Uniform Parameterized Theory of Convection in Medium Sized Icy Satellites of Saturn

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A b s t r a c t

We develop a parameterized theory of convection driven by radiogenic and tidal heating. The tidal heating depends on eccentricity e of a satellite's orbit. Using parameterized theory we determine the intensity of convection as a function of e and satellite's properties. The theory is used for 6 medium sized satellites of Saturn. We find that endogenic activity on Tethys and Dione is possible if e exceeds some critical values e_{cr}. For Enceladus, e was probably close to the present value for billions of years. We cannot find constrains for e of Mimas and Iapetus. The theory successfully predicts the possibility of present endogenic activity in Dione and rules out such activity in Tethys. Both these facts were recently confirmed by Cassini mission.

Key words: medium-sized satellites, thermal evolution, tectonics, orbit, eccentricity.