Constant-Scale Natural Boundary Mapping to Show Enceladan Polar Terrain in Global Context. C. S. Clark[1] and P. E. Clark[2], [1]Chuck Clark architect (1100 Alta Avenue, Atlanta, GA 30307, rightbasicbuilding@gmail.com) [2]Jet Propulsion Laboratory, California Institute of Technology (pamela.e.clark @jpl.nasa.gov).

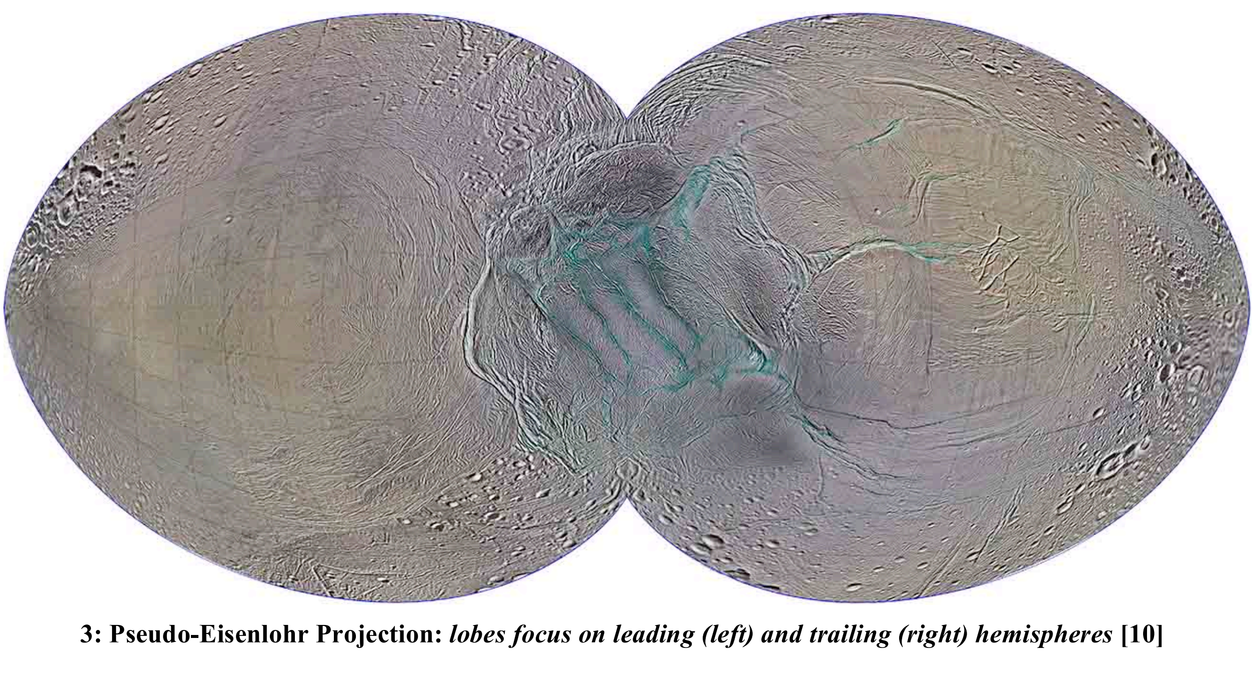
Background: As in the 16th century, when global explorations outmoded existing maps and led to Mercator's projection of 1564, we toe a similar threshold: current cartographic paradigms struggle to portray global dynamics. Mercator's projection, with later improvements, remains basic in cartography [1], yet this evolution matured long before the need arose to track global dynamics, as on Enceladus [2]. In 1614 Edward Wright applied algebra to Mercator's map, thereby eliminating tedious plotting of points [3], and opening the door to those later improvements—the panoply of projections with which all scientists are familiar. But Wright's innovation (simplifying slightly) limited the freedom to cut more than or less than 180˚: dividing by zero is a paradox. A specialist said, *Deepening the cusp of the Eisenlohr* [4] *while simultaneously preserving constant scale around the perimeter is mathematically quite challenging and likely would result in a definition of a projection that cannot be readily expressed by a finite combination of well-known transcendental functions* [5]. Yet a cut of 180˚ makes a map (Figure 2) with a polar region too small for satisfactory appraisal of global kinematics. For Enceladus a cut of 270˚ is excellent [6] because the cut stops at stress-regime inflection points. Constant-scale natural boundary mapping (CSNB) transforms the surface of any essentially globular object to the 2-dimensional plane by, in the first instance, following rules of perspective [7]; it allows 270˚ cuts. Algebraic shortcuts may be impossible, but CSNB is digitizable [8].

CSNB mapping: The cut is oblique, centered on the north pole (Figures 1, 4 and 5). Maps are hand plotted and Photoshopped. Figure 3 shows drafting the boundary: a wire controls constant scale; tape adjusts wire-position to force polar geometry (45˚S–90˚S) to cohere with azimuthal equidistant projection. (Note that constant scale also exists across the map's neck.) We elsewhere investigate the boundary's physical quality to analyse shear patterns [9].

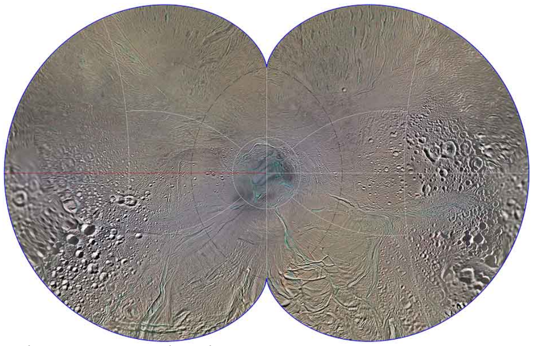
Summary: Comprehensive, well-focused and accurately proportioned images help to contemplate and communicate about planetary objects and processes. CSNB generates such images. We seek collaborations with science teams with resources to digitize CSNB.

To honor mathematician Fredrich Eisenlohr (1831–1904), who in 1870 presented the first map with constant-scale edge, we name this projection *pseudo-Eisenlohr*. It may be apt for other planetary objects.

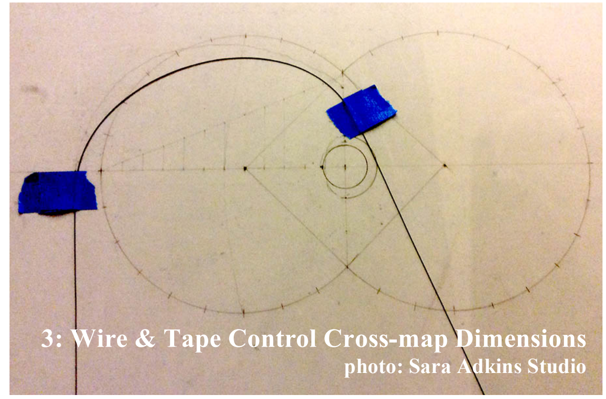
References: [1] Boyer C. B. (1968) *A History of Mathematics,* p. 329. [2] Clark C. S. and Clark P. E. (2015) *LPS XLVI*, Abstract #1389. [3] Boyer p. 329. [4] Snyder J. P. (1989) *An Album of Map Projections*, USGS Prof. Paper 1453, p. 184–185. [5] Strebe D., *Geocart*, (2015) pers. comm. [6] Pappalardo R. T. (2016) pers. comm. [7] Clark P. E. and Clark C. (2013) "Constant-Scale Natural Boundary Mapping to Reveal Global and Cosmic Processes," *SpringerBrief,* 116 pp. [8] Kirk R. L. (2007) pers. comm. [9] Clark C. S., Clark P. E. and Stooke P. J. (LPS 47 submitted). [10] photomosaic: PIA18434 NASA/JLP-Caltech/SSI/LPI.



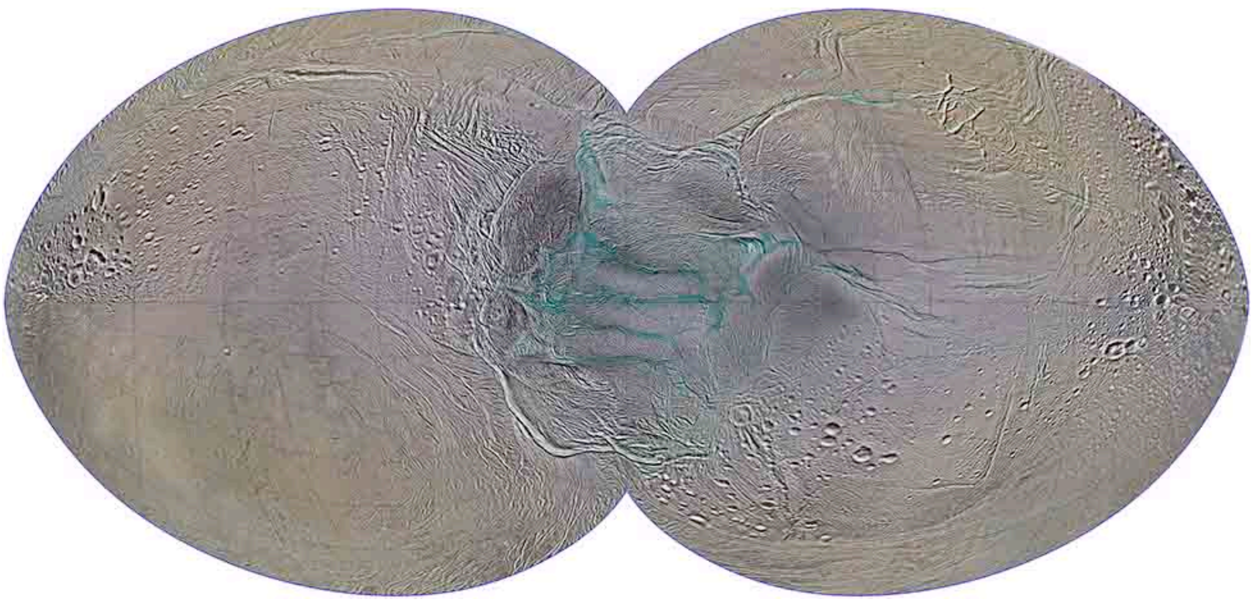
3: Pseudo-Eisenlohr Projection: ***lobes focus on leading (left) and trailing (right) hemispheres*** **[10]**



2: Eisenlohr Projection:
Note small southern pole, relative to lobes **[10]**



3: Wire & Tape Control Cross-map Dimensions
photo: Sara Adkins Studio



4: Pseudo-Eisenlohr Projection: ***lobes focused on tiger-stripe end conditions (dendrites left; hooks right)*** **[10]**

5: Pseudo-Eisenlohr Projection: ***lobe focus on sub-Saturnian (left) and anti-Saturnian (right) hemispheres*** **[10]**