<15,000 km^2) of Tempe Terra is a unit of older, plateau material with ridges (Figure 1) that have no obvious formation process. In order to investigate the orgin of these features, characteristics of the ridges were compared to characteristics of possible terrestrial analogs.

Background: Geologic mapping has revealed that the oldest terrains in Tempe Terra are the highly fractured plateau material that is thought to be Noachian aged layered deposits consisting of fluvial and aeolian sediments, volcanic material, and crater ejecta These units were later resurfaced by water, fractured and faulted, followed by volcanism in the Hesperian. Volcanism continued into the Amazonian and the area is currently exposed to aeolian processes [1].

It is generally agreed that volcanism began in the Tharsis region in the Hesperian [2, 3]. Recent crater age dating of lava flows and shields in the region give an age for Tempe Terra volcanism as young as a few hundred million years and <100 Ma for the Tharsis shields [4].

The ridged plateau material has previously been mapped as Hesperian-aged Knobby Material (HNk) [5], as Hilly-Piedmont Material (ph) and Hilly and Cratered Material (hc) [6], as Older Fractured Material (Nf) [7], as Terraced Plateau Material (Nplt) and Fractured Plateau Material (HNplf) [1], and most recently as Hesperian Fractured Plateau (Hfplt) [8].

Observations: Dozens of linear ridges, some as long as 10s of kilometers in length, have been identified in the ridged plateau unit. Ridges may be flat topped (Figure 2a) to rounded (Figure 2b) and often have an axial trough which gives them a double ridged appearance (Figure 1c). Ridges can be up to ~ 30m high and have widths up to 500m. Individual ridges may not have a single morphology and may transition from single to double ridged. Ridges may be straight but can also be arcuate to slightly sinuous. Ridges commonly intersect one another. No dendritic or braided patterns are seen in the ridges but they may bifurcate. A characteristic unique to these ridges seen near 272.4 E 33 N are ridges that have terminal or intermedial domes or knobs (Figure 2d, arrows). In several areas, the ridges appear to be erroding from overlying material (Figure 2e, arrows).

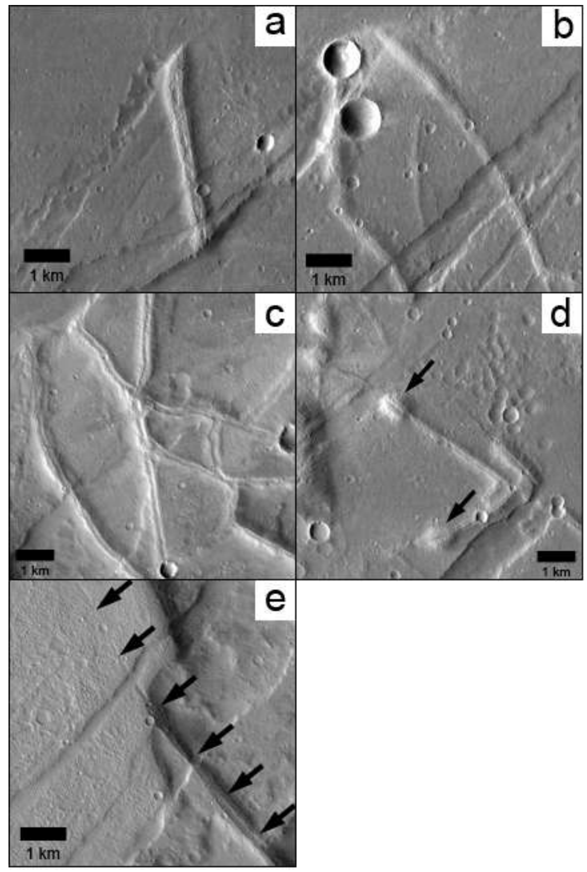

Figure 2. *(a-d) CTX images of various ridge morphologies. (e) Ridge eroding from overlying material. Note linear depressions following trend of the exposed ridge in overlying material suggesting its presence.*

Interpretation: Morphologically similar landforms seen on Earth and suggested to exist on Mars include: eskers [9, 10], volcanic dikes exposed at the surface [11-13], volcanic pressure ridges [14], lava channel levees [15], and inverted stream beds [16]. Other features seen on planetary bodies that share characteristics with the ridges but that are less likely to be analogous are the "Inca City" ridges, and ridges seen on Jupiter's moon Europa.

Based on observations of terrestrial analogs the following characteristics are shared by exposed volcanic dikes and the Tempe Terra ridges: narrow, single or double ridged forms, straight to arcuate forms, cross-cutting and a consistant width regardless of topography. These ridges also ignore local topography. Eskers and these ridges can both be single or double ridged, and ignore local topography. Volcanic pressure ridges and the Tempe Terra ridges both can have axial troughs. Lava channel levees and the ridges can be narrow, straight to arcuate, and single or double ridged. Inverted stream beds and the ridges can be straight to arcuate and have positive relief.

Based on ridge morphologies, the volcanic dike interpretation is favored because they are consistent with the most characteristics of the Tempe Terra ridges. This is in agreement with mapping of the area by [1] and [8] who have also suggested these ridges may be volcanic dikes.

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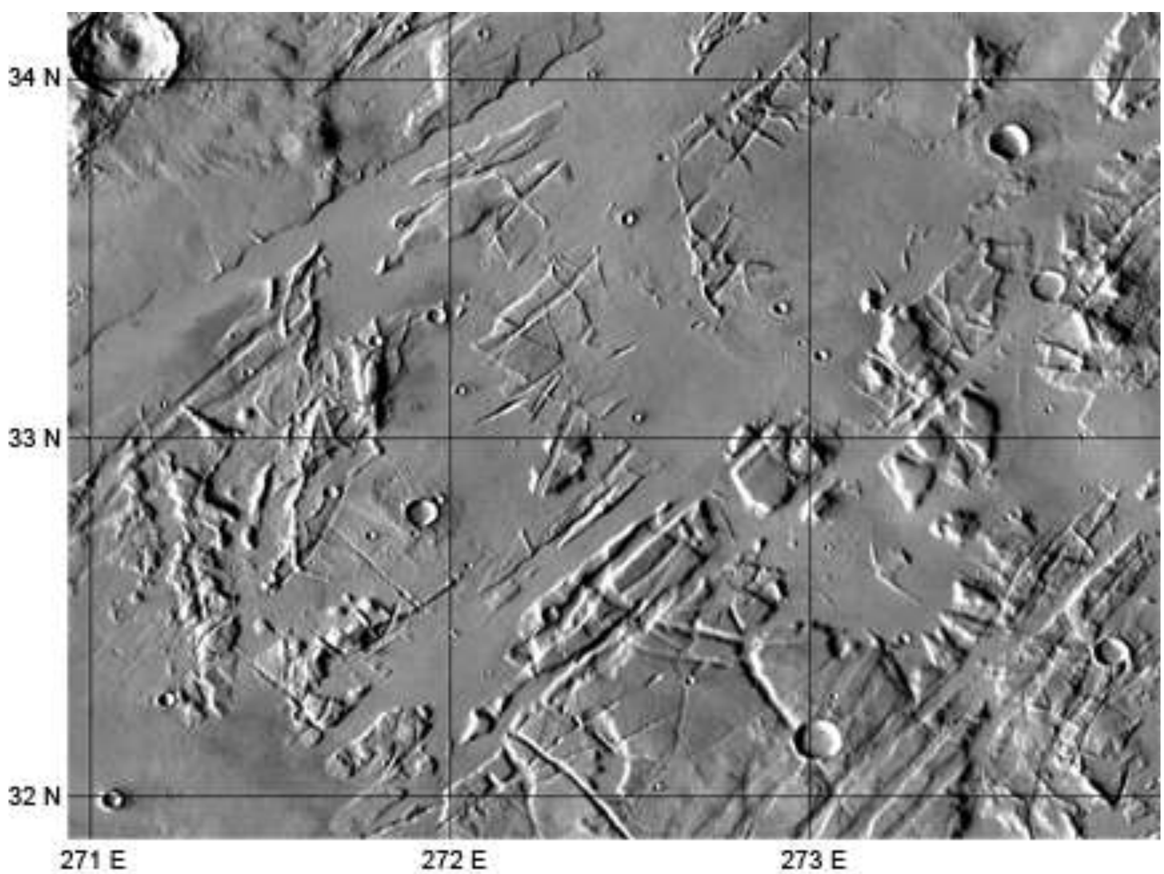

Figure 1. *Ridged plateau unit in Tempe Terra is shown in the THEMIS day IR mosaic. Plateau material without ridges is present as well as younger, embaying volcanic material. Fractures are largely northeast trending while the ridges appear to have a northwest trend.*