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Saturnian Earth-like worlds, Titan and Enceladus: a surficial comparative study.

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Saturn's satellites Titan and Enceladus are few of the most interesting planetary bodies in the Comparative Planetology domain. Both satellites have been and are still explored by the Cassini-Huygens joint ESA/NASA mission, launched in 1997. In particular, Titan is the second largest moon in the Solar System, with an earth-like atmosphere and a landscape including dry river networks and hydrocarbon lakes [1]. Observations suggest Titan's surface as very complex geologically, showing evidence of major planetary geologic processes, including tectonics and "volcanism" [2]. Since the surface temperature is approximately 93K, the internal activity that forms the frozen superficial edifices is referred to as cryovolcanism in reference to terrestrial volcanism but in a cold environment. Specifically, several surface features like "lava" flows, volcanic domes and shields as well as caldera shaped faults, have been interpreted as cryovolcanic in origin [2]. The existence of liquid bodies identified as lakes exposed on the surface [3], equatorial dunes, dentritic flows, potential tectonics and volcanism, enhance Titan's resemblance to our own planet. Prior to this discovery, such combination of surface features and dense nitrogen atmosphere had only been identified on the Earth's surface. Another intriguing Saturnian moon, Enceladus, is the second privileged target in comparative planetological studies due to its strong plumes emanating from the South Pole [4]. Enceladus presents several types of tectonic features including faults, scarps, belts of grooves and ridges and more impressively explosive active plumes coming from unknown internal activities, suggesting cryovolcanic processes [5]. These internal activities possibly resemble the terrestrial hot springs Geysers seen in Yellowstone and Iceland. Data collected in 2008, showed that Geysers' jets consist of water vapor, ammonia, CO2 and organics, suggesting Enceladus as a promising world for potential habitual environment due to water and organics [6]. This study presents a comparison between Earth, Titan and Enceladus regarding the internal processes and the surface geological structures. Finally, even though the Cassini-Huygens mission provides us with unexpectedly valuable data, there are still aspects, e¬¬specially regarding the surface that are not yet covered along with several unanswered questions. Therefore, the significance of a future mission focusing on these earth-like worlds as the Titan Saturn System Mission (TSSM) [7] is obvious. Indeed, the TSSM concept, consisting of an orbiter, a lake lander and a Montgolfiere, is designed to carry the essential instrumentation to study the surface as well as the subsurface. The surface exploration payload includes instruments on-board the orbiter, such as a high-resolution imager and spectrometer and a penetrating radar and altimeter, a balloon imaging spectrometer, a visual imaging system and a radar sounder aboard the Montgolfiere and finally a probe imager and a surface properties package on the lander [7].

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