Exploring Enceladus's Geologic History Through Time

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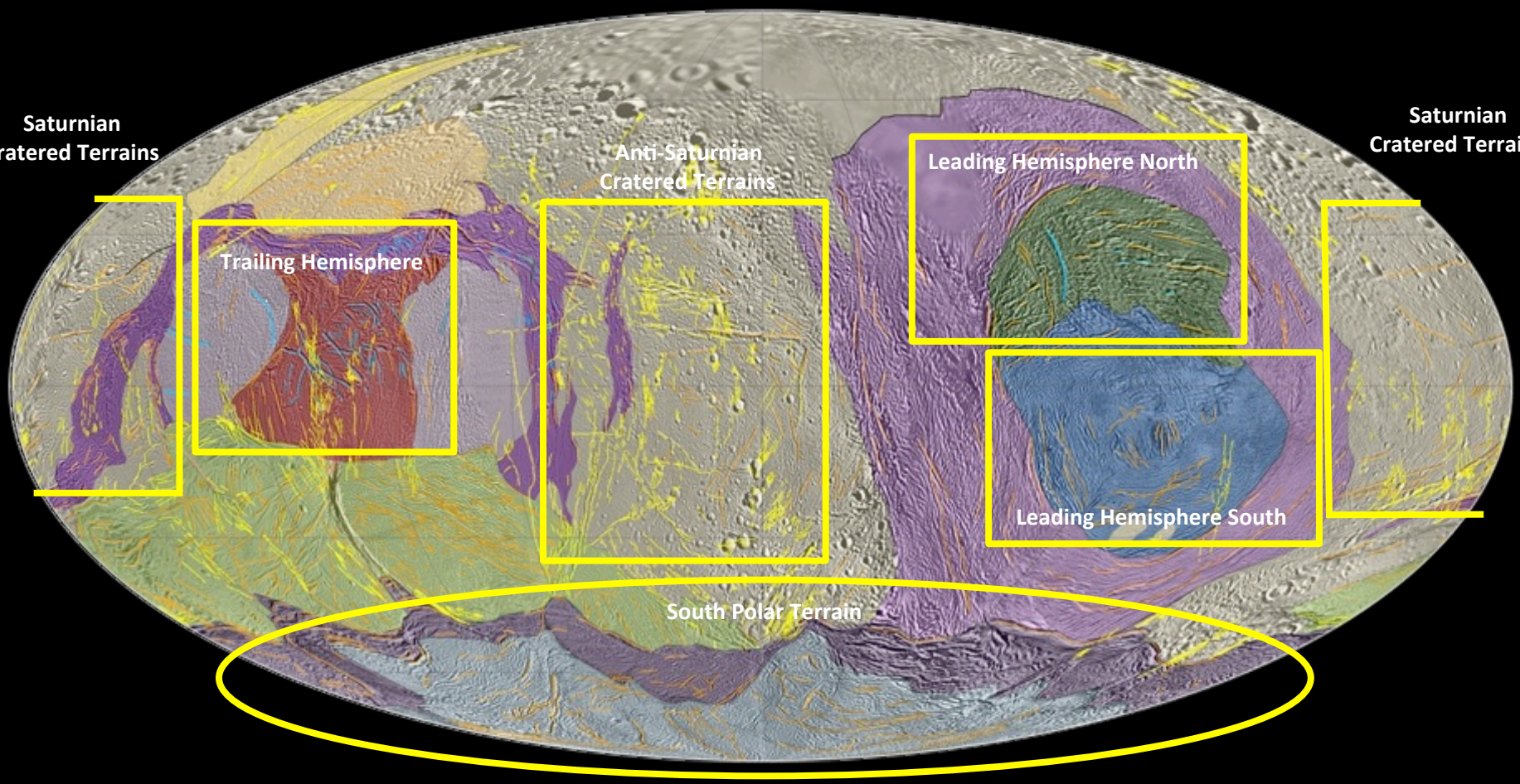
Georgia Institute of Technology
[5]Center for Radiophysics and Space Research,
Cornell University
[6]Lunar and Planetary Institute

California Institute of Technology
Postdoctoral Program
JPL-Student Internship Program

LPSC
March 25, 2016

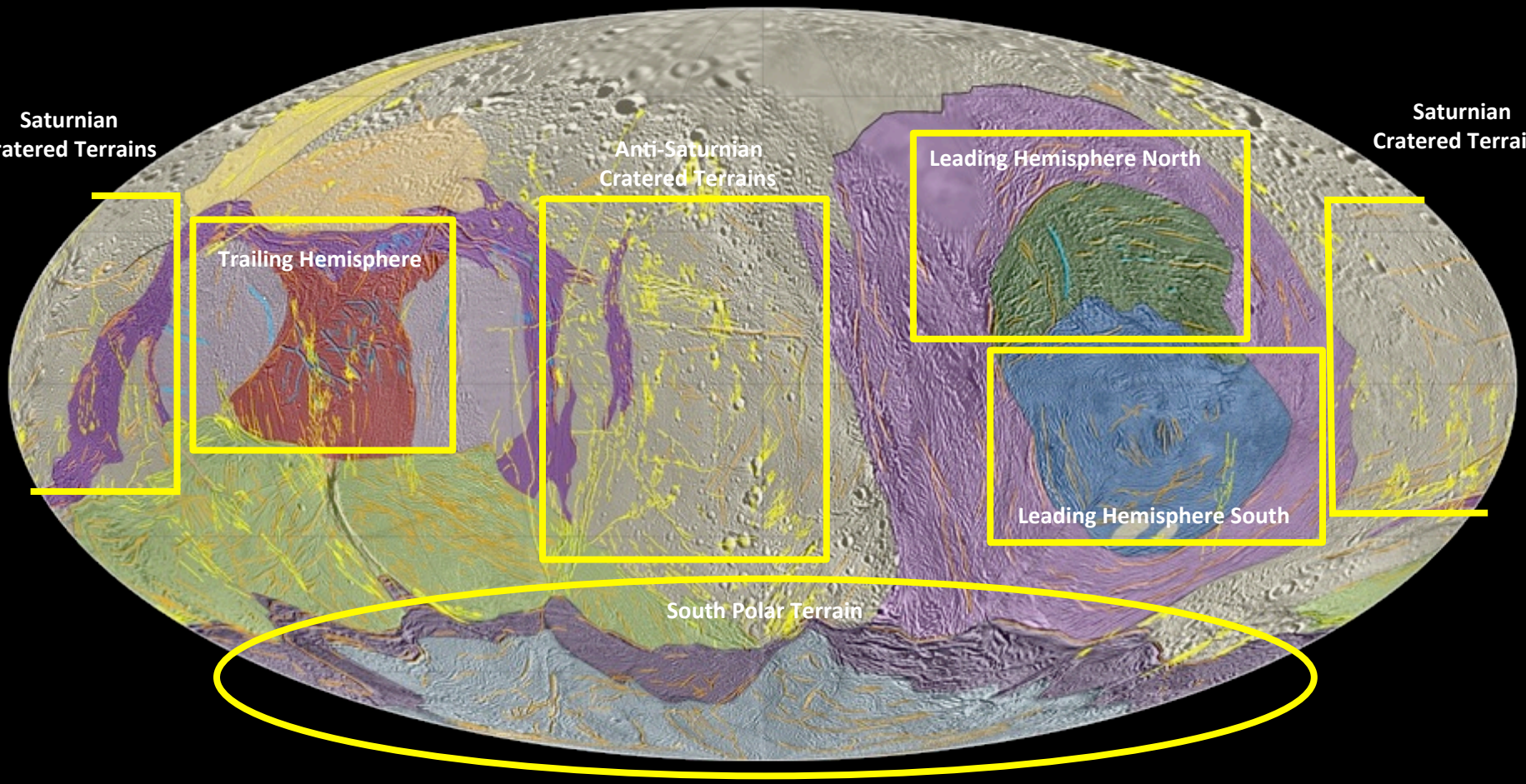
Enceladus
Ridges and Troughs



Cassini ISS basemap (Roatsch et al, 2013)

Crow-Willard & Pappalardo, 2015

Ancient
Ridge and Trough Locations



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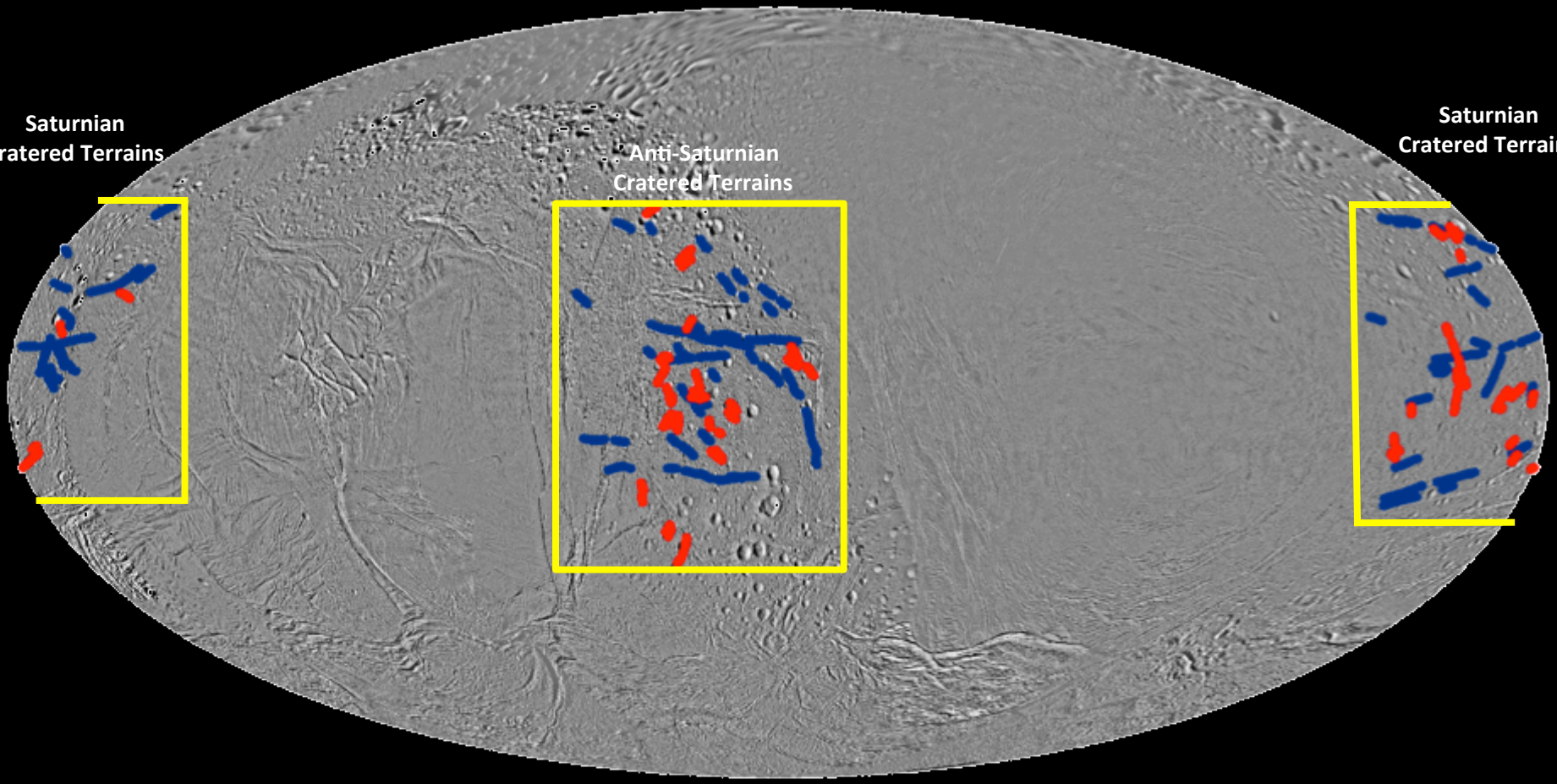
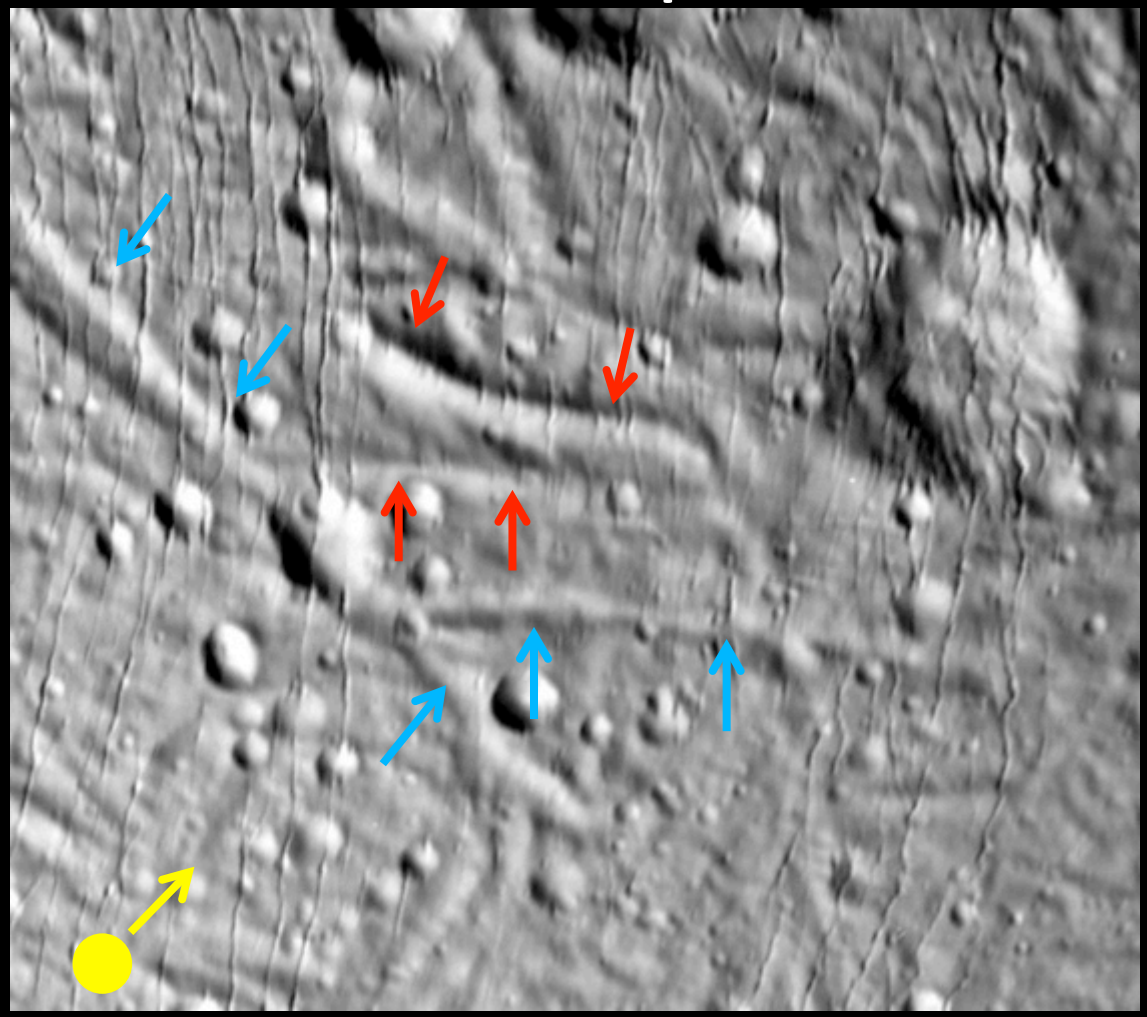


Cassini ISS basemap (Roatsch et al, 2013)

Crow-Willard & Pappalardo, 2015

Ancient Ridges and Troughs
Anti Saturnian Hemisphere

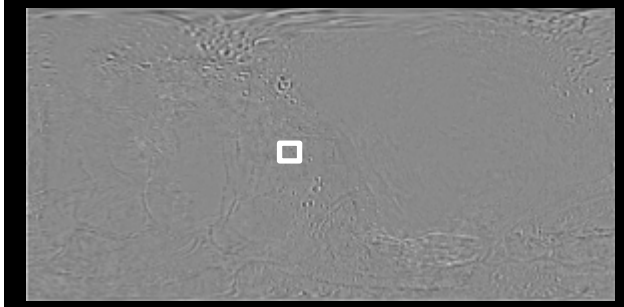
- Small ridges
- Linear troughs
- Overlain by craters



N1489050409

ridge

trough



Modified from Martin 2015

Ancient Ridges and Troughs
Saturnian Hemisphere

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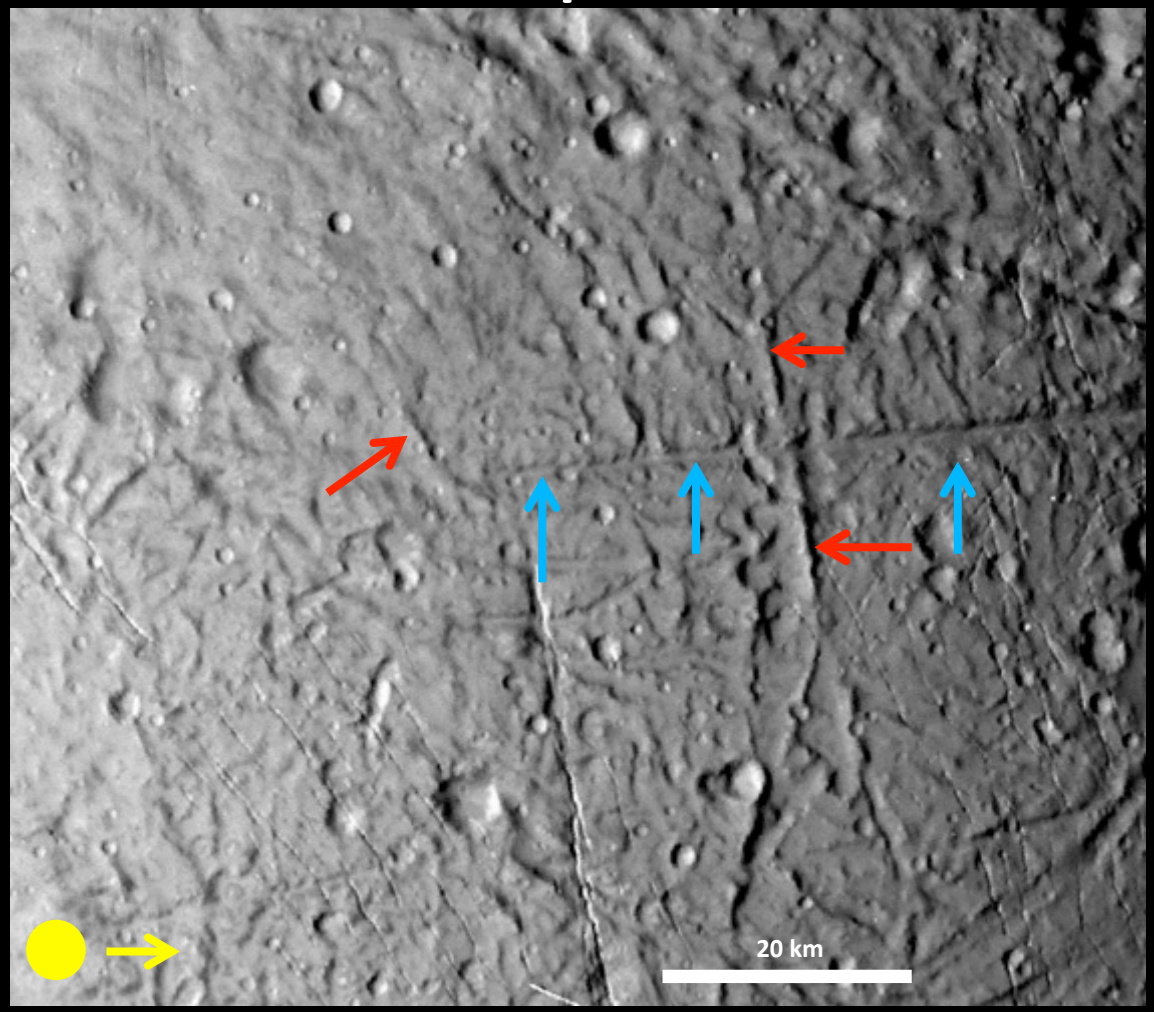
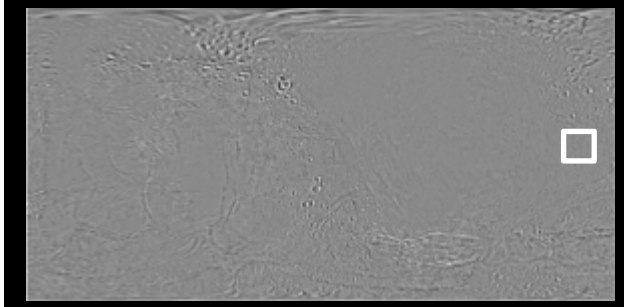
- Linear troughs
- Overlain by craters



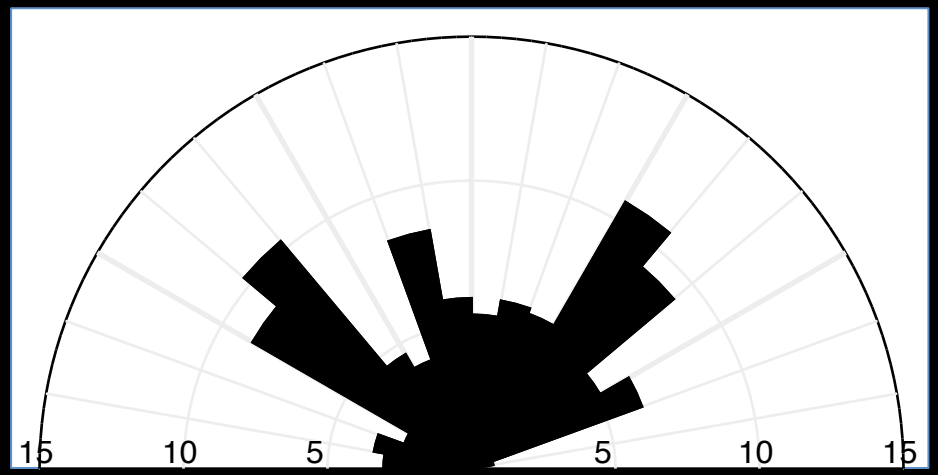
ridge

trough

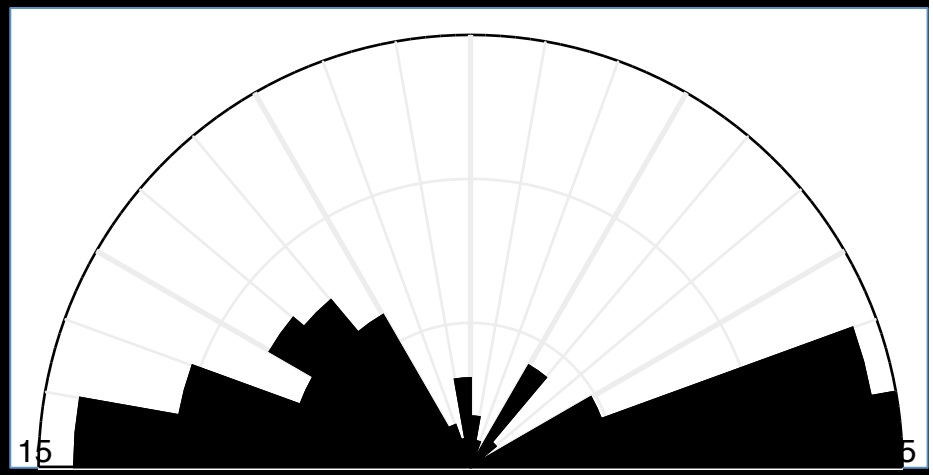


N1660435791

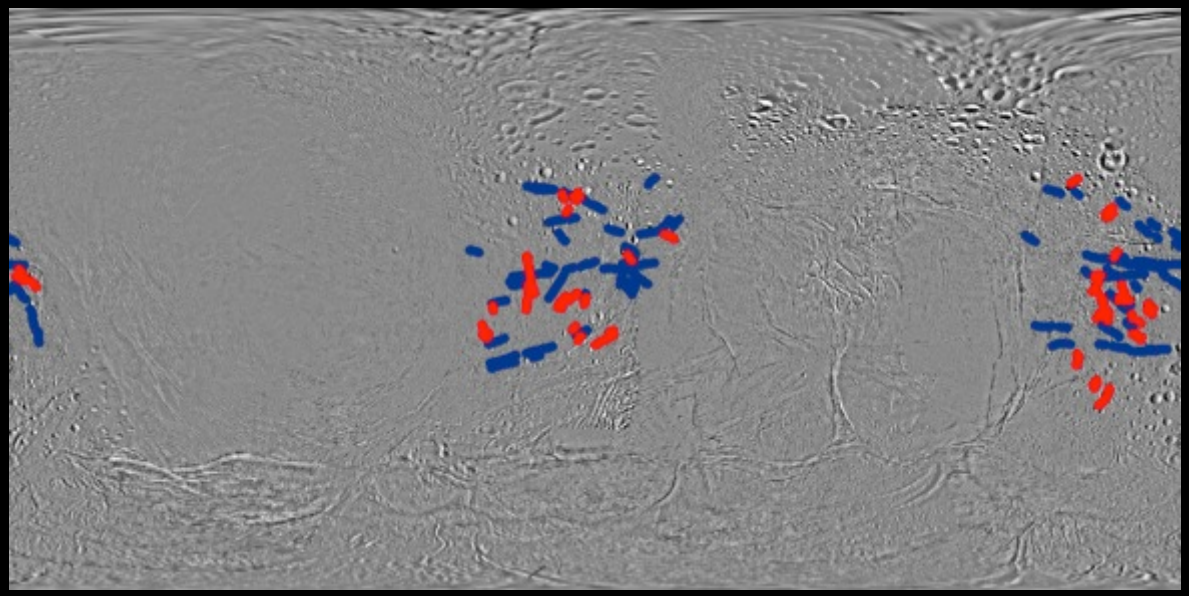
Ancient Ridge and Trough Orientations



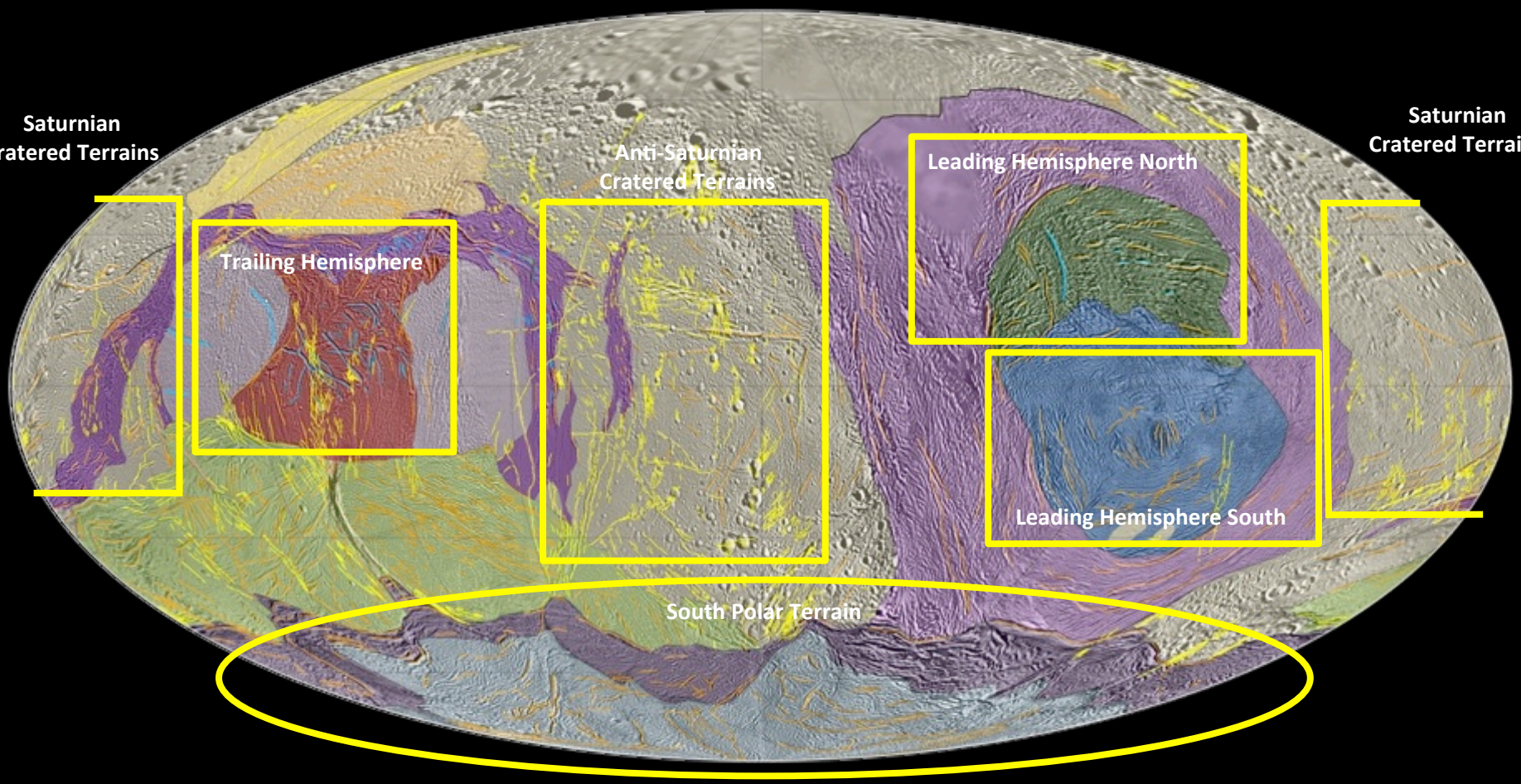
Ancient Ridges
(red)



Ancient Troughs
(blue)



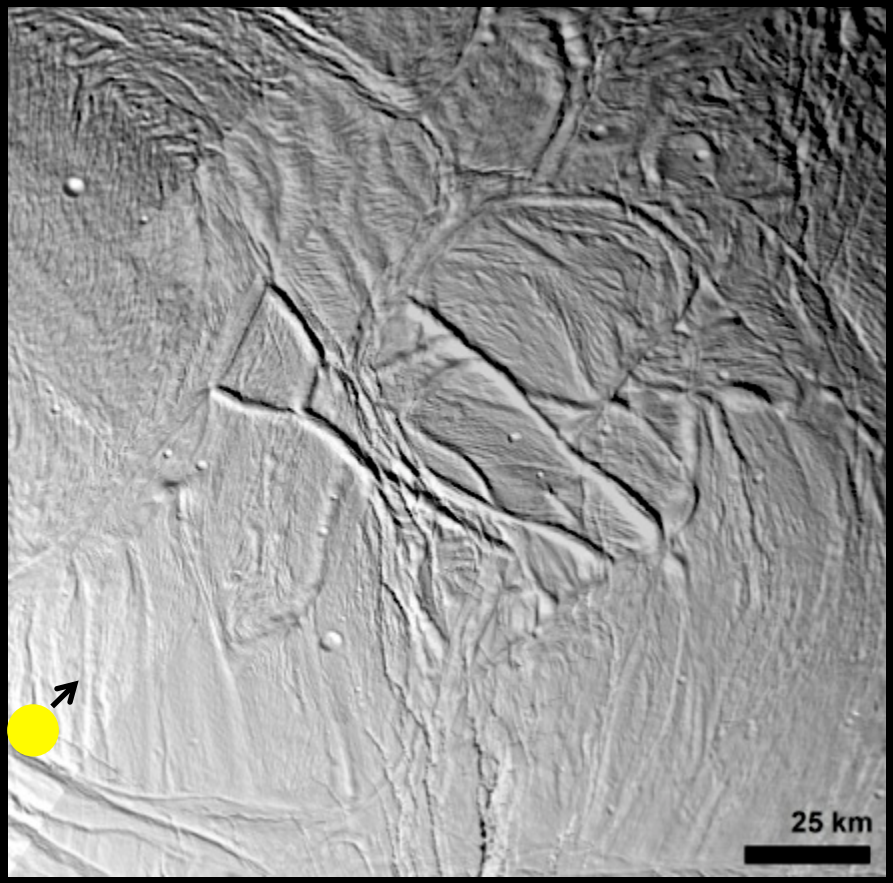
Recent Ridge Locations

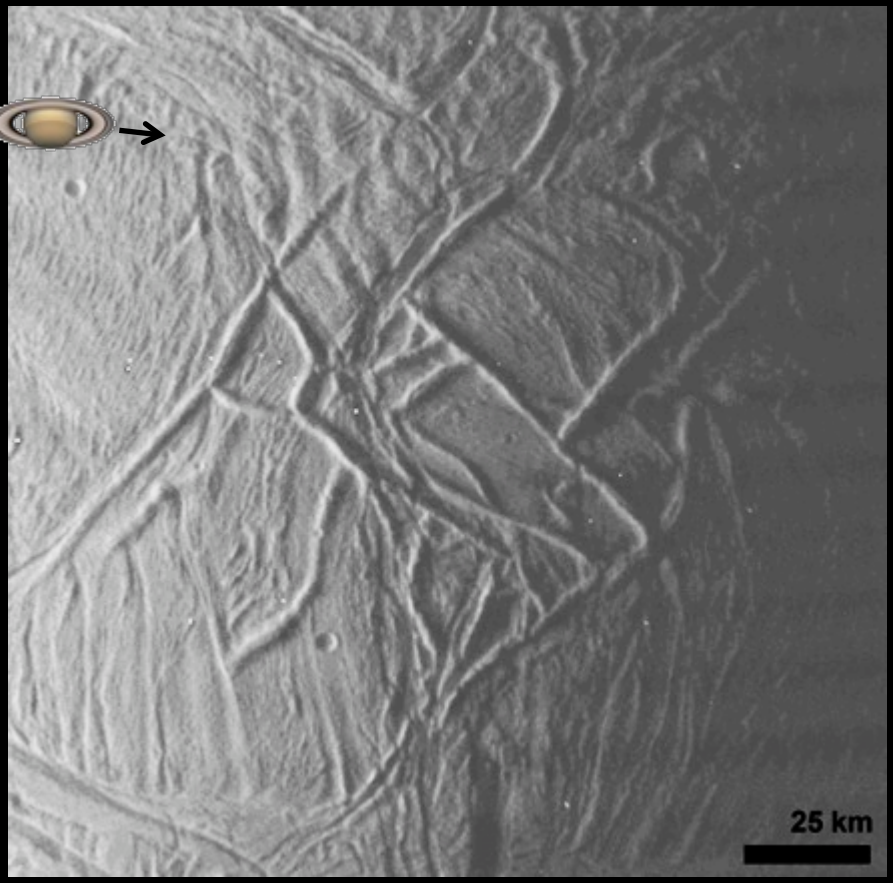


Cassini ISS basemap (Roatsch et al, 2013)

Crow-Willard & Pappalardo, 2015

Recent Ridges on the Trailing Hemisphere

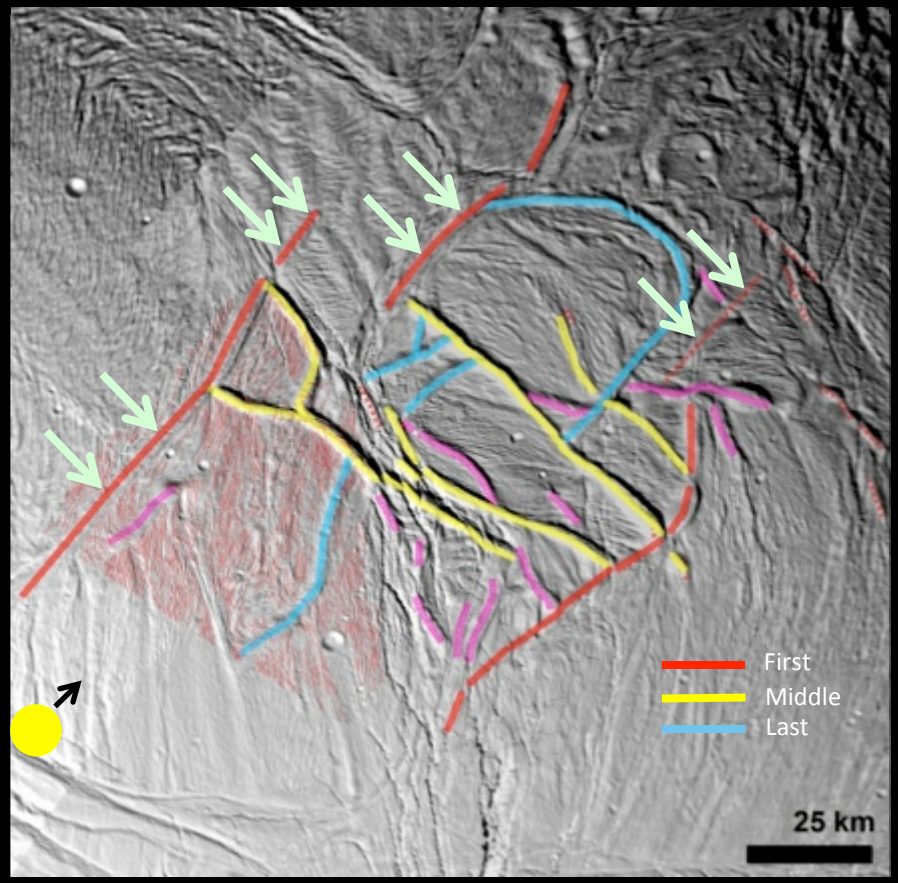


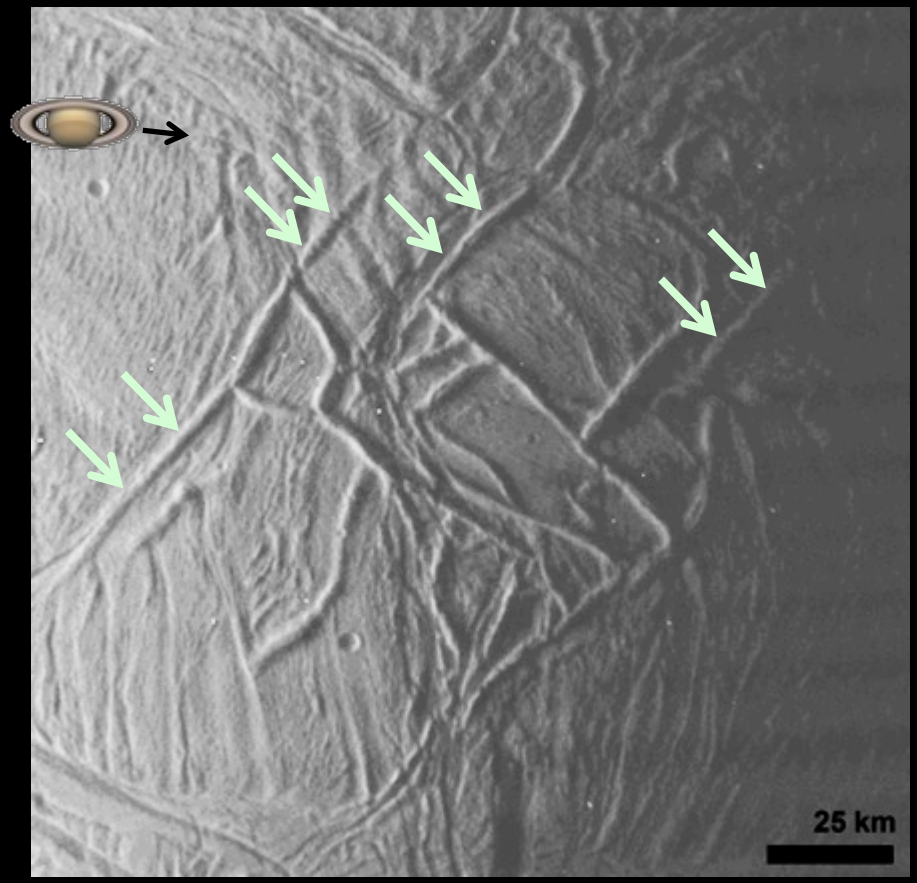


N1487302209, N1487299578, N1487300285, N1487300107, and the Cassini ISS basemap (Roatsch et al, 2013)

N1675146616

Recent Ridges on the Trailing Hemisphere





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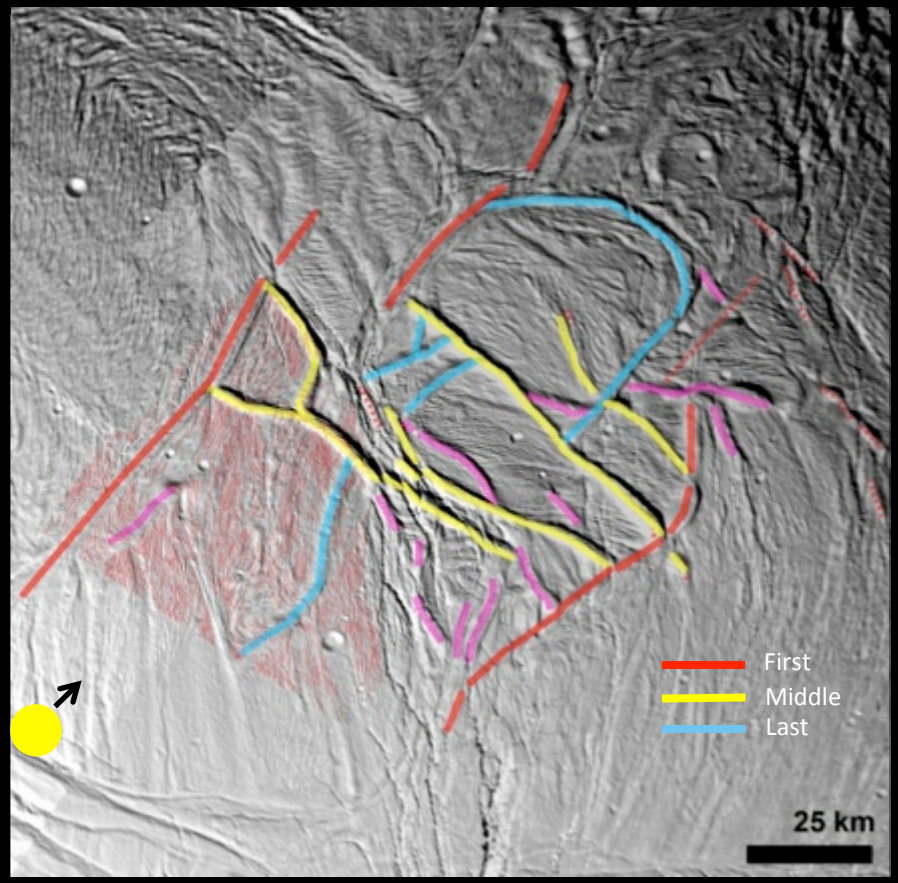
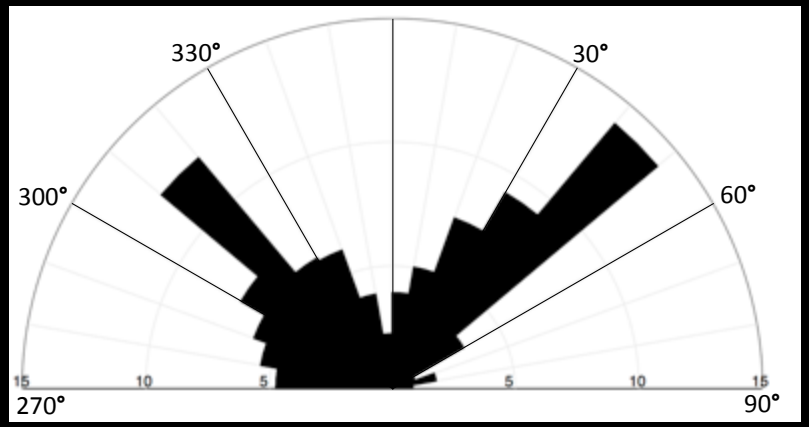
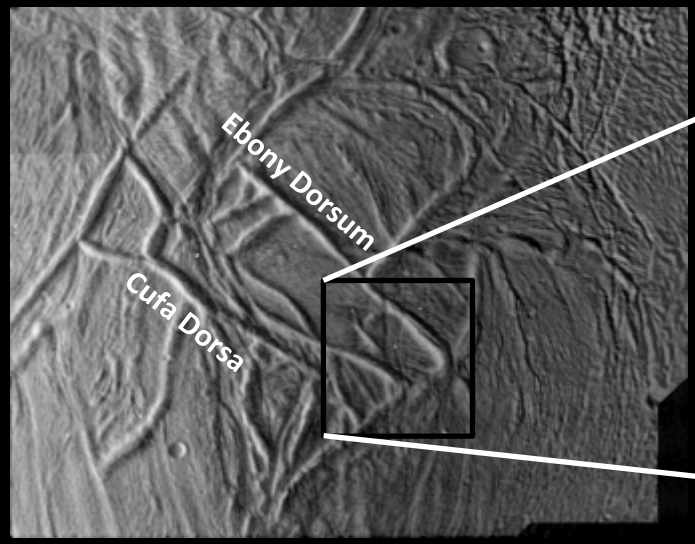




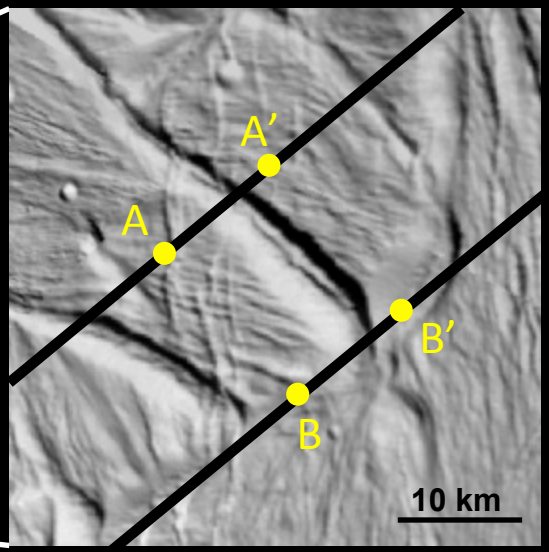
N1487302209, N1487299578, N1487300285, N1487300107, and the Cassini ISS basemap (Roatsch et al, 2013)

N1675146616

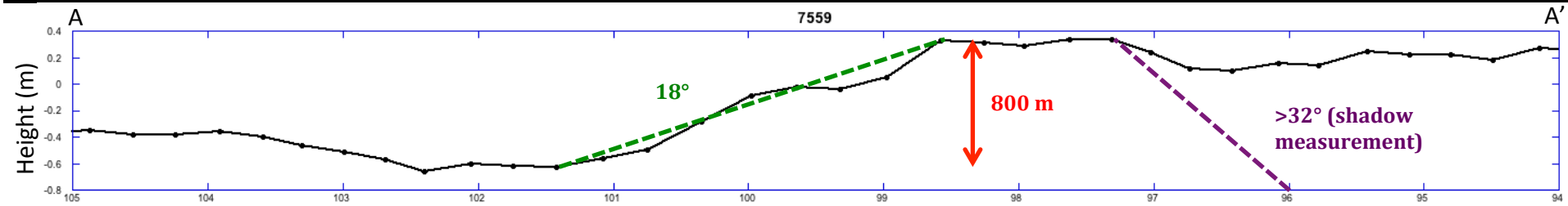
Ebony Dorsum Limb Profiles

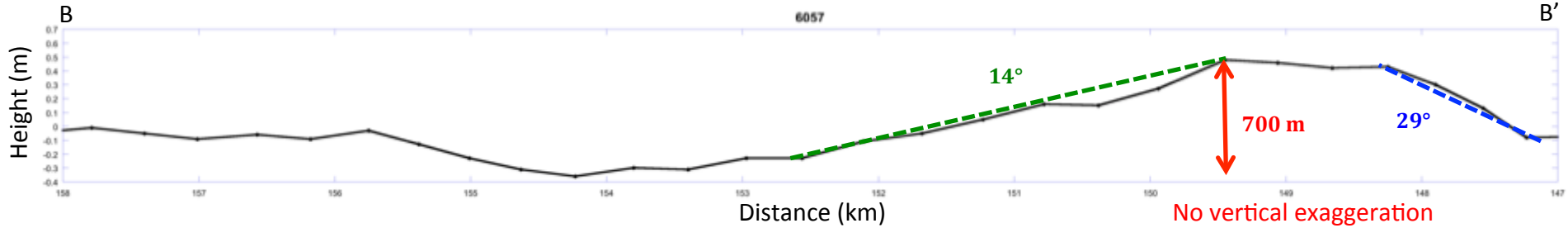


N1675146616 and Cassini ISS basemap

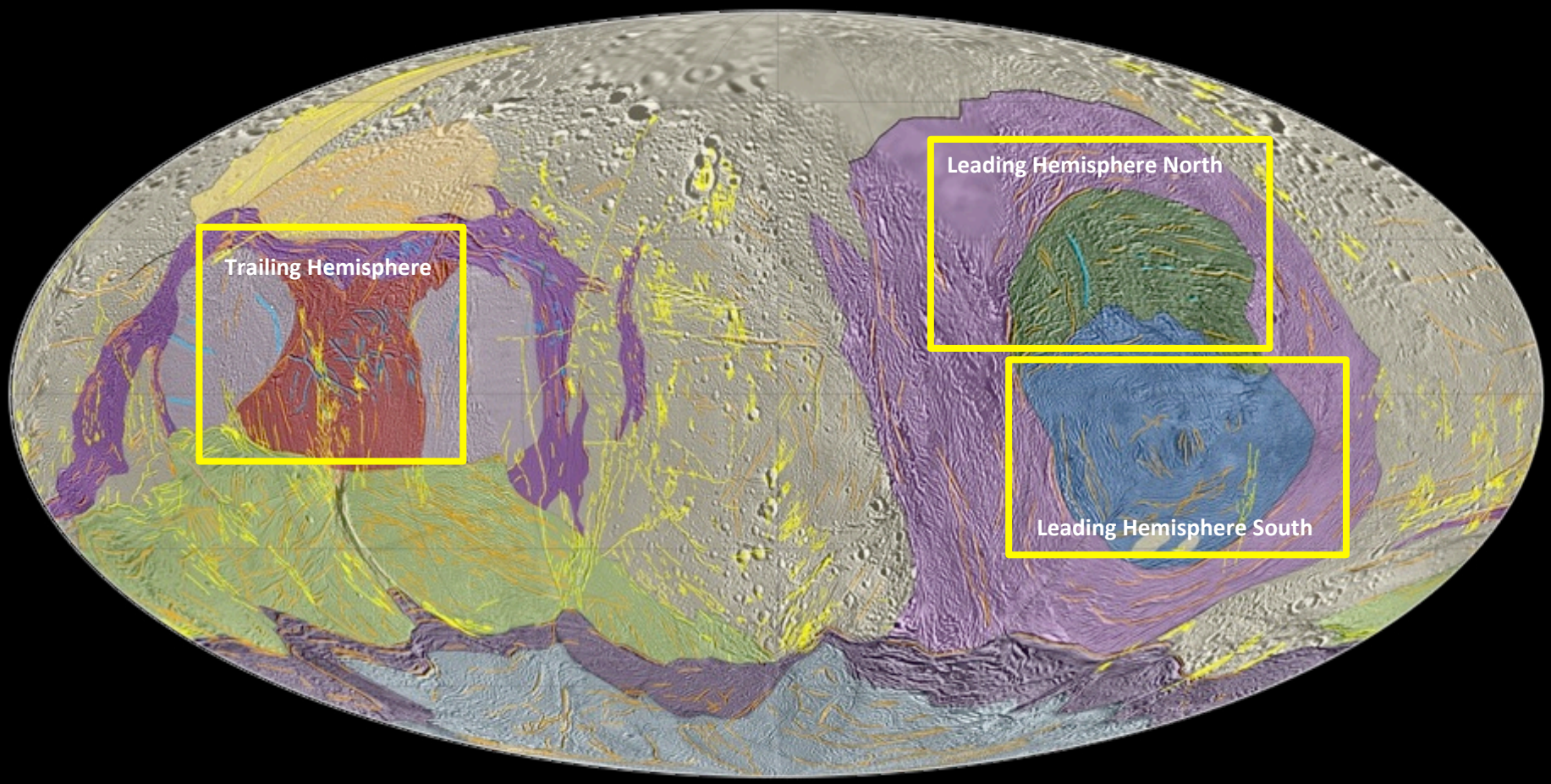


N1487299578, N1487300107, and 1487302209





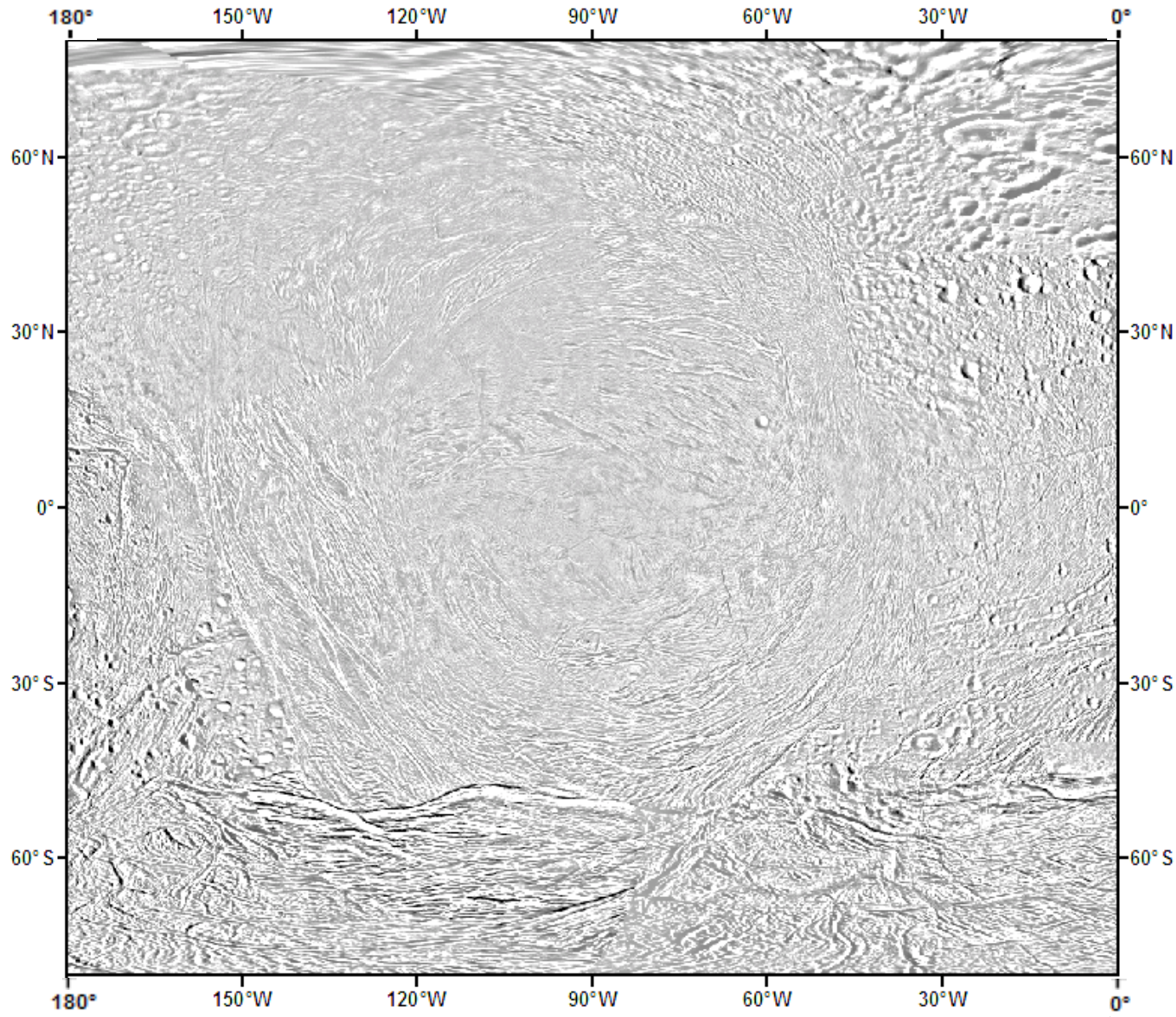
Recent
Ridge Locations



Cassini ISS basemap (Roatsch et al, 2013)

Crow-Willard & Pappalardo, 2015

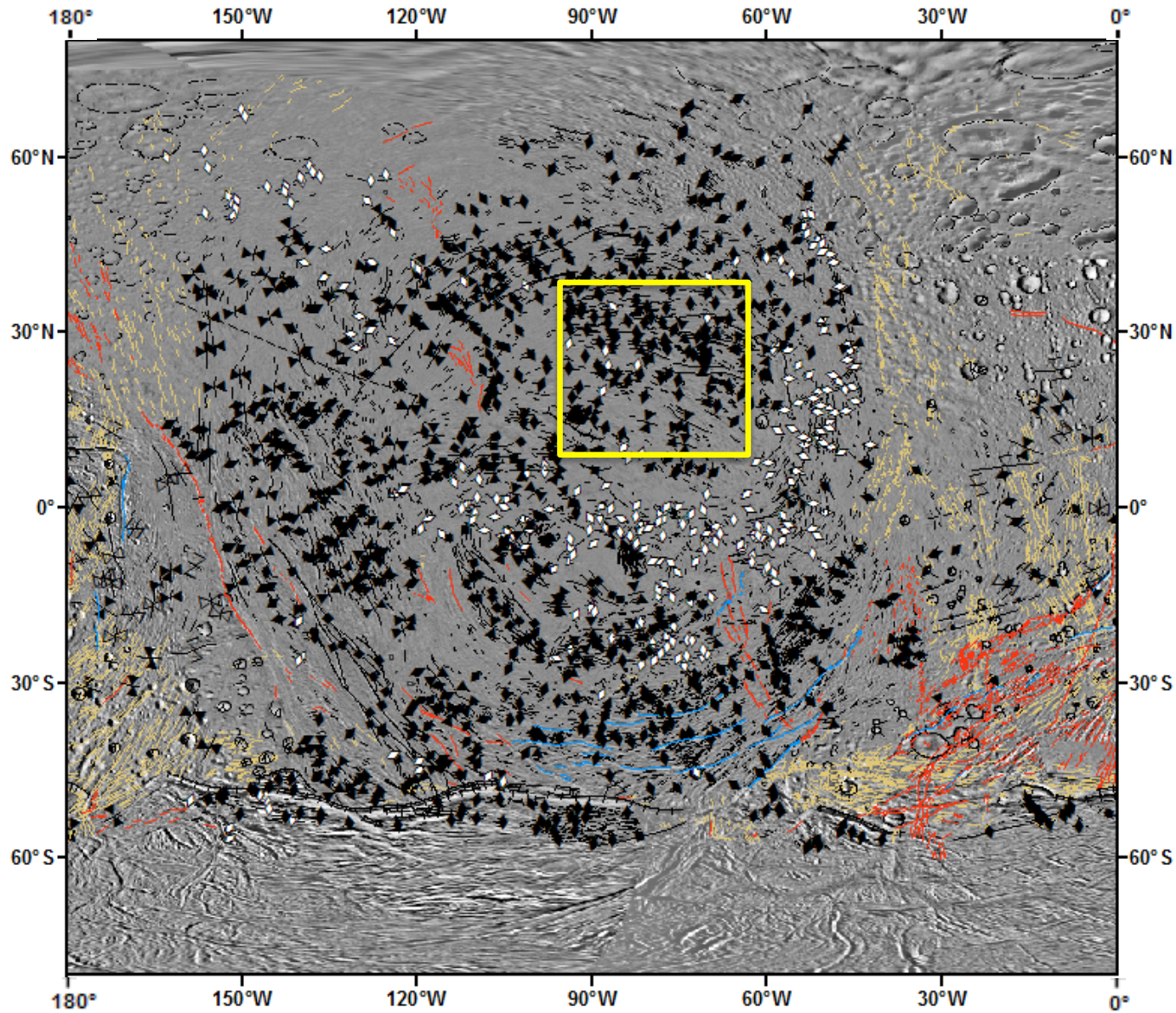
Recent Ridges of the Trailing Hemisphere



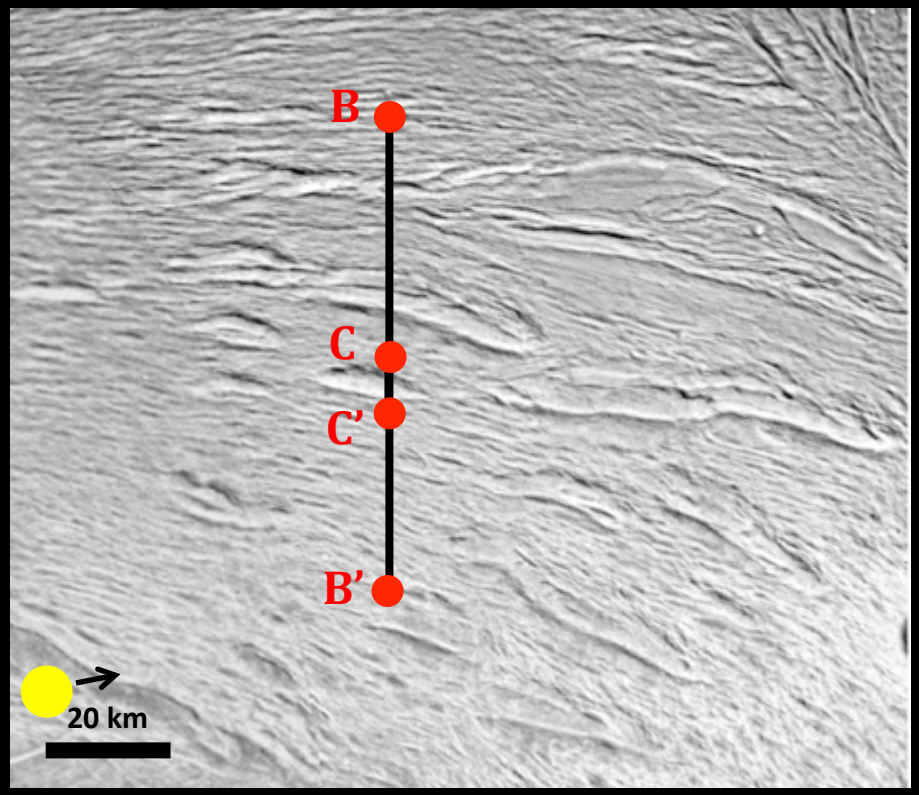
Recent Ridges of the Trailing Hemisphere

Linear Features

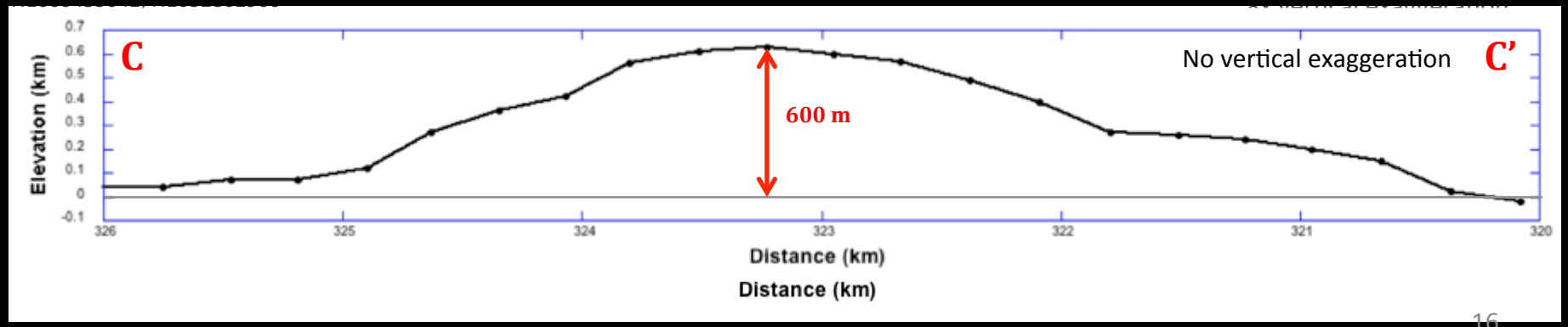
- crest of buried crater
- crest of crater rim
- fault, approx.
- graben trace, approx.
- graben trace, certain
- groove
- lineament
- ridge crest (type 1), certain
- ridge crest (type 1), approx.
- ridge crest (type 2), certain
- ridge crest (type 2), approx.
- scarp base
- scarp crest
- small crater rim
- trough (type 1)
- trough (type 2)
- generic linear 1
- generic linear 2
- generic linear 3



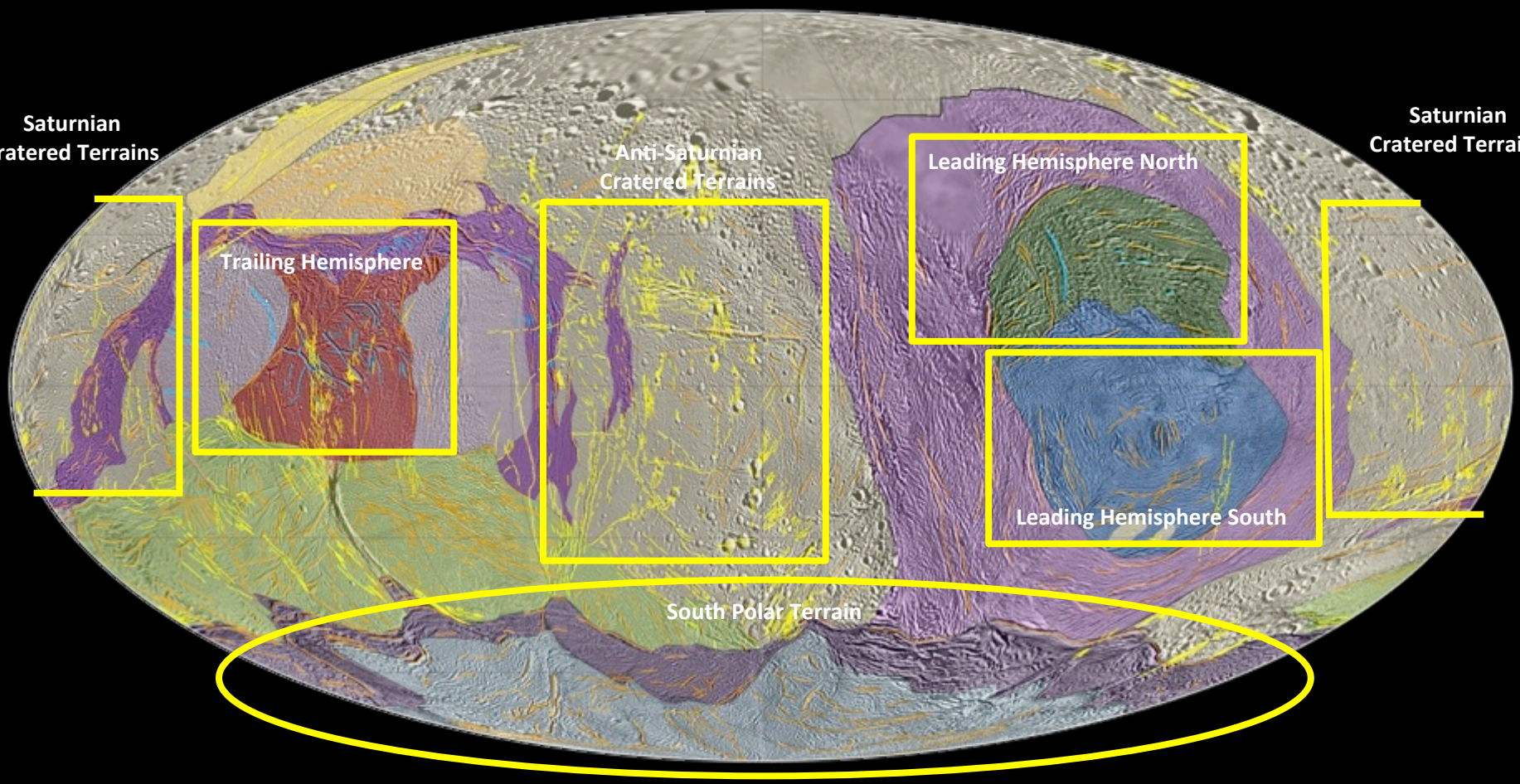
Leading Hemisphere North



- Smaller ridges
  - Heights: 50 – 100 m
  - Lengths: 2 – 10 km
  - Widths: < 2km
- Larger ridges
  - Heights: 100 – 600 m
  - Lengths: 10 – 50 km
  - Widths: 2 – 5 km
- Topographic wavelength ~2 km
- Rounded peaks
- Slopes ~30°



South Polar Terrain

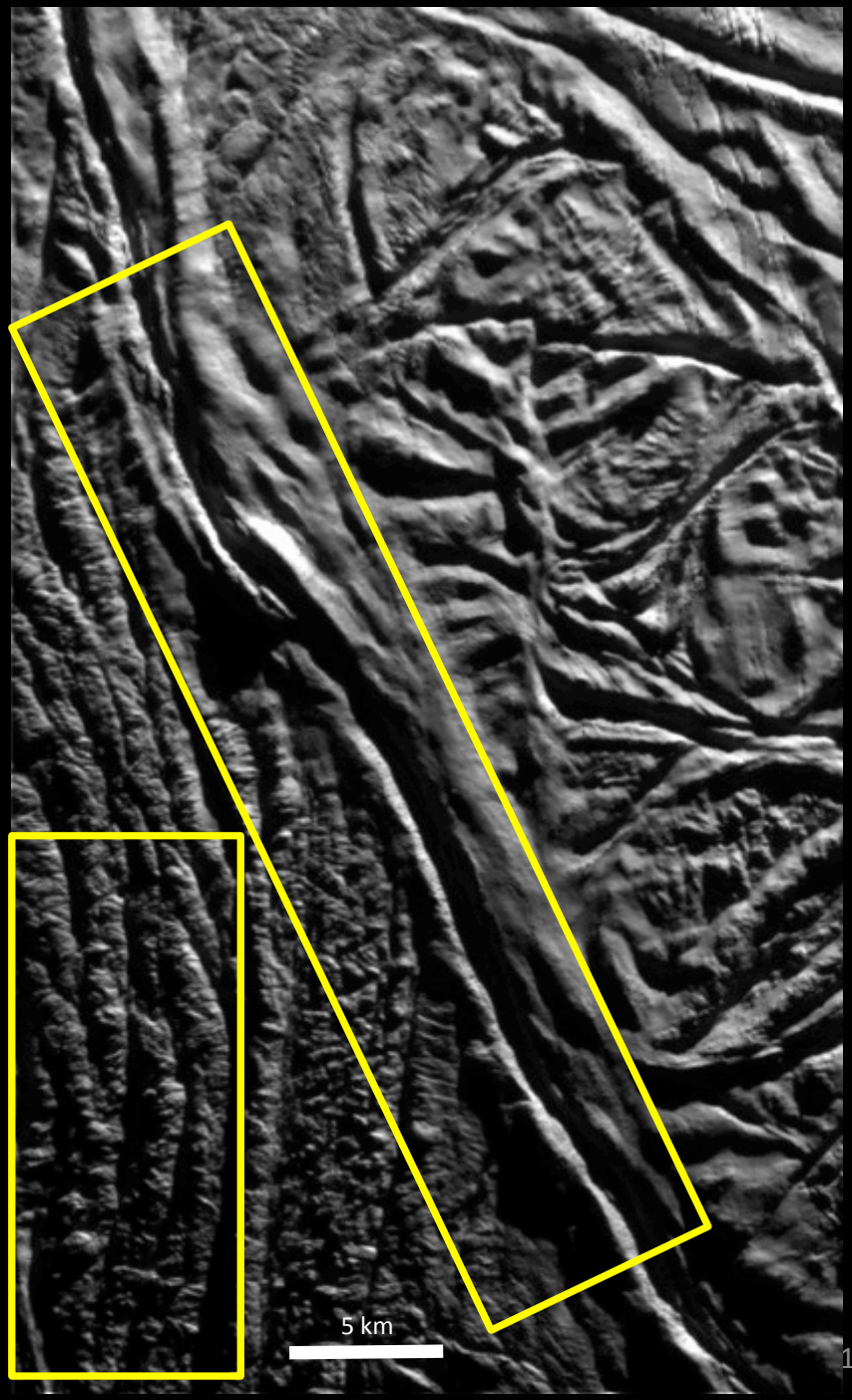


Cassini ISS basemap (Roatsch et al, 2013)

Crow-Willard & Pappalardo, 2015

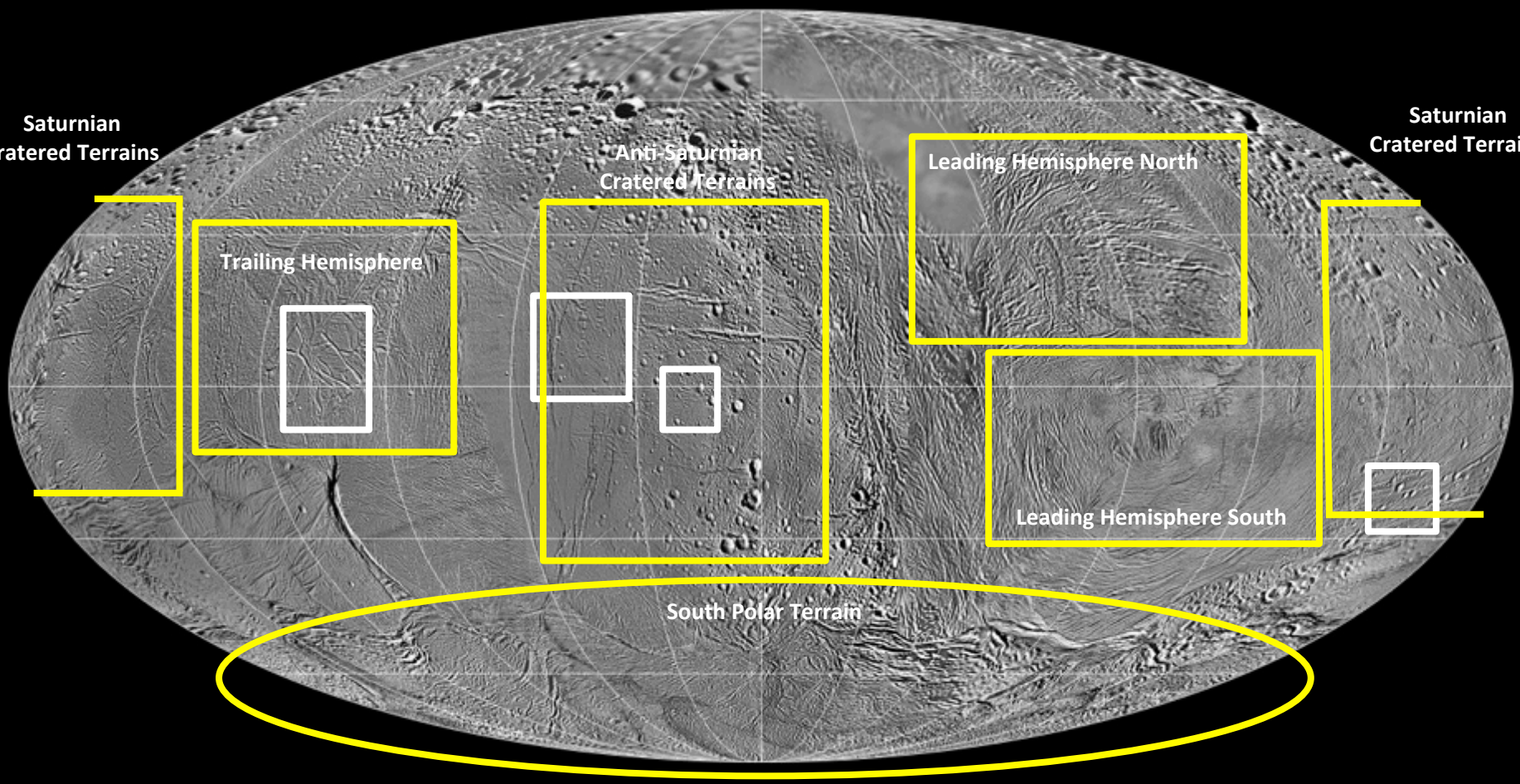
SPT Ridge Types

- Ropey terrain
- Double ridges
  - Tiger stripes



N1597182735

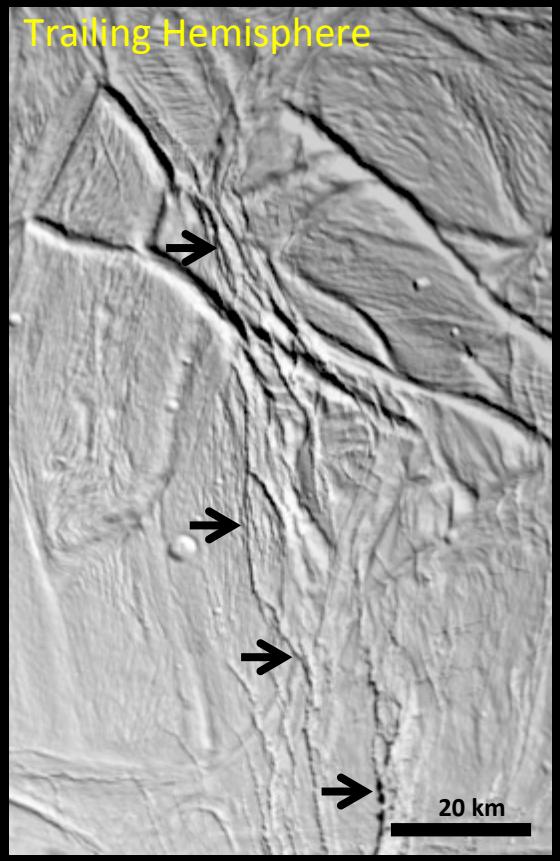
Recent Fracturing

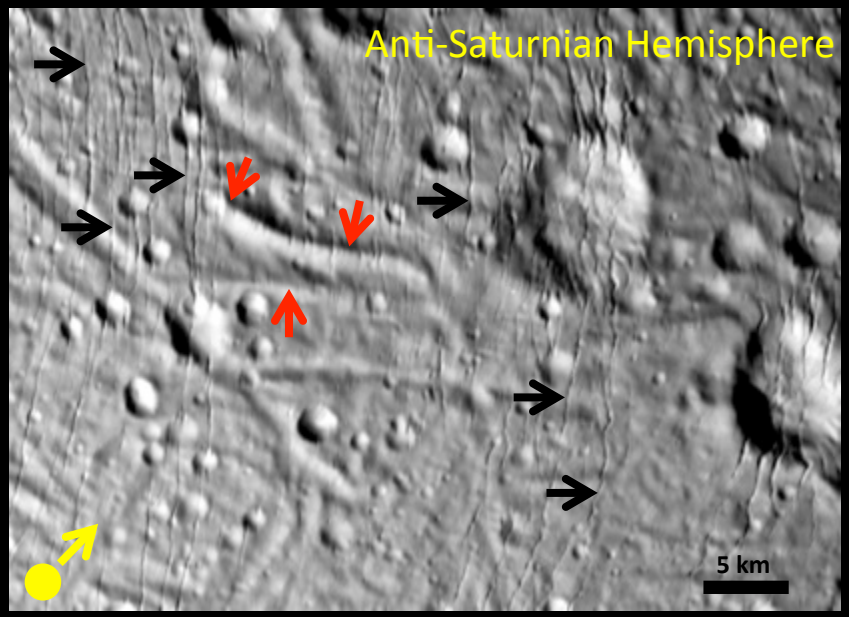


Cassini ISS basemap (Roatsch et al, 2013)

Crow-Willard & Pappalardo, 2015

Recent Fractures





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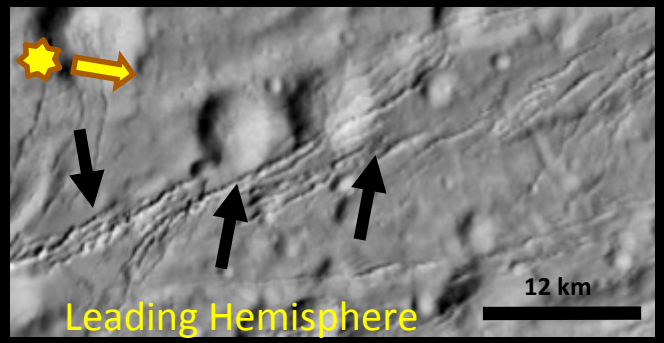
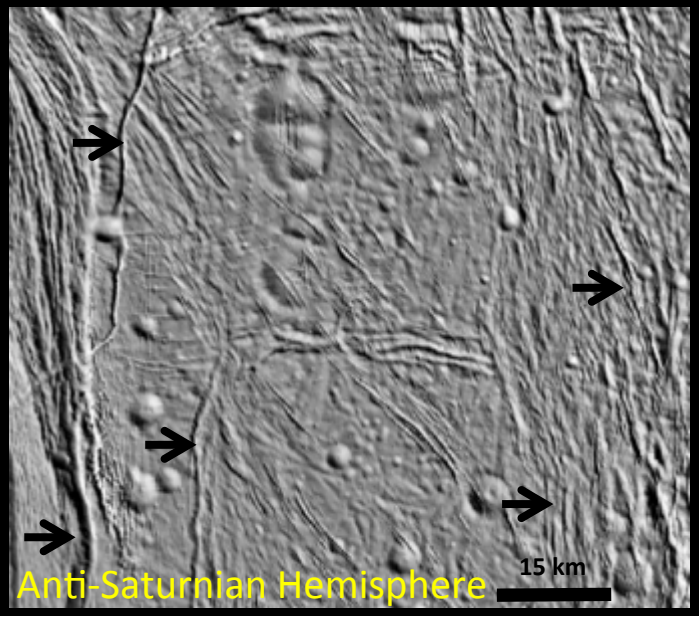


USGS Cassini Basemap



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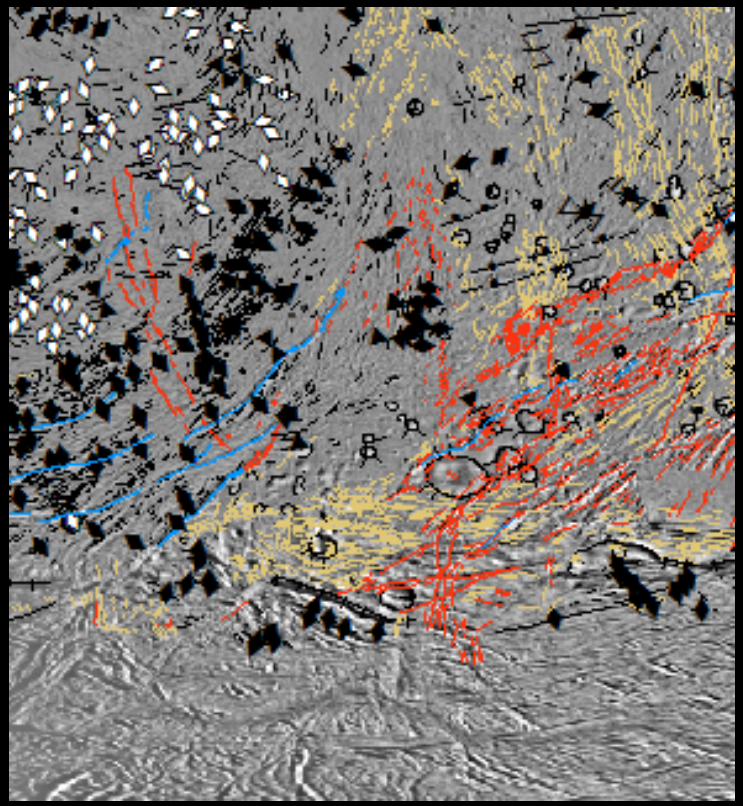
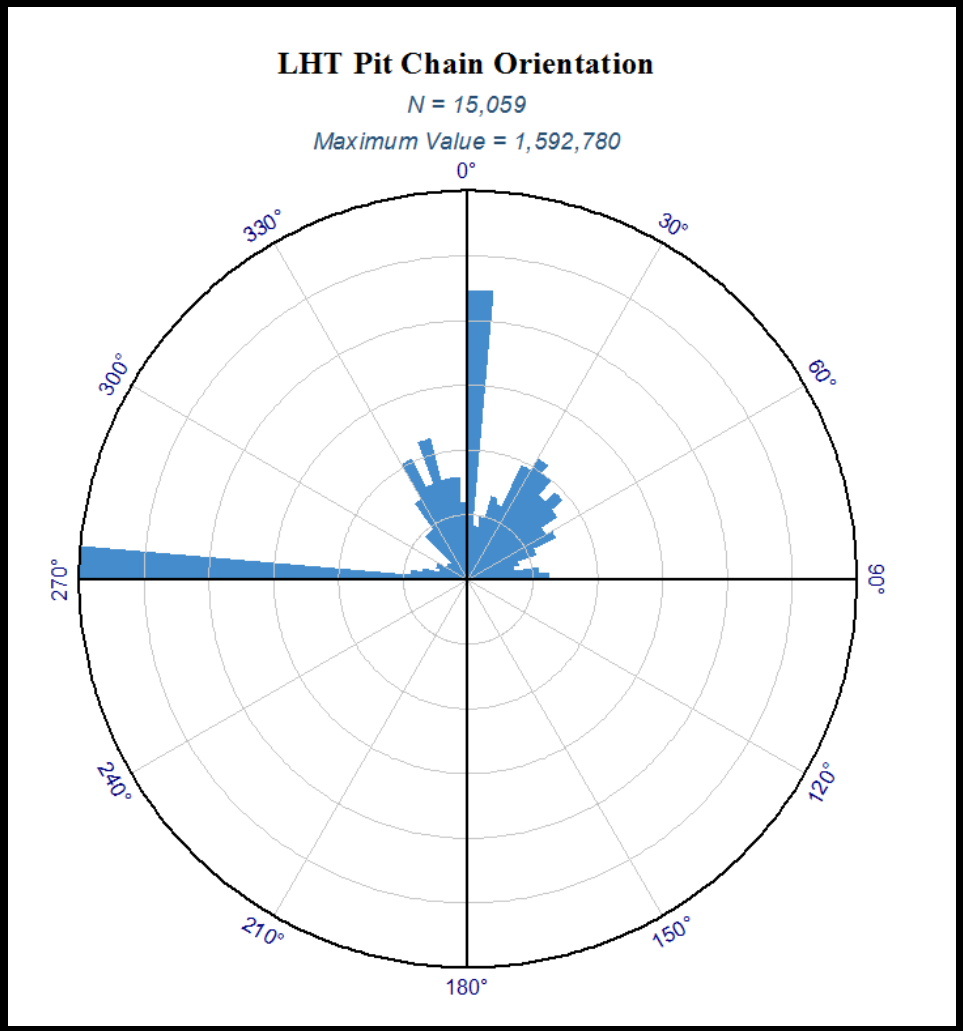
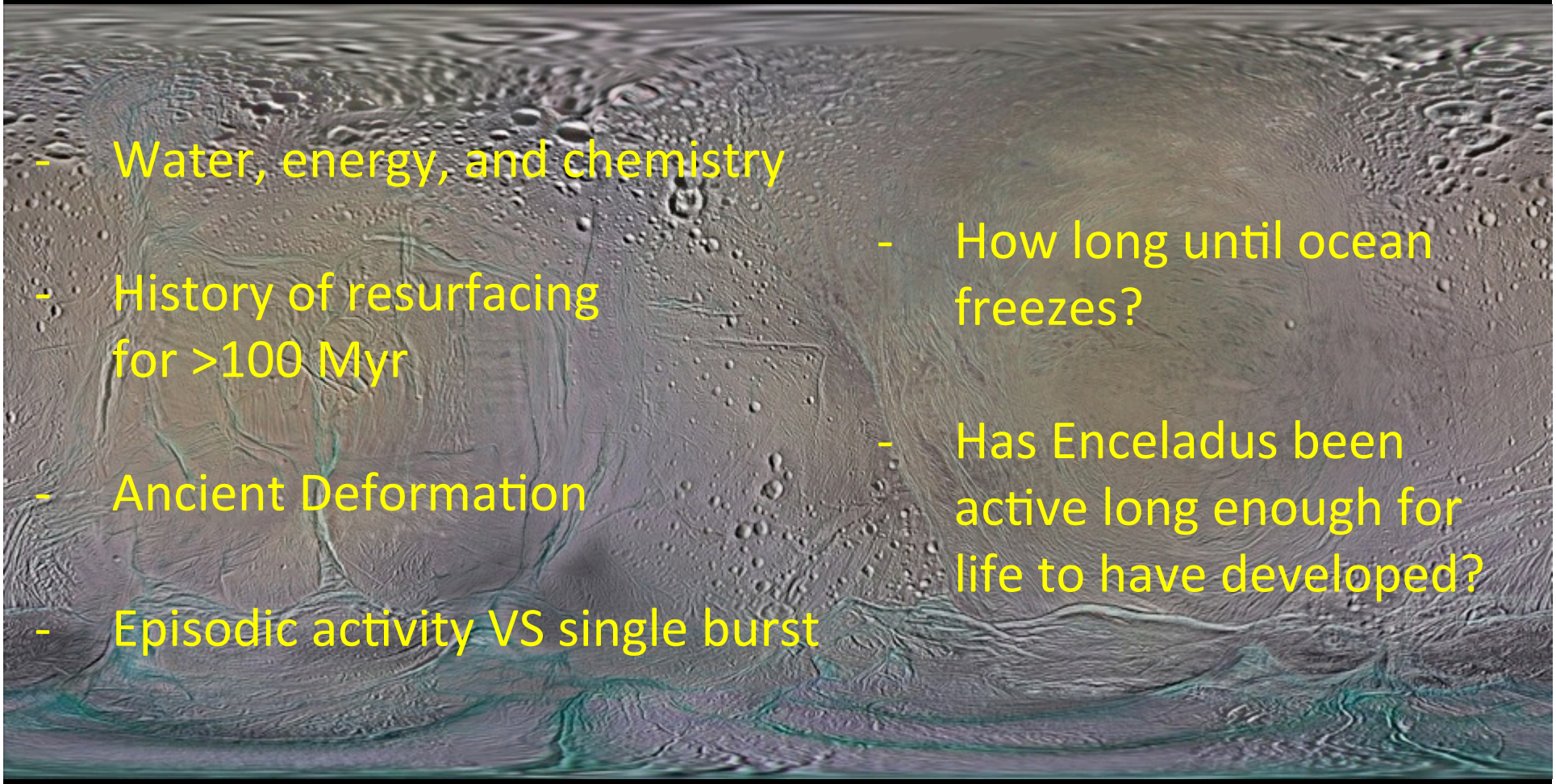
USGS Cassini Basemap

Orientation of Fractures in the Leading Hemisphere





Summary



- Water, energy, and chemistry
- History of resurfacing for >100 Myr
- Ancient Deformation
- Episodic activity VS single burst
- How long until ocean freezes?
- Has Enceladus been active long enough for life to have developed?