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Cryovolcanic candidate areas and morphotectonic features on Saturn's satellite Titan

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Spectro-imaging and radar measurements by the Cassini-Huygens mission suggest that some of the Saturnian satellites may be geologically active and could support tectonic processes. In particular, Titan, Saturn's largest moon, possesses a complex and dynamic geology as witnessed by its varied surface morphology resulting from aeolian, fluvial, and possibly tectonic and endogenous cryovolcanic processes [e.g. 1]. The Synthetic Aperture Radar (SAR) instrument on board Cassini spacecraft indicates the possibility for morphotectonic features on Titan's surface such as mountains, ridges, faults and canyons [e.g.2]. We suggest that contractional tectonism followed by atmospheric modifications has resulted in the observed morphotectonic features. To test the possibility of morphotectonics on Titan, we provide in this work a comparative study between Cassini observations of the satellite versus terrestrial tectonic systems and infer suggestions for possible formation mechanisms [3]. A significantly interesting type of the morphotectonic features are the cryovolcanic features, which even if they are not yet identified, they considered to have formed due to correlation between volcanic and tectonic actions. Nowadays there are three locations on Titan suggestive as strong cryovolcanic candidates, namely Tui Regio, Hotei Regio and Sotra Facula [4]. Data analysis using statistical and radiative transfer methods [5] and the retrieval of meaningful surface albedos without the atmospheric contribution, enhance the supposition for a cryovolcanic origin by showing temporal variations in surface albedo for at least two candidate areas [6]. Furthermore, methane on Titan seems to follow the same pattern that water does on Earth, while its preservation limit is 100 Myr [7] suggesting that a methane reservoir that supplies the atmosphere is required. Cryovolcanic eruptions emanating from the candidate active regions could potentially provide the observed amount of methane. Both the typical morphotectonic features, such as mountains (30°S and 30°N) and faults (10°S-26°S), and the cryovolcanic features (20°S-30°S) are concentrated in equatorial latitudes and are likely associated with surface stress field. Thus, within the 30°S - 30°N zone, elevated, fractured and volcanic-like crustal features are observed while this association indicates a morphotectonic pattern. The presence of morphotectonic features and the recent data analysis indicating changes within the candidate cryovolcanic regions, suggest that similarities do exist between surficial features observed on the Earth, where both tectonic and volcanic activities are dominant, and on Titan. In addition, a recent study [8] that calculates Titan's tidal response and investigates the possible correlation between tidal deformation, near-surface processes and geological features, provides significant indications for the connection of the interior with the cryovolcanic candidate and morphotectonic features with implications for the satellite's astrobiological potential.

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