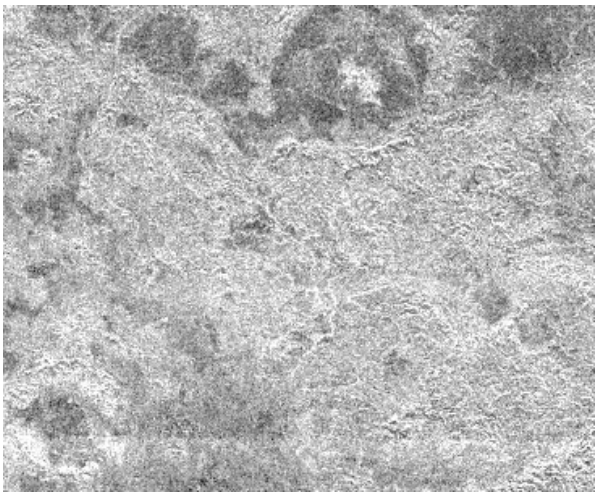
Titan's Xanadu: Ancient and Young. C. A. Wood[1], J. D. Radebaugh[2], Ellen Stofan[3], and Howard Zebker[4]. [1]Planetary Science Institute, Tucson, AZ 75721 & Wheeling Jesuit University, Wheeling, WV 26003; chuckwood@cet.edu, [2]Brigham Young University, Department of Geological Sciences, Provo, UT 84602, [3]Proxemy Research, Rectortown VA 20140. [4]Stanford University, CA.

Introduction: Xanadu is the most unusual region on Titan, being exceptionally bright in visible and radar wavelengths, and extreme in other physical characteristics [1]. Xanadu has a rough surface with many hills, channels and other topographic irregularities. It has a higher density of impact craters than any other region seen by the Cassini radar instrument [2]. Remarkably, the distribution of craters is very uneven: all of the eight recognized impact craters in Xanadu are in its eastern quarter, and therefore all of Xanadu is not the same age. Strikingly, the lack of craters in the central and western portions implies those surfaces are as young as any region on the satellite.

Morphological Units: Xanadu's morphology is not identical across its 3000 km width. As described by Wood et al [3] (who considered just the T13 radar swath) there are three distinct morphological units, with the eastern third that contains the craters, all of which are degraded, called Subdued Cratered Terrain.

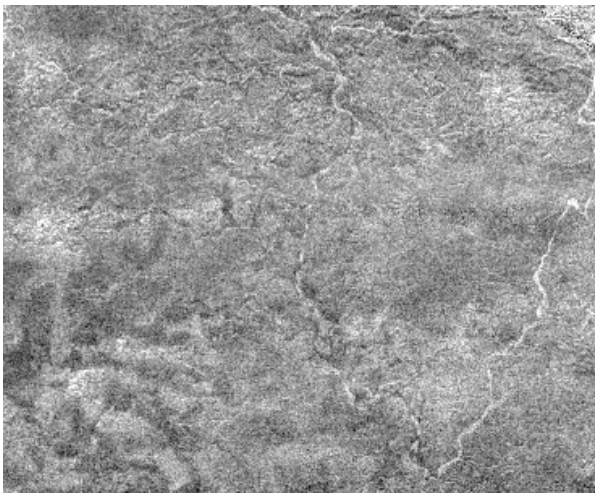


Subdued Cratered Terrain – notice large craters at top center (diameter 63 km) and bottom left and a smaller one at mid-right.

The middle of Xanadu is dominated by small peaks – the Knobby Terrain of [3], and the western part (Mottled Riverland) is relatively flat with elongated dark areas. Both are cut by well-developed river channels. Because they contain no impact craters, we conclude that the Knobby Terrain and Mottled Riverland are renewed surfaces that have destroyed, heavily modified, or covered pre-existing impact craters.

Change Processes: There may be different mechanisms to account for the renewal of terrains with different textures. The regular distribution of small hills suggests that the Knobby Terrain could be an active karst-like surface that results from dissolving existing rock units. Or the material could be friable and have been heavily eroded by rainfall. These morphologies look like any other terrestrial mountainous area that has been extensively eroded by rainfall. The Knobby Terrain is embayed by elongate flat dark patches, which contain no hills. None of this Knobby Terrain contains compelling evidence of impact craters.

Knobby Terrain above and Mottled Riverlands below.



The Mottled Riverland has two facies. A central V-shaped region is cut by a strong network of river channels. A mottled surface of intermediate backscatter

both sides of the channeled area has relatively flat surfaces interspersed with roughly oval, dark patches that appear to be topographically lower. One very suggestive radar-dark patch, actually on the edge of the river-cut area, is tadpole shaped, implying some sort of flow structure. We can speculate that the intermediate backscatter material is volcanic flows, cut by dark diapirs, and both units are transgressed by river valleys and their sediments.

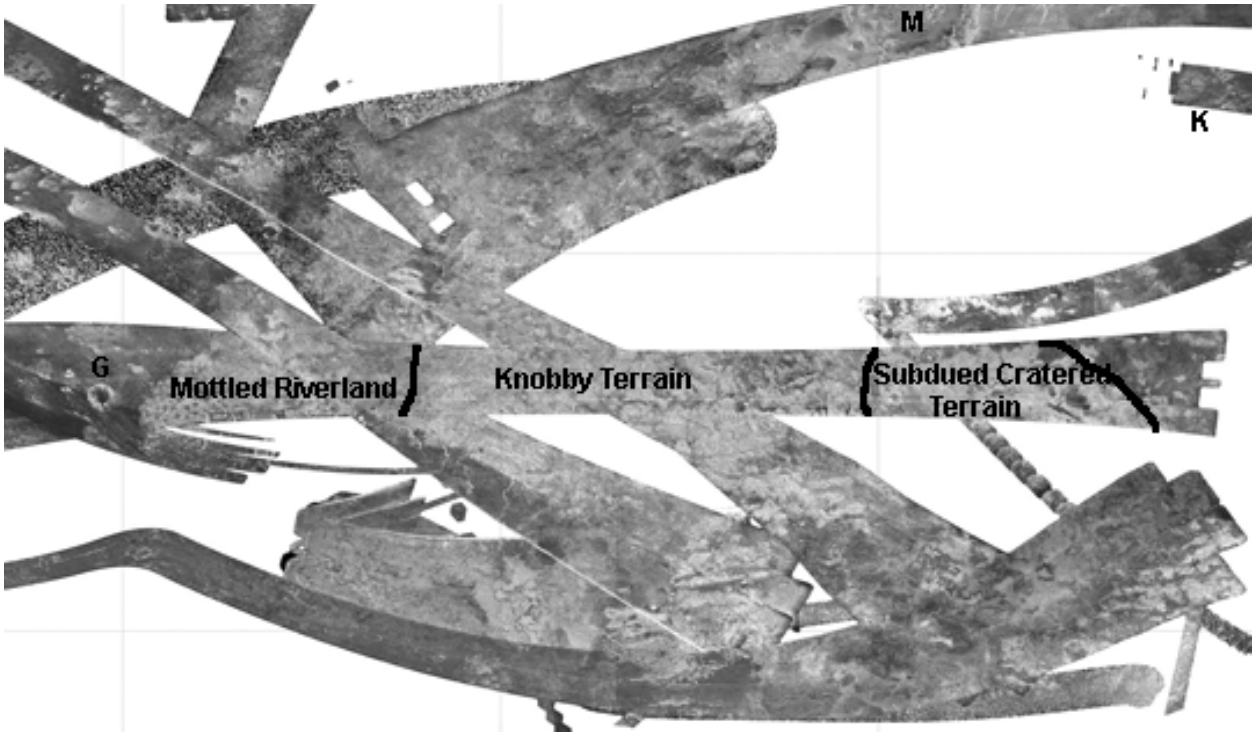
None of these speculative processes – dissolution, rainfall erosion and volcanism – has completely erased the craters from the nearby Subdued Cratered Terrain. However, this terrain is cut by large flat and radar-dark swaths which seem to disaggregate the brighter terrain [4]. If this process continues the Subdued Cratered Terrain may be erased in the future, but that would be a different mechanism for resurfacing than seen in the rest of Xanadu.

The processes that resurfaced three-fourths of Xanadu cannot be identified with certainty. It is conceiveable that all resurfacing is simply different manifestations of weathering – rainfall and subsequent river erosion. However, any atmospheric process might be expected to be uniform and thus not account for differences in crater retention ages across Xanadu.

The radar-dark oval patches cutting the Mottled Riverland seem likely to have formed by internally driven geologic processes. And the likely volcanic flows along southern Xanadu [5] provide evidence of cryovolcanism in this region. Clearly, different geologic processes have operated in various locations within Xanadu, it does not have a unified history.

Finally, although most of Xanadu has no impact craters, it is surrounded by terrains that do. To the west and northwest (left on the mosaic below) are at least six likely impact craters that appear as bright circles surrounded by dark sand seas; Guabanito (G) is the largest. At top right is the impact basin Menrva (M) and the relatively fresh impact crater Ksa (K). The existence of these impact structures outside, but near, Xanadu, suggests that the modification processes were localized to Xanadu, and not broadly regional.

References: [1] Radebaugh J. et al (2009) *LPSC XXXX,* Abstract #1047. [2] Wood, C.A. et al (2009) Icarus, doi:10.1016/j.icarus.2009.08.021. [3] Wood, C.A. et al (2007) *Bulletin Am. Astro. Soc., 39*, 500 [4] Wood, C. A. et al (2007) *Workshop on Ices, Oceans, and Fire: Satellites of the Outer Solar System. LPI Contribution No. 1357, p.149-150*. [5] Wall, S. et al. (2009) *GRL 36*, DOI: 10.1029/2008GL036415.



Mosaic of Radar images covering Xanadu – T13 is the radar swath that is labeled with terrain names.