

True Polar Wander of Enceladus From Topographic Data. Radwan Tajeddine^{1,*}, Krista M. Soderlund², Peter C. Thomas¹, Paul Helfenstein¹, Matthew M. Hedman³, Joseph A. Burns⁴, Paul M. Schenk⁵.

¹Center for Astrophysics and Planetary Science, Cornell University, Ithaca, NY 14853, USA

²Institute for Geophysics, John A. & Katherine G. Jackson School of Geosciences, The University of Texas at Austin, J. J. Pickle Research Campus Building 196 (ROC), 10100 Burnet Road (R2200), Austin, Texas 78758-4445, USA

³Department of Physics, University of Idaho, Moscow, ID 83844-0903, USA

⁴College of Engineering, Cornell University, Ithaca, NY 14853, USA

⁵Lunar and Planetary Institute, Houston, TX 77058, USA

*Corresponding author: Tajeddine@astro.cornell.edu

Abstract: Apart from the relative motion of lithospheric plates, the Earth as a whole moves with respect to its rotation pole, as shown by paleomagnetic, astrometric and geodetic measurements [1]. Such so-called *true polar wander* (TPW) occurs because our planet's moments of inertia change temporally owing to internal thermal convection and to the redistribution of surficial mass during ice ages. Thus, to conserve angular momentum while losing rotational energy, Earth's axis of maximum moment of inertia aligns with its spin axis. Theoreticians suspect similar reorientations of other celestial bodies but supporting evidence is fragmentary, at best [2]. Here we report the discovery of a global series of topographic lows on Saturn's satellite Enceladus indicating that this synchronously locked moon has undergone reorientation by $\sim 55^\circ$. We use improved topographic data from spherical harmonic expansion of Cassini limb [3,4,5] and stereogrammetric [5,6,7] measurements to characterize regional topography over the surface of Enceladus. We identify a group of nearly antipodal basins orthogonal to a topographic basin chain tracing a non-equatorial circumglobal belt across Enceladus' surface (Figure 1). We argue that the belt and the antipodal regions are fossil remnants of old equator and poles, respectively. We place the former north and south poles respectively at (79°W , 35°N) and (259°W , -35°N). The topographic lows are proposed to arise from isostatic compensation [7,8] with their pattern reflecting variations in internal dynamics of the ice shell. Our hypothesis is consistent with a variety of geological features visible in Cassini images [9].

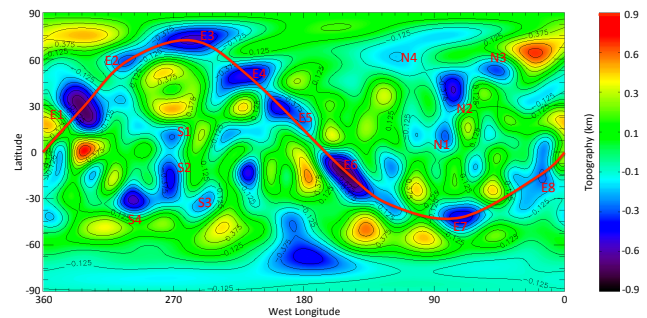


Figure 1. Topographic map of Enceladus based on degree $l=4$ to $l=16$ in spherical harmonics.

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