Testing Models for the Formation of the Equatorial Ridge on Saturn’s Moon Iapetus via Crater Counting

Amanda Damptz and Andrew Dombard
Department of Earth and Environmental Sciences
University of Illinois at Chicago

Introduction

Iapetus’s equatorial ridge is unique in the solar system (Fig. 1)

Formation of the ridge is likely attributed to key events in the evolution of Iapetus

Several hypotheses have been proposed for ridge formation, all of which fall under two categories: endogenic and exogenic

Endogenic
Despinning
Upwarping of the Lithosphere
Cryovolcanism

Exogenic
Impact Generated
Ancient Ring System

Purpose of this study: examine the crater population on and around the ridge, test the various models of ridge formation, and assess the age of the ridge

Formation Model Hypotheses

Each model includes predictions about the crater population that, in turn, can be used to differentiate these models

We compiled a list of models for ridge formation and expecant crater population (see Table 1)

Testable predictions include the time frame of ridge formation, crater saturation, and elongated or transformed craters

Crater saturation plays a major role in this study - if reached a lower age limit will be obtained

Methods

We use two global mosaics of Iapetus: (1) Cassini and Voyager data (c/o Cassini Image Science Team), (2) Cassini data only (c/o P.M. Schenk)

Craters are measured and cataloged in ArcGIS using the Crater Helper Tool
An ellipse (6-point) is used to generate latitude, longitude, diameter, extent, and major and minor axis azimuth

All craters counted within 8° North and South are considered "on ridge"

Identifying craters in areas of low-resolution
Crater rims in the high-resolution regions are indicated by bright pixels (Fig. 2A)

Crater rims can then be identified in low-resolution regions by using the brightest pixels surrounding dark depressions (Fig. 2B)

Resolution of images available for Iapetus limits further crater classification (e.g., simple, complex, and multi-ring basin, ejecta deposits, primary and secondary craters, etc.)

Some features are somewhat ambiguous as to whether it is a crater or mass wasting on the ridge

We make use of a recent study that identified large scale landslides [13]

Preliminary Results

The database, to date, contains 8,029 craters

Craters range from 1 km to 591 km in diameter

Total counts from leading and trailing hemispheres are 4,603 and 3,426 respectively

Lower numbers in the trailing hemisphere could be an observational bias

Our preliminary results focus on the region of highest resolution (186,616 km²) and contains 2,013 craters

We have yet to perform a robust statistical analysis other than generate confidence intervals

Our counts are similar to other published cumulative crater size-frequency distribution of Iapetus [14]

The ridge appears to be less cratered (younger?)
It is possible that landslides effectively reset the surface of a smaller crater population

Orrientation of craters located on the central ridge do not show a strong preference in the E-W direction but perhaps N-S
It is unclear if this is an observational bias due to reprojection of the images of the ridge itself

Off ridge, as expected, does not show any orientation preference of the long axis

Preliminary Conclusion:
The crater population in the high-resolution region is most consistent with the impact generated formation model [1]