Constant-Scale Natural Boundary Mapping

Maxwell's Constant-scale Surfaces

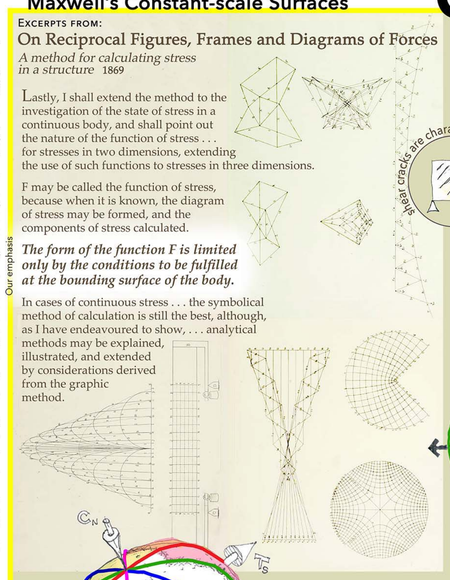
Excerpts from:
On Reciprocal Figures, Frames and Diagrams of Forces
A method for calculating stress in a structure 1869

Lastly, I shall extend the method to the investigation of the state of stress in a continuous body, and shall point out the nature of the function of stress . . . for stresses in two dimensions, extending the use of such functions to stresses in three dimensions.

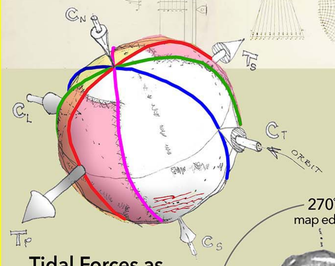
F may be called the function of stress, because when it is known, the diagram of stress may be formed, and the components of stress calculated.

The form of the function F is limited only by the conditions to be fulfilled at the bounding surface of the body.

In cases of continuous stress . . . the symbolical method of calculation is still the best, although, as I have endeavoured to show, . . . analytical methods may be explained, illustrated, and extended by considerations derived from the graphic method.



James Clerk Maxwell (1831–1879), *Transactions of the Royal Society of Edinburgh*, Vol. 26, pp. 1-40
Our emphasis

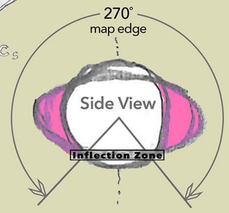


Tidal Forces as Equivalent Concentrated Loads

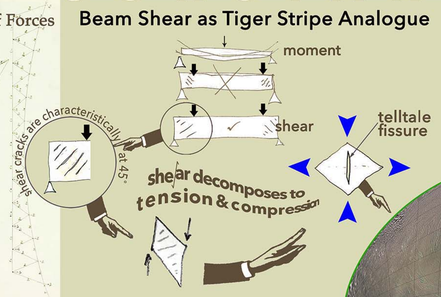
- T_P tension toward stars
- T_S tension toward Saturn
- tension bulge
- leading hemisphere

- C_N compression @ north pole
- C_S compression @ south pole
- C_T compression @ trailing hemisphere
- C_L compression @ leading hemisphere

✓ checks *(at right)* indicate alignment of required shear vector with tidal vector

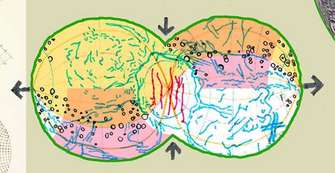


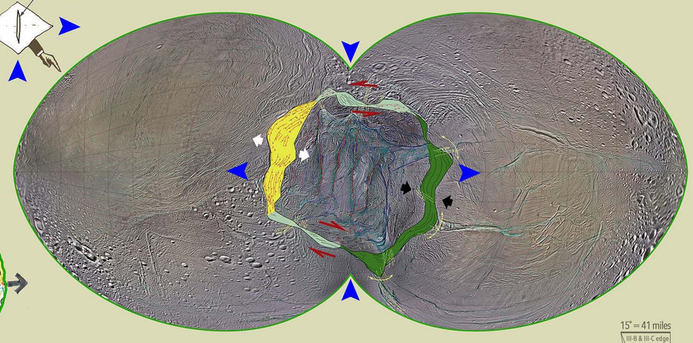
Beam Shear as Tiger Stripe Analogue

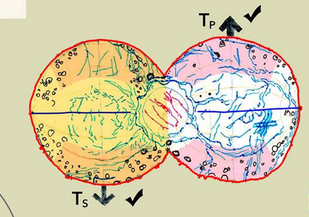


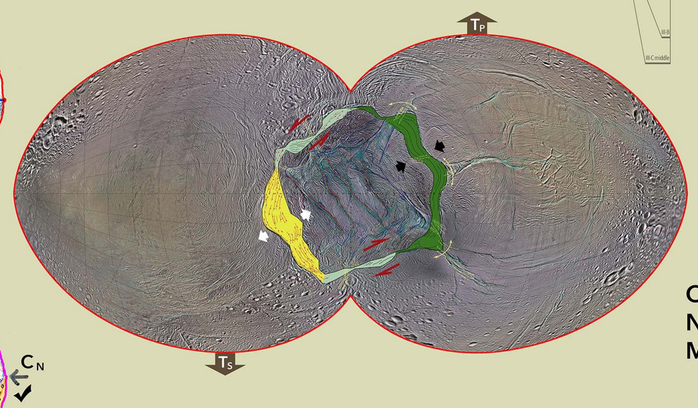
South polar graphic adapted from A. Yin & B. Pappalardo
Fig. 2(B) **Interpreted Structural Map of South Polar Terrain**
in "Gravitational spreading, bookshelf faulting, and tectonic evolution of the South Polar Terrain of Saturn's moon Enceladus," *Icarus* 260 (2015) 409–439

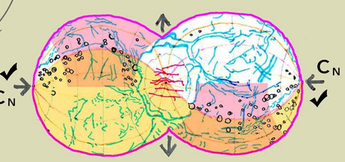
Pseudo-Eisenlohr Projections as non-Euclidean Maxwell Surfaces

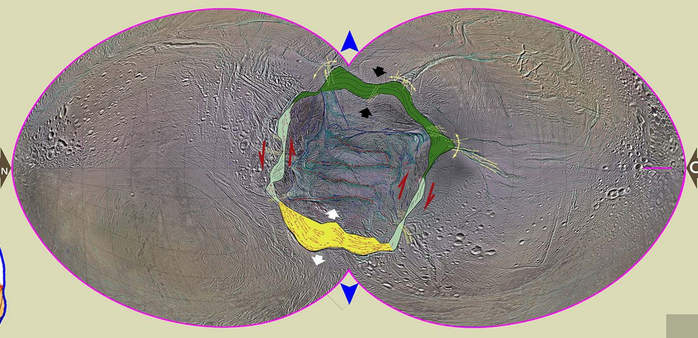


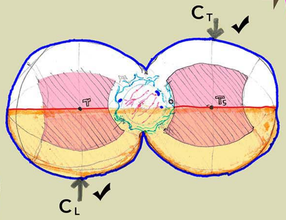


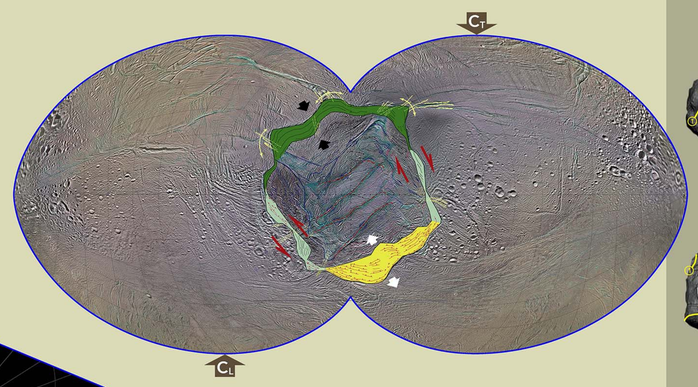






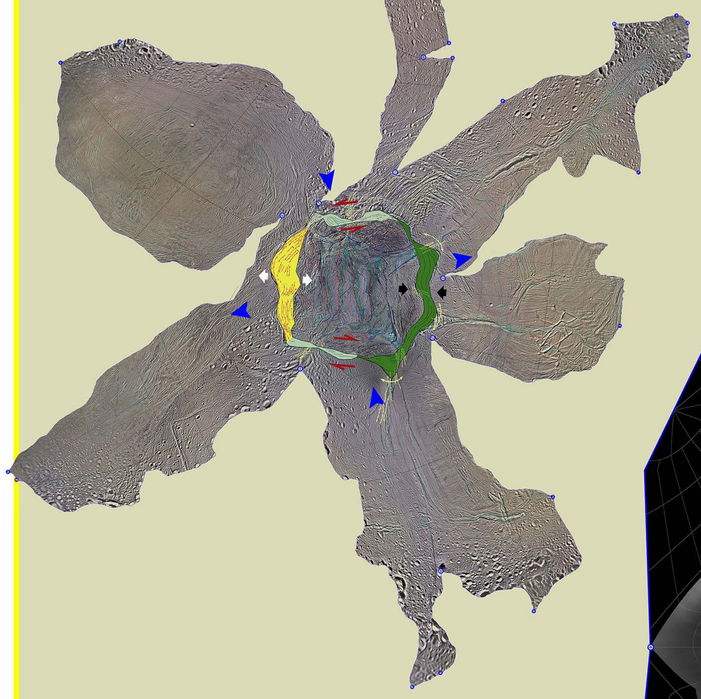




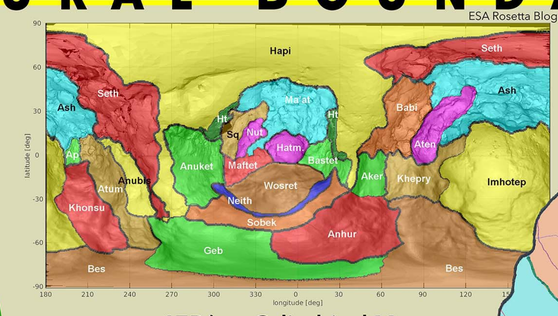


Enceladus

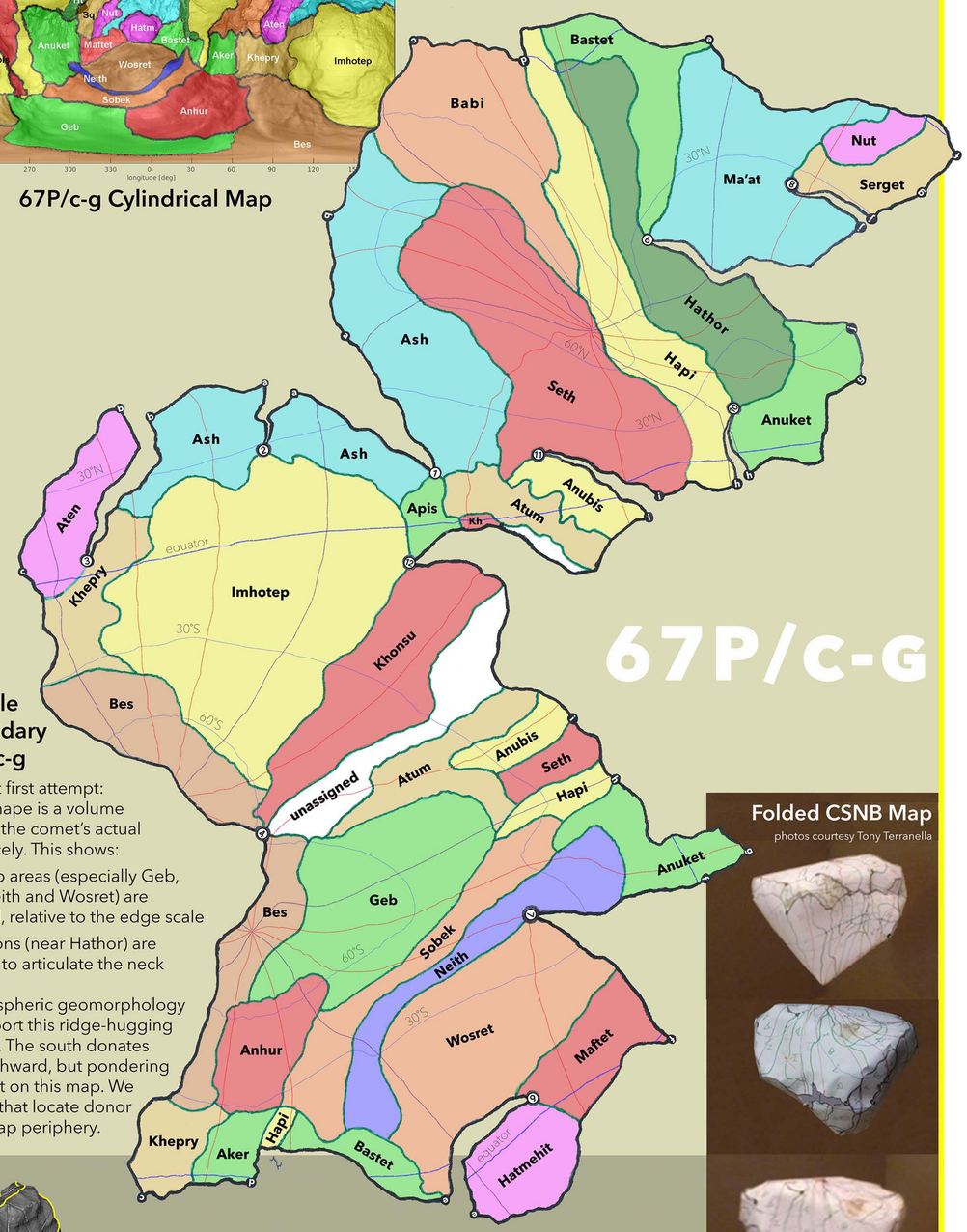
Assuming Enceladan tiger stripes are shear cracks, sepia arrows show forces necessary to produce the observed 45° orientation, if the Enceladan surface were a simply supported beam. Enceladus, of course, is not a beam; it is a falling body subject to parent-planet and sibling-moon gravitation. Nonetheless, the analogue might hold.



ESA Rosetta Blog



67P/c-g Cylindrical Map



67P/c-G

Constant-Scale Natural Boundary Map of 67P/c-g

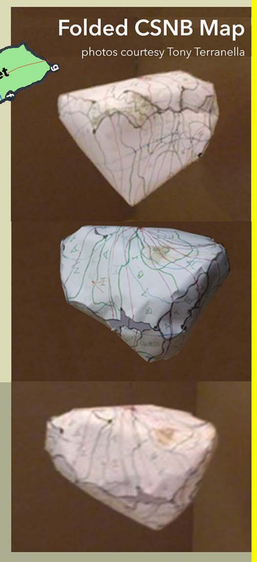
An imperfect first attempt: the folded shape is a volume within which the comet's actual shape fits nicely. This shows:

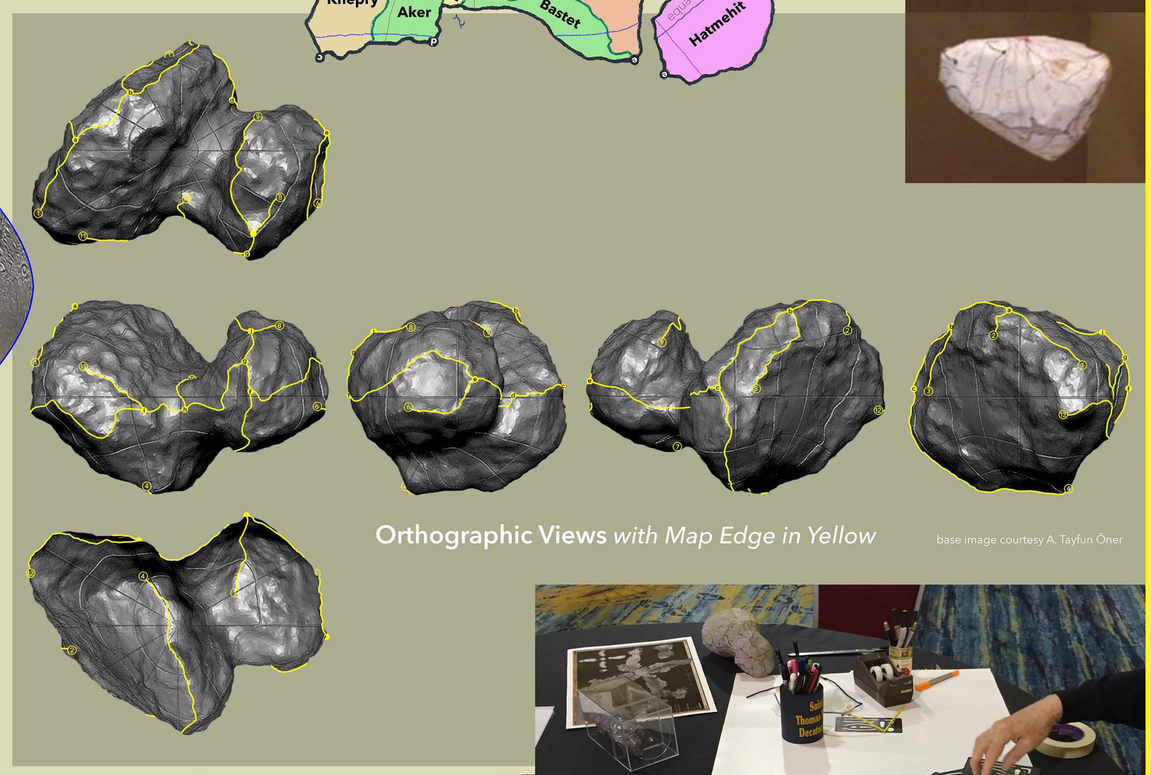
- Some map areas (especially Geb, Sobek, Neith and Wosret) are elongated, relative to the edge scale
- Interruptions (near Hathor) are necessary to articulate the neck

A flaw: hemispheric geomorphology doesn't support this ridge-hugging edge choice. The south donates material northward, but pondering this is difficult on this map. We need edges that locate donor regions at map periphery.

Folded CSNB Map

photos courtesy Tony Terranella



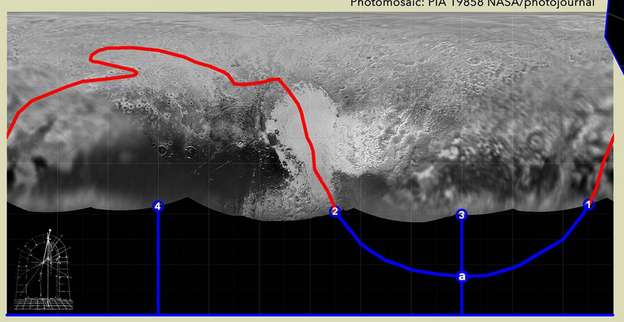


Orthographic Views *with Map Edge in Yellow*

base image courtesy A. Tayfun Öner

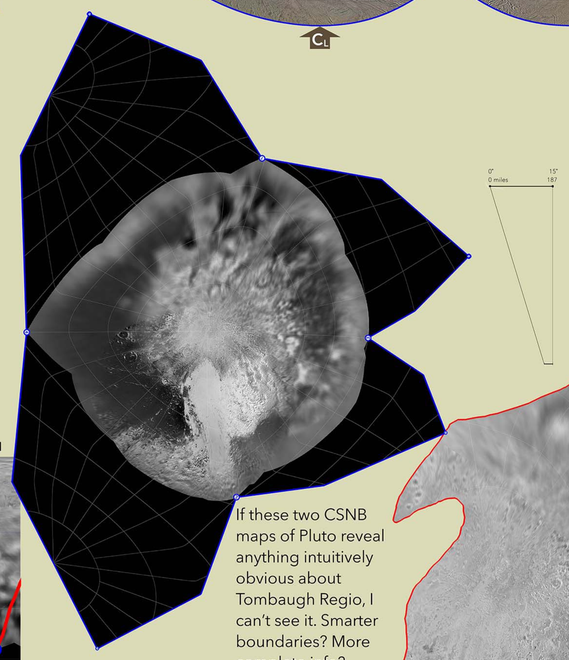
Map Assembly photo courtesy Marianne Mader

Photomosaics transformed from PIA18434, NASA/JPL-Caltech/SSI/LPI

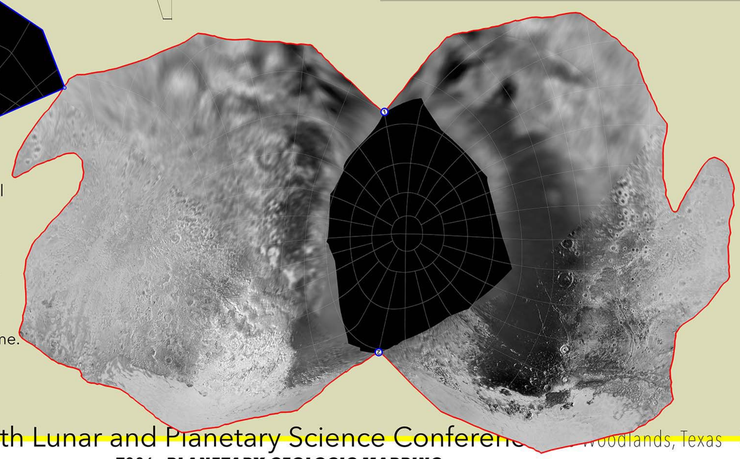


HOMAGE: Rampant Vault from *Brouillon Projet* (1640)
Girard Desargues, architect (1591–1661)

Photomosaic: PIA 19858 NASA/photojournal



If these two CSNB maps of Pluto reveal anything intuitively obvious about Tombaugh Regio, I can't see it. Smarter boundaries? More complete info? Suggestions welcome.



Pluto

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T326: PLANETARY GEOLOGIC MAPPING

Poster & Handouts courtesy: riot creative imaging
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