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Oceanus: A New Frontiers orbiter to study Titan's potential habitability

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The New Frontiers 4 AO includes the theme "Ocean Worlds (Titan and/or Enceladus)" focused on the search for signs of extant life and/or characterizing the potential habitability of Titan and/or Enceladus. The Cassini has demonstrated that Titan is an organic world of two oceans: surface hydrocarbon seas [1,2] that cover part of the north polar region and a deep water ocean [3] that decouples the outer ice crust from an inner core likely composed of hydrated silicates [4]. Oceanus is an orbiter that would follow up on Cassini's amazing discoveries and assess Titan's habitability by following the organics through the methanologic cycle and assessing ex-change processes between the atmosphere, surface, and subsurface.
Titan's reduced nitrogen-rich atmosphere operates as an organic factory [5] where heavy organic molecules are produced by a series of reations starting by the photolysis of methane [6,7]. The mass spectrometer will perform high–resolution in situ measurements of the organic material over a large mass range and at different altitudes. It will provide the information required to determine (i) the processes at work to form the heavy molecules, (ii) the functional group pattern of large molecules providing information on their composition.
These organics coat Titan's surface and are moved around through a complex source-to-sink sediment transport system analogous to surface processes here on Earth. Titan's 90-95 K surface temperature at 1.5 bar surface pressure permit me-thane and ethane to condense out of the atmosphere and flow as liquids on the surface. As a result, Titan's methane-based hydrologic system produces a rich set of geologic features (dunes, river net-works, polar lakes/seas, etc.). Cassini's observations of this rich geomorphology is hindered by kilometer-scale resolution. Oceanus will take ad-vantage of a narrow atmospheric window at 5 μm to acquire 25 m/pixel (< 100 m resolution) images of Titan diverse surface [8].
The presence of 40Ar, a product of the decay of 40K contained in the silicate core, and methane whose origin is still controversial argue for ex-change processes between the interior and the atmosphere. Like we see here on Earth, these processes will be chronicled in the interaction between geological features on Titan's surface. Oceanus will investigate specific features identified by Cassini as potential candidates for cryvolcanism, impact, and tectonic processes that could facilitate exchange with the interior.

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