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The surfaces of Titan and Enceladus studied by a future mission

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Abstract

Titan is a complex world more like the Earth than any other: it has a dense, nitrogen dominated atmosphere, with an active climate and meteorological cycles where conditions are such that the working fluid, methane, plays the role that water does on Earth. Titan's geology, from lakes and seas to broad river valleys and mountains, while carved in ice is, in its morphological processes, much like Earth. Supporting this panoply of Earth-like processes is an ice crust that floats atop what appears to be a liquid water ocean. Titan is also rich in organic molecules—more so in its surface and atmosphere than any other place in the solar system, except Earth. These molecules form in the atmosphere, are deposited on the surface and, in coming into contact with liquid water may undergo an aqueous chemistry that could replicate aspects of life's origins.

Enceladus is a world apart from Titan in many respects; however, the unexpected high heat flow from Enceladus' South Pole and its eruptive, water plumes indicate that it, too, may harbor liquid water beneath its surface. For Enceladus, an important science goal is to characterize the strikingly heterogeneous lithosphere (including the plumes' dynamic properties, temporal variability and spatial distribution of gas and dust), as well as to define the interior structure and determine the existence of a sub-surface liquid water ocean.

The Titan Saturn System Mission (TSSM), a follow-up on the TandEM ESA CV proposal [1] and the Titan Explorer NASA Flagship study [2], was studied last year [3] and prioritized second to go by the NASA and ESA agencies in February 2009. TSSM comprises a Titan orbiter provided by NASA that would carry two Titan *in situ* elements provided by ESA [4]: the Montgolfière and the lake lander. The mission is expected to launch in the 2023-2025 timeframe and would arrive 9 years later for a 4-year mission in the Saturn system. The Montgolfière would travel in Titan's atmosphere for at least 6-12 months and the lake lander would survive 8-10 hours floating in a northern lake (Kraken Mare), carrying out a physical and chemical assay of the sea [5].

Following the release of the ESA *in situ* elements on a trajectory to Titan, the Titan orbiter would provide communications support for the deployed elements and would explore the Saturn system via a 2-year tour that includes several Enceladus and Titan flybys before going into orbit around Titan itself to study it in unprecedented detail [3].

References

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[4] TSSM in situ elements, ESA assessment study report, ESA-SRE(2008)4

[5] TSSM NASA/ESA Joint Summary Report, 15 November 2008, ESA-SRE(2008)3, JPL D-48442, NASA Task Order NMO710851