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The Geology of Tita: a summary

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Titan, the largest and most complex satellite in the solar system exhibits an organic dominated surface chemistry and shares surface features with other large icy satellites as well as the terrestrial planets. It is subject to tidal stresses, and its surface appears to have been modified tectonically. Cassini's global observations at infrared and radar wavelengths as well as local investigations by the instruments on the Huygens probe has revealed that Titan has the largest known abundance of organic material in the solar system apart from Earth, and that its active hydrological cycle is analogous to that of Earth, but with methane replacing water. The surface of Titan exhibits morphological features of different sizes and origins created by geological processes that span the entire dynamic range of aeolian, fluvial and tectonic activities, with likely evidence that cryovolcanism might exists where liquid water, perhaps in concert with ammonia, methane and carbon dioxide, makes its way to the surface from the interior [e.g. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19]. Extended dune fields, lakes, mountainous terrain, dendritic erosion patterns and erosional remnants indicate dynamic surface processes. Valleys, small-scale gullies and rounded cobbles require erosion by extended energetic flow of liquids. There is strong evidence that liquid hydrocarbons are ponded on the surface in lakes [e.g. 13, 15, 20, 21, 22, 23, 24, 25, 26], predominantly, but not exclusively, at high northern latitudes. A variety of features including extensive flows and caldera-like constructs are interpreted to be cryovolcanic in origin. Chains and isolated blocks of rugged terrain rising from smoother areas are best described as mountains and might be related to tectonic processes. Impact craters form on all solid bodies in the solar system, and have been detected on Titan. But very few have been observed so they must be rapidly destroyed or buried by other geologic processes The morphologies of the impact craters are more similar to those seen on silicate planets than on icy satellites [22]. Removal of impact craters by burial and erosion is likely, given the evidence for fluvial and cryovolcanic processes, and the relatively degraded appearance of hills and ridges. The obvious lack of craters compared with other icy satellites indicates the surface of Titan is young and modified by volcanism and erosion. However, the existence of the large Menrva impact structure (>400 km in diameter) suggests that in some places larger (and thus potentially older) craters can be preserved [e.g 2, 19, 20, 21, 22, 24, 27]. In general, Titan exhibits a geologically active surface indicating significant endogenic and exogenic processes, with diverse geological, geophysical and atmospheric processes reminiscent of those on Earth and Mars [e.g. 1 - 27].

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