

Hydrogen hydrates inside Titan

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Saturn's celebrated moon, Titan, is continuously discharging enormous number of hydrogen atoms into space. Origin of the hydrogen has been attributed to photosensitized dissociation of methane in the atmosphere, where many kinds of organic molecules are photochemically synthesized. The active photochemistry during the satellite's long history should have produced a liquid layer of condensable hydrocarbon products, which accumulates to at least a kilometer on the satellite's frozen surface. However, the Cassini-Huygens mission has failed to find this 'promised' global ocean, which provokes the sensational discussion about how to secretly sequester the liquid hydrocarbon products. Here we propose that continuous hydrogen supply could be outgassing from the satellite's frozen solid body, rather than coming from the dissociation of atmosphere. We first report anomalously fast diffusion phenomena of hydrogen through many crystalline hydrate phases which build up substantial part of solid Titan. The hydrogen stored in these hydrates was originally produced by iron-water or silicate-water reaction within the satellite's primordial core, which had occurred in the very early history of the satellite.