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Composition and Structure of Iapetus - Constraints on the Kronian Nebula

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On January 1, 2005, Cassini flew by Iapetus at a distance of 55,300 km. The satellite's GM was determined from navigation data as 120.5432 $\pm$ 0.0791 km3/s2 (Cassini Navigation Team, personal communication.) Limb measurements from Cassini images indicate that Iapetus has a mean radius of 725 $\pm$ 5 km. However, large topography anomalies are present at different scales: the overall departure from sphericity may be well over 10 km. Combination of these data yields a density equal to 1132 $\pm$ 24 kg/m3. This density is lower than the mass-weighted average of the Saturnian icy satellites, 1300 kg/m3. It is unlikely that porosity be responsible for such a small value, due to self-compression and partial to full melting of the satellite during its evolution. This suggests a possible enrichment in volatiles and low-density hydrocarbons. The rock mass fraction ranges from 0.21 to 0.30, depending on the hydrated state of the silicates. We will discuss the constraints Iapetus' GM hints on the environment in which it formed and evolved. Thermal evolution models take into account the effect of short-lived radiogenic elements if Iapetus formed earlier enough after the formation of CAIs. The effect of species such as NH3 and CO2 will be discussed. The possibility of thermal convection within the ice will be assessed based on models that account for temperature-dependent viscosity. The link between marginal convection and the large topography anomalies that are present at different scales will be discussed. The presence of a prominent equatorial ridge, 1300 km long, and up to 20 km high in certain places is singular for a body composed mainly of water and volatiles. Iapetus' evolution model is compared with that of Rhea, whose degree-two gravity field will

be measured by Cassini in November 2005. This will constrain Rhea's density profile and by comparison give some input on Iapetus'geological history.