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Geomorphological map of the Soi crater region on Titan

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Abstract

We present a geomorphologic map of the Soi region of Titan, an area spanning from the equator to 60º N and from 180ºW to 100ºW which contains the Soi crater as a distinctive feature. We use the same methodology and units as presented by [1] but introduce a new unit, "bright gradational plains". We note a large area of "scalloped plains" in the region, an important unit to the understanding of Titan as it is a transitional region between the aeolian-dominated mid-latitudes and the polar regions, where aeolian features are scarce. The scalloped plains, in particular, appear to be representative of this transition.

1. Introduction

The surface of Saturn's moon Titan has been revealed by the Cassini-Huygens spacecraft to be geologically complex with both endogenic and exogenic processes at play. Titan's dense atmosphere and active methane cycle has enabled aeolian, fluvial, pluvial and lacustrine processes to exist and modify the surface by erosion and deposition. Relatively few impact craters are seen [1, 2, 3], attesting that the surface is geologically young. Tectonism and possibly cryovolcanism have contributed to surface modification [4, 5, 6, 7]. The rich variety of geologic features on Titan and how the processes have dominated at different latitudes are discussed in several papers [8, 9,10]. Geologic mapping is a tool that helps us understand the geologic history of a planet or moon, or regions thereof. We recognize that our terrain units are primarily based only on common radar backscatter and morphological characteristics and may or may not correspond to true geological units (based on rock composition, age, and history) and therefore refer to the map as a geomorphologic map. Previous geomorphologic maps of regions on Titan include those of the Afekan region [1], the Menrva region [11] and the polar regions [12]

2. Mapping the Soi crater region

We present a geomorphological map of the Soi crater region (Fig. 1). The map helps us to understand the types and extent of the geomorphologic units and to infer the geological processes responsible for their formation and evolution. Our mapping of the Soi region followed the general principles of previous Titan mapping and other planetary mapping efforts outlined in [1]. We used the Cassini's Synthetic Aperture Radar (SAR) data as the basemap, but we also incorporated information from other datasets, including microwave emissivity, topography, and infrared spectra. We examined the relations of different terrain units in terms of spatial relations and, where possible, stratigraphic relationships. The total area of the region was 9,692,120 km^2, spanning from the equator to 60º N and from 180ºW to 100ºW. However, in this area only 5,184,591 km^2 (53%) was covered by SAR data of sufficient high resolution for mapping. Some low spatial resolution ISS and VIMS data are available for the remainder, enabling us to make some inferences about the types of units present, from correlations obtained previously. We find that, as for the Afekan region, plains are the dominant unit in Titan's mid-latitudes, with Undifferentiated Plains ("Blandlands") being the most extensive, covering 38% of the mapped area. Other plains units cover an additional 35% of the area mapped, while dune units make up 14% and mountainous units 1.5%. Mountainous units are identified as the oldest, dune units and streak-like plains are the youngest, while undifferentiated plains are of intermediate age. Only 8 craters, including Soi, are identified in this region. From cross-cutting relations we infer that they are older than plains and dune units but there is no direct contact between these craters and the mountainous units. Other craters are likely present in this region, but their degraded state makes them hard to identify. The microwave emissivity of the undifferentiated plains and dune units are consistent with organic materials while the microwave emissivity of the mountainous units is consistent with fractured water ice materials as previously discussed by [13].

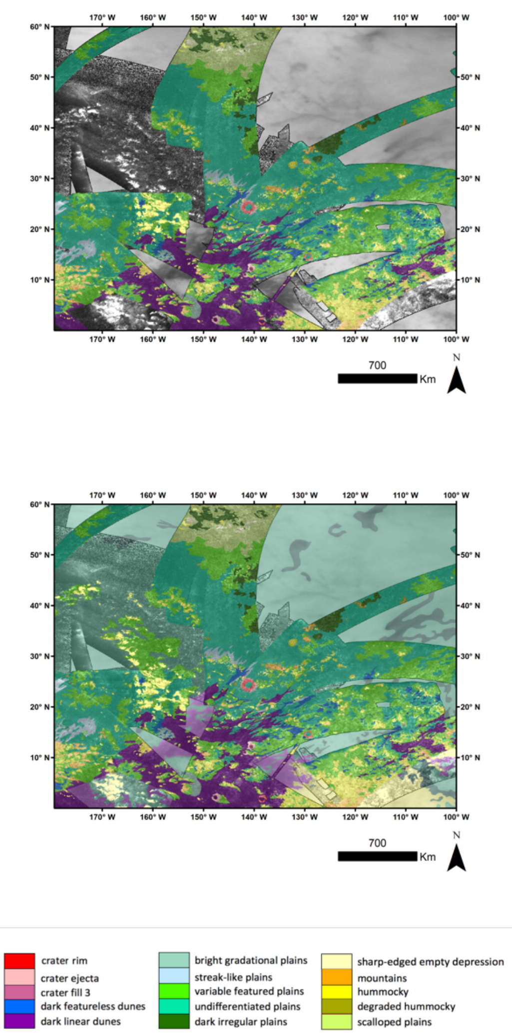

Figure 1: Geomorphologic map of the Soi crater (in center) region of Titan. The areas for which SAR data are available (above) are mapped at a scale of 1:800,000 following the methods outlined in [1], while the areas for which no SAR coverage exists (below) were mapped at the scale of 1:2,000,000 using correlations between SAR, radiometry, and data from other instruments.

3. Summary

Our analysis of the geomorphology of the Soi crater region agrees with previous conclusions that the mountainous terrains, including those in the Xanadu region, are the oldest exposed unit and most consistent with the presumed icy, crustal materials of Titan [e.g., 6]. The plains materials are consistent with deposits resulting from the transport and emplacement of organic-rich materials predominantly by aeolian mechanisms. We defined the bright gradational plains, and mapped a larger area of "scalloped plains", which appear to be a transitional unit between the sedimentary-dominated mid- and the high latitudes, where aeolian features are rare.

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