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Constraints on Tidal Heating in Enceladus and Mimas

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Surface features suggest recent geologic activity of the Saturnian satellite Enceladus. Additionally, observations of plumes obtained by the Cassini spacecraft show, that Enceladus is active at present. However, the internal source of energy, necessary to initiate and to maintain such an activity, is not known. One conceivable possibility would be tidal heating in the moon's interior in combination with radiogenic heating in the rocks. However, for the present orbital and rotational state of Enceladus the tidal heating rate turns out to be rather small. In this study we estimate an upper bound of energy provided by tidal dissipation for the present state of Enceladus. We explore the parameter space, mainly rheological parameters like viscosity and rigidity of ice and rocks, as well as different interior structure models to estimate the maximum tidal heating rate. We apply our model also to Mimas, the inner neighbor of Enceladus. Although the rock content is smaller in Mimas, both satellites are rather similar with respect to their sizes and bulk compositions. With Mimas being closer to Saturn, the lack of activity on Mimas makes an explanation of present activity on Enceladus due to tides even more difficult.