



Enceladus' Hydrothermal Activity

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Eruptive plumes and a large heat flow observed by Cassini in the South Polar Region are expressions of hydrothermal activity inside Enceladus. We discuss a model that delivers the required heat flow and also supplies the necessary chemicals, including gas bubbles to the chambers from which the plumes erupt. A subsurface ocean charged with dissolved gases is the source for the heat and the chemical species. A closed-loop circulation system brings water up from the ocean to the surface region where heat is transferred to the surface ice that radiates it to space. As ocean water moves toward the surface, pressure is reduced and gases come out of solution and form bubbles. This bubbly mixture is less dense than the icy crust and rises toward the surface through conduits. As the water transfers heat to the ice lid, it cools rapidly, bubbles contract and dissolve, and the now relatively dense mixture descends via cracks and returns to the ocean. Once the closed-loop circulation has started it is self-sustaining. The amount of water-circulation required by the erupting plumes is relatively small compared to the amount needed to maintain the heat flow. A number of processes can start the hydrothermal activity and the relative merits of their applicability for Enceladus will be considered. This work was conducted at the Jet Propulsion Laboratory, California Institute of Technology under NASA contract, and for JIL under "Incentivazione alla mobilit  di studiosi stranieri e italiani residenti all'estero" of Italy.