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# Possible morphotectonic features on Titan and similarities with the Earth

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## Abstract

Saturn's largest satellite Titan is one of the most interesting planetary bodies. Since 2004 it is being explored by the Cassini-Huygens joint ESA/NASA mission, whose results indicate that it might be geologically active and may support local tectonic processes. Titan possesses a dynamic, multivariable and Earth-like (albeit with different materials) geology modified by fluvial, aeolian, impact and most probably tectonic and cryovolcanic processes as seen mainly from the Synthetic Aperture Radar (SAR), the Visual and Infrared Mapping Spectrometer (VIMS) onboard Cassini and Huygens probe's data. Morphotectonic-like structures such as ridges, mountains, faults and canyons [1; 2] as well as cryovolcanic structures like calderas, domes, flows and radial faults [3] are surficial evidence of the aforementioned dynamic activities. Herewith, we present the major morphotectonic structures seen on Titan and compare them with terrestrial ones in order to discover visual and constructional similarities. We also provide an association of the surface features with current internal models, as well as with formation processes occurring on the Earth.

## 1. Introduction

Morphotectonics correlate the relation of landscape morphology to tectonics [4] by studying the direct effect of the solid body's movements on landform evolution. Erosional processes that may influence the shape of the feature after its formation hamper their identification, also rendered difficult due to the lack of both *in situ* data and samples acquisition. Thus, a comparative study between Titan and Earth since they both display -at least in shape and structure- similar surficial expressions, could shed some light to our understanding of Titan's surface morphology and tectonic processes.

## 2. Observations

The basic morphotectonic surficial features identified on Titan so far are mountains [e.g. 2;1], ridges [5], faults [6] as well as rectangular drainage patterns controlled most likely by tectonism which resemble the terrestrial ones in shape and structure but not in size. Each of the major features observed has been accompanied by a proposed genesis mechanism with the most prevalent ones being those that suggest crustal shrinking either due to localized compression or folding or repeated episodes of extensional and compressional tectonism.

## 3. Figures

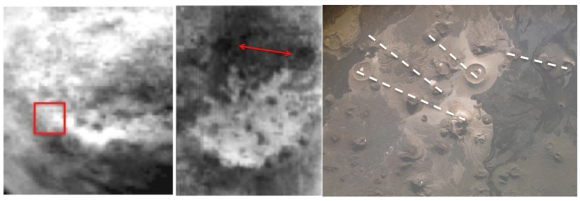

Figure 1: Area on Tui Regio (left) with possible tectonic influence; two dark patches on Hotei Regio (middle) interpreted as volcanic caldera ridges (NASA/JPL/University of Arizona); Harrat Khaybar (right), massive volcanic terrain in western Saudi Arabia, the dashed lines indicate the linear trend of the volcanic vents suggesting tectonic control (NASA).

## 4. Table

Table 1: Major cryovolcanic candidates and their association with tectonics

| Location | Name | Description | Tectonic-like features |
|---|---|---|---|
| 20°S, 130°W | Tui Regio | Flow-like region | Trending dark linear marks on VIMS data [7] |
| 26°S, 78°W | Hotei Regio | Volcanic-like terrain | Circular tectonic features [3] |
| 15°S, 42°W | Sotra Facula | Volcanic-like terrain | Topographic elevation, mountain-like structures (unidentified) |

## 5. Summary and Conclusions

The morphotectonic structures presented hereinabove seem to be the most important elevated as well as carved features seen on Titan. In general, most of the mountain features are concentrated in equatorial latitudes between 30°S and 30°N while possible cryovolcanic spots (Fig. 1) are located within the same zone (20°S-30°S) and are likely associated with surface stress field. Additionally, linear features are observed between the region 10°S-26°S. Thus, since within the zone 30°S-30°N around the equator, elevated as well as fractured crustal features are observed, a morphotectonic pattern association can be indicated Their shape, size and morphology as well as their distribution in specific zonal area, suggest that they are caused by a local tectonic field. These morphotectonic features are mountains, ridges, hills, faults, joints and canyons that are assumed to originate from internal compressional and extensional tectonic activity. The triggering mechanism that leads to such dynamic movements is possibly to be Titan's tidal forces especially due to the concentration of morphotectonic structures around the equator and if their age is relatively young. From the detailed account of the landforms traced from the data of the Cassini mission and discussed hereabove, and even if the picture is still incomplete awaiting for more data, it appears that similarities do exist between surficial features observed on the Earth and on Titan.

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