TOPOGRAPHY OF ENDOGENIC FEATURES ON SATURNIAN MID-SIZED SATELLITES. J.M. Moore[1] and P.M. Schenk[2], [1] NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035 (jeff.moore@nasa.gov), [2]Lunar and PlanetaryInstitute, 3600 Bay Area Blvd., Houston, TX 77058 (schenk@lpi.usra.edu).

Introduction: We have produce digital elevation models (DEMs) from images of the middle-sized saturnian satellites by *Cassini*. Among several studies we've utilized these DEMs is an investigation of the endogenic features (tectonics and putative cryovolcanism) on these satellites. As Enceladus has been subjected to many focused studies, we have concentrated on the other mid-sized satellites. Among our initial findings are that: (1) Dione (Fig. 1) has ridge-bounded high-standing plains; (2) Rhea (Fig. 2) has a N-S belt of well-defined graben and extensional faults at ~270° that are co-incident with its 'wispy terrain;' and (3) Tethys' plains unit boundary is (at least in the first region we examined) is gradational.

Topographic Mapping Techniques: Topographic mapping of the Saturnian satellites has been limited in the past to limb profiles describing the general shape of the satellites [e.g., 1] and very limited photoclinometry (PC) line profiles of selected features [e.g., 2]. Our new topographic mapping of these satellites is based on two methods, stereo image analysis and PC of low-sun regions, and allows us to produce DEMs of large surface areas. Stereo analysis is based on an automated scene recognition algorithm successfully applied to the Galilean satellites [3] and recently updated to improve surface resolution of the DEM [4]. Areal coverage of stereo DEMs is limited by the rapid nature of the *Cassini* flybys. Not considering Enceladus, Tethys, Dione (Fig. 1) and Rhea (Fig. 2) have the best stereo coverage, with much of their surfaces mappable at better than 100 m vertical resolution and better than 1 km horizontal resolution. Photoclinometry (PC) greatly extends topographic coverage, with the proviso that long-wavelength topographic variations are suspect using this technique, unless controlled by coincident stereo coverage. We employed a PC algorithm developed by the second author for rapid 2-dimensional PC mapping that includes modeling of local albedo changes [5]. PC mapping is generally limited to areas within 30° of the local terminator.

A necessary precursor to topographic mapping using imaging is the existence of an accurate coordinate control network for the *Cassini* images. Extensive effort was made to adjust the control on the relevant images using ISIS software. In order to do so successfully, it was necessary to close the network over 360° of longitude despite the fact that there was usually a factor of 20 or more difference in the resolution from the first to the last images used. Based on these new networks we have constructed new global mosaics for each satellite using the best available images for all surface areas.

Observations and Initial Inferences:

Tethys – The region antipodal to the 450 km-diameter Odysseus is covered by plains. If the plains were formed by seismic shaking from the Odysseus impact event, there would probably be a significant transition zone between that unit and the hilly and cratered terrain (i.e., a blocky, rugged zone similar to Mercury's hilly and lineated terrain). Alternatively, it has been suggested [e.g., 6] that the plains were form by cryovolcanic resurfacing, in which case the boundary should be abrupt and presumably composed of plains-facing scarps. Our initial DEM of the plains boundary at one location seems to support the seismic shaking hypothesis, as there is no obvious sharp transition from the plains to the cratered terrain to the west. Additional on-going processing of currently available coverage of other areas of the plains boundary and much better coverage planned for later this year will hopefully further clarify the nature of this boundary.

Dione – Several *Voyager* era studies [7, 8] noted the presence of a smooth plain, crossed by both ridges and troughs, near the 90°W longitude, and extending eastward. *Cassini* coverage now allows us to see the westward extension of this plain. Like the eastern portion observed by Voyager, the western plain also exhibits both ridges and troughs. However, the ridge system is much more pronounced. The western ridges are planometrically narrower and morphologically better expressed (e.g., their relative lack of degradation). These western ridges also much more closely conform to the boundary between the plain and the older rolling cratered terrain to the west. Surprisingly, the plains unit is topographically higher than the cratered terrain. This seems a little difficult to reconcile with the plains being emplaced as a low-viscosity cryovolcanic flow. One possibility is that the plains material was emplaced as a deformable plastic (like terrestrial glaciers), but this, or any other, explanation needs both further evidence and thought.

Rhea – Images, and DEMs derived from them, of the trailing hemisphere of Rhea seen from both mid northern and far southern latitudes clearly show the wispy terrain is associated with a graben/extensional-fault system. This is the first recognition of unambiguous expression of regional endogenic activity on Rhea. In previous work [9] large, broad, generally N-S trending ridges located west of the graben/scarp system, including a prominent ridge at ~ 0°W, have been tentatively interpreted as compressional features. If these ridges are, in fact, due to compressional tectonics, their geometric relation to the graben/scarp system may also indicate a genetic relationship. Nowhere so-far seen on Rhea in DEMs are any regions that would qualify as plains, enforcing the perception that Rhea shows no record of cryovolcanic resurfacing. However, unlike Dione, the diffuse nature of the wisps in Rhea have yet to be explained by numerous smaller bright scarps associated with fracture and faulting, and may yet be shown to be an expression of cryo-pyroclastic mantling [10].

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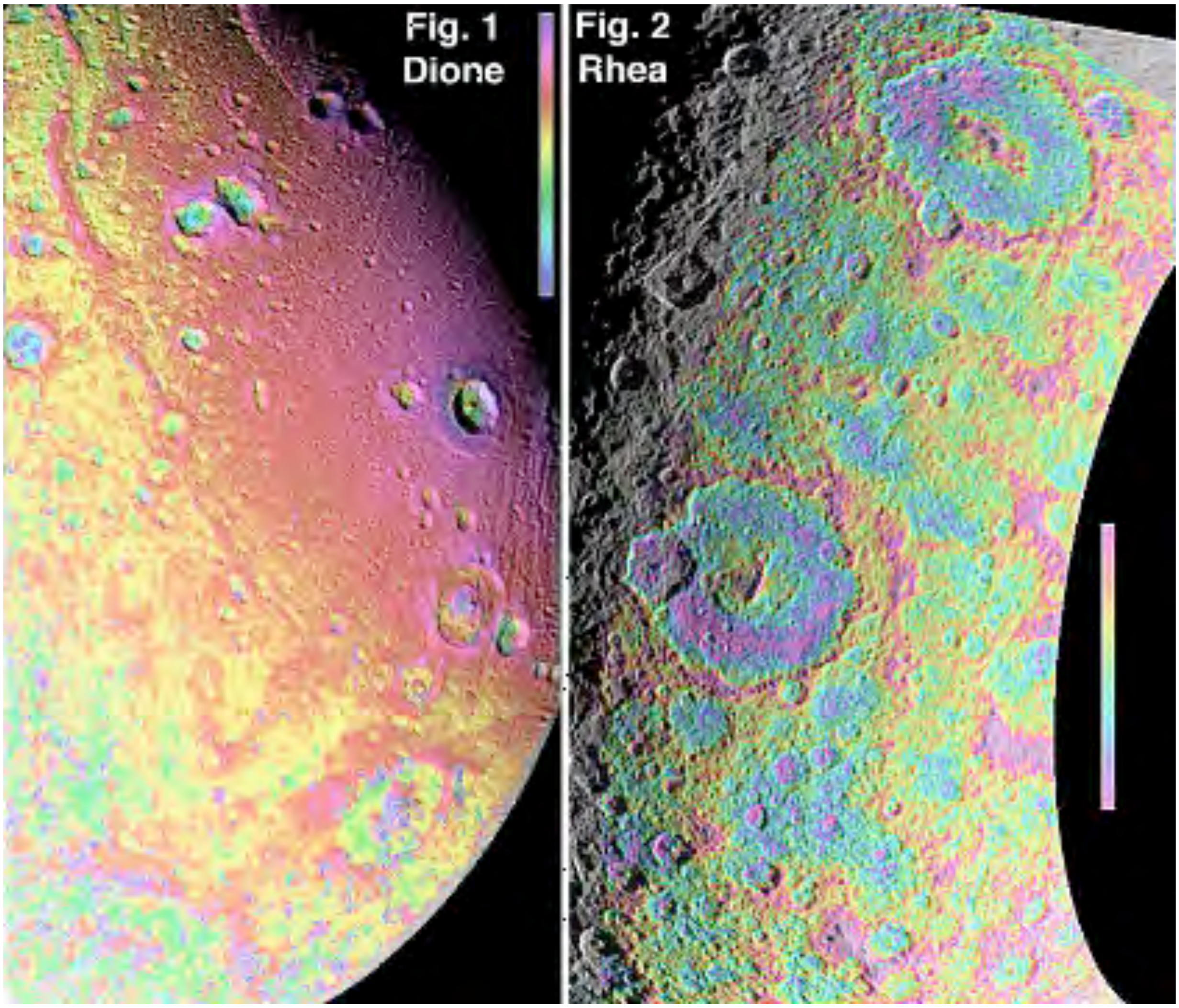

Fig. 1. DEM of Dione's plains W of ~90°W revealing that the plains stand higher than the older cratered terrain to the west of the plains. Note also that the ridge system closely conforms to the boundary of the plains and post dates the plains,

Fig. 2 DEM of the high southern latitudes of Rhea along the ~270°W longitude. Note the N-S trending graben and extensional fault system that is especially well seen between the two large craters. This graben/fault system continues northward for another ~60° and is the first recognized unambiguous expression of endogenic activity observed on Rhea. This graben/fault system is coincident with Rhea's "wispy terrain." Vertical relief bars in both DEMs = +3 to -3 km.