RIDGES OF ENCELADUS'S LEADING AND TRAILING HEMISPHERES.
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Introduction: Numerous ridges cover the leading and trailing hemispheres of Saturn's icy moon Enceladus (Fig. 1). Both regions contain only a few craters larger than about 1 km, suggesting a strikingly young surface. The ridges suggest a recent history of shortening in the area given the size and extent of the ridges on both hemispheres. However, the ridges on each hemisphere appear different. The trailing hemisphere contains a suite of large, linear ridges (termed dorsa) centered roughly on the equator (Fig. 2). Conversely, the leading hemisphere is dominated by more numerous, rounded ridges (Fig. 3). Here we will show our most recent detailed maps of the ridges and other structures within the leading and trailing hemispheres of Enceladus. This effort is part of the global geologic map of the icy world.

Trailing Hemisphere: The trailing hemisphere consists of semi-concentric tectonic terrains centered roughly along 0˚, 285˚W. The primary tectonic structures are two main sets of ridges: a set of smaller ridges (10-25 km long, ~50 m high, 1-2 km wide), and the larger dorsa (~50 km long, ~800 m high, 2.5 km wide) which can bifurcate in a branching manner with branches that can intersect other dorsa near-orthogonally (Fig. 2). A set of north-south fractures cuts across the dorsa, and in some instances they appear to laterally displace the ridges.

In cross section, the dorsa display broad, rounded tops and asymmetrical flanking slopes of ~15–30°. Ebony Dorsum appears to have a dual-component slope on its southwest-facing flank, with the upper slope being steeper (20 – 35°) than the lower slope (12 – 18°).

Leading Hemisphere: On the leading hemisphere terrain (LHT) are two different ridge types: a smaller set (1–20 km long, 10 m high, 1-5 km wide), and a larger but less numerous set (~600 m high, 15–35 km long, 5-10 km wide) that have a lens-like shape in map view (Fig. 3). The larger ridges we interpret to be large-scale thrust faults. Few fractures appear to transect this region; however, surrounding the terrain are a series of fractures that cut through some of the leading hemisphere ridges and have a north-south trend.

Previous efforts [1] further divided the leading hemisphere into 3 sub-terrains: northern and southern regions surrounded by a curvilinear terrain. Each region contains different types of ridges. In the northern portion of the leading hemisphere are two ridge types, one smaller in amplitude and wavelength, and a second larger amplitude set (Fig. 2). Here we show that the smaller ridges have a spacing of 1–2 km, are ~10 m high, and 1–20 km long. The larger ridges are ~600 m high, 15–35 km long, show a lens-like shape in map view, and in cross-section are broad with flank slopes of 6–30°. The southern region of the leading hemisphere is dominated by ridges that are similar in size and shape to the smaller ridges to the north; however, this region lacks a larger ridge set.

Discussion: Crosscutting relationships and the deformation of the striated plains on the southern flanks of Cufa Dorsa on the trailing hemisphere indicate that the dorsa are the youngest features in the region. Older structures of the striated plains are apparent on some ridge flanks suggesting uplift. On other ridge flanks the striated plains are not visible but instead truncate the older terrain and may represent fault scarps. These relationships are inconsistent with a cryovolcanic origin [2] of the dorsa. Instead, we favor a tectonic uplift model, likely thrust faulting, to create these prominent ridges.

The branching nature of the dorsa could be explained by multi-directional contractional strain, where the maximum compressional strain was oriented in a NE-SW direction and minimum compression was oriented NW-SE. The western termini of the Cufa Dorsa are against a prominent, long, gently arcuate tectonic trough, which may have served as a transcurrent fault that permitted north-south directed contraction. We support the suggestion that the dorsa are thrust faults, and they could accommodate ~10% shortening

The leading is likely older than the active South Polar Terrain [1, 3]; however, the region has still been heavily modified by recent tectonic activity [Spencer et al., 2009]. The raised topography, sinuosity, and lack of lobate features strongly suggest the LHT ridges likely formed as a result of a compressional stress event, possibly as much at 10% or more.

References: [1] Crow-Willard and Pappalardo (2015), *JGR Planets,* 120, doi:10.1002/2015JE004818. [2] Spencer, J.R., et al. (2009) *Saturn from Cassini-Huygens*, 683-724. [3] Porco, C.C., et al. (2006) *Science, 311,* 1393–1401.

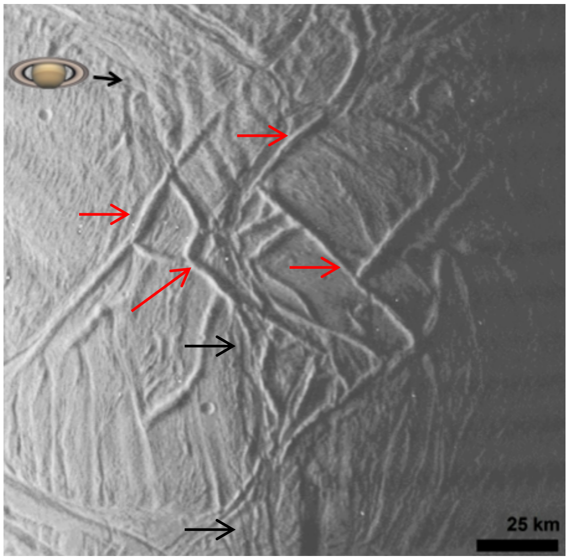

Figure 2. Saturn shine image of the trailing hemisphere. Red arrows show large dorsa and black arrows show younger fractures.

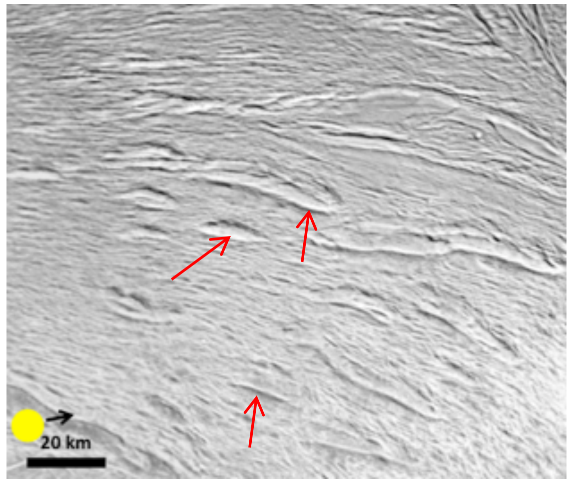

Figure 3. Leading hemisphere ridges. Red arrows point to the largest ridges in the region.

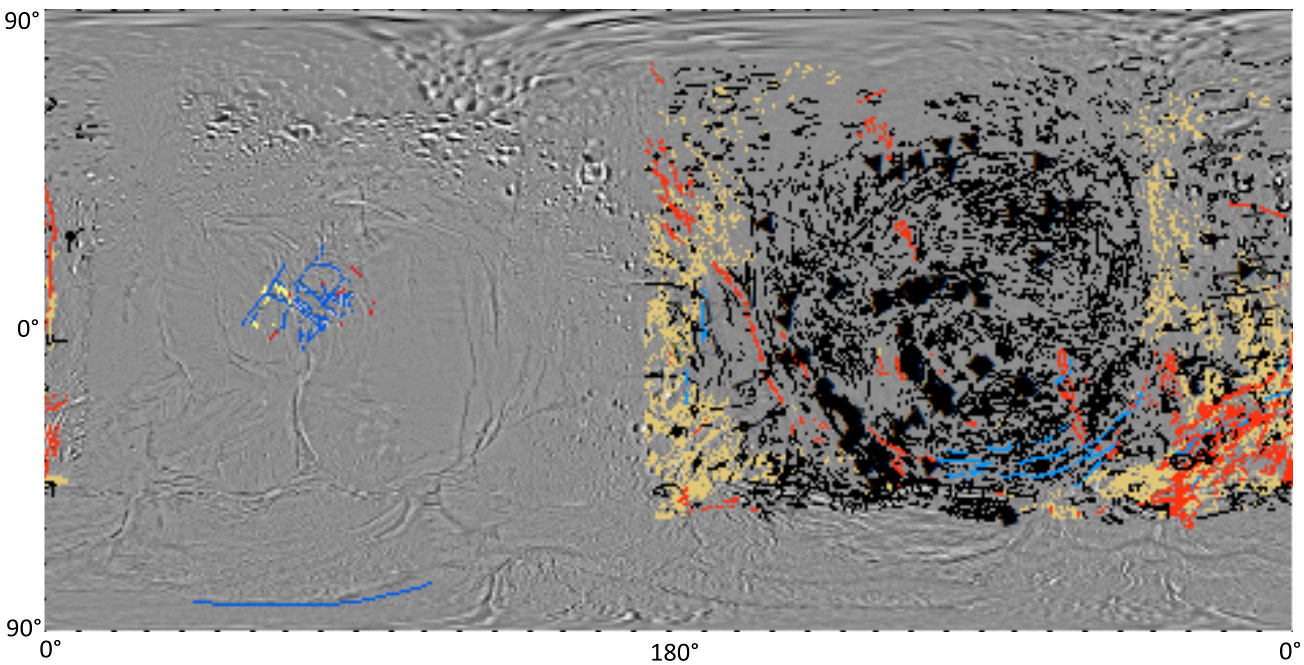

Figure 1. Geologic map of the leading and trailing hemisphere major ridges.