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"Heating of Enceladus: Is there a subsurface ocean?"

James Roberts

University of California, Santa Cruz

Cassini has revealed some striking features on Enceladus. The south polar region is particularly interesting, with its young surface age, vast "tiger-stripe" fractures, vapor plume, and elevated heat flow, all on a world only 500 km across. In this talk, I will review these fundamental observations, and describe my attempts to use geodynamic models to explain the surface features and to infer the state of the interior. Tidal dissipation may be significant in the ice shell if the shell is decoupled from the silicate core by a subsurface ocean, and is the probable heat source for the south polar thermal anomaly. I will present models of convection and conduction in the ice shell of Enceladus which include the spatially-variable tidal heat production. In all cases, the shell removes more heat from the interior than can be produced in the core, resulting in cooling of the interior and the freezing of the putative ocean. I will also discuss the effects of near-surface heating through shear motion along the tiger-stripes, and show that localized near-surface heating enhances convective upwelling beneath it. The near-surface heating promotes melting of ice deep in the shell, which likely results in subsidence of the surface topography. The subsidence and plume buoyancy may drive planetary reorientation, potentially explaining the south polar location of the observed thermal anomaly. However compositional effects are likely required in addition to thermal effects to generate large degrees of reorientation.