CHANNEL LENGTH, STREAM ORDER AND CHANNEL NETWORK INTEGRATION ON TITAN.

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Introduction: Synthetic aperture radar (SAR) images taken of Titan with the Cassini RADAR instrument have revealed many features consistent with fluid-carved channel valleys (hereafter channels) ([1], [2], others). Many of these features have been discussed in previous works ([3], others), and previous researchers [4] have noted the organization of some of these features into branching networks similar to river systems seen on Earth and Mars. We discuss channel lengths for the streams on Titan and stream order for the channel networks. We also discuss the implications of these well-integrated features.

Observations and Measurements: Using the highest-available resolution SAR data, we recorded positions and measured the length of all channels present in RADAR data through the T19 SAR swath. We determined length by measuring short segments, assuming great circle distance for each segment. The median length of all channels on Titan was 29 km. The shortest channels we identified were barely 3 km long and were between the north polar lakes; the longest, almost 350 km long, belonged to a dendritic network located in the southern mid-latitudes.

Previous work has noted several distinct morphologies for streams on Titan ([1]-[3], others). We notice the same, but focus in this work on the channels that are part of one of four branching networks that we have identified. The T13 SAR swath covers two networks: one on either edge of the bright near-equatorial region Xanadu. A third network is present in the southern mid-latitudes of the T7 swath, and a final network is located in the near-equatorial latitudes of the T19 swath.

Stream order. As stream order in the networks was a convenient method of organizing these streams and defining the extent of individual members, we counted stream order for the four channel networks listed above. We marked 106 streams in the four networks. Median channel length among these was above 45 km, higher than the overall Titan median, with 22 channels exceeding 100 km in length

The highest-order channel on Titan so far, located in the western Xanadu network (Figure 1), is fourth order. The other channels and networks are all third order or lower. This result is not directly comparable to fluvial networks on Earth or Mars, since properly determining stream order relies upon the ability to distinguish the smallest features present. Because the stream network seen in the Huygens descent images[5][6] also contains a fourth-order stream, and that network is not resolved in the corresponding SAR swath[7], this is almost certainly an underestimate of the stream order for Titan's largest channels.

Channel network integration.. The channels present on Xanadu and those revealed in T7 seem to be almost fully integrated channel networks. At the resolution of the instrument there are few unconnected drainage features, which suggests that these features represent mature, well-developed stream systems[8]. Stated another way, a large amount of sediment must be transported from the highs of a landscape into the depressions for a river system to form that drains the area it dissects. Within the 3 x 10^5 km^2 area encompassing all of the channels on western Xanadu, 79% by length of the streams are integrated into one of the large order streams (Figure 1, Figure 2).

Ongoing Work: For what is initially a disorganized ensemble of small, disjointed streams to unite and form the kind of features seen on Titan, a large amount of rainfall-driven sediment transport must have occurred. The exact amount of time required depends on many factors, and is thus difficult to determine, but the total volume of sediment transport required to connect these channels should be independent of time and frequency of rainfall. That a few of Titan's channels exhibit this level of organization may constrain the amount of sediment those streams have carried.

We are currently constructing a landscape evolution model to track the volume of sediment moved during the formation of a channel network by flowing liquid. Using the sediment transport values determined by Burr et al.[9] for liquid methane under Titan conditions, we hope to constrain the volume of liquid methane needed to carve the channel networks seen on Titan.

References: [1] Elachi, C. et al. (2005) *Science,* 308, 970-974. [2] Stofan, E. et al. (2006) *Icarus,* 185, 443-456. [3] Lopes, R. et al. (2007) *Icarus,* 186, 395-412. [4] Elachi, C. et al. (2006) *Nature,* 441, 709-713. [5] Perron et al. (2006) *JGR* 111,E11001. [6] Tomasko, M. et al. (2005) *Nature*, 438, 765-778. [7]Rogers, J. (2006) *J. Br. Astron. Assoc.,* 166-168 [8] Glock, W. (1931) *Geographical Rev.,* 21, 475-482. [9] Burr, D. et al. (2006) *Icarus,* 181, 235-242.

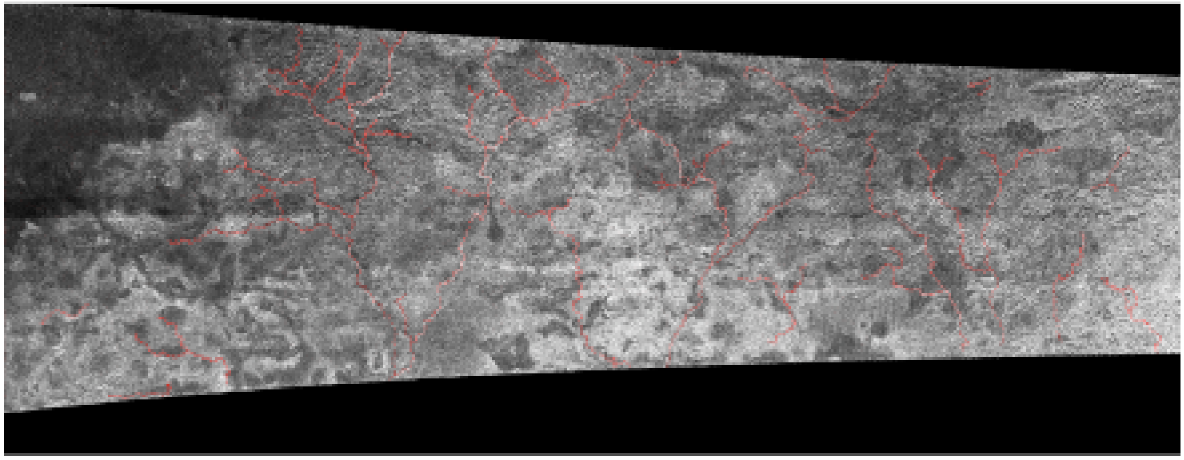

Fig 1. Channel network from the western edge of Xanadu. Our measured channels are marked in red. Latitude and longitude (positive east) in this image correspond to the plot below.

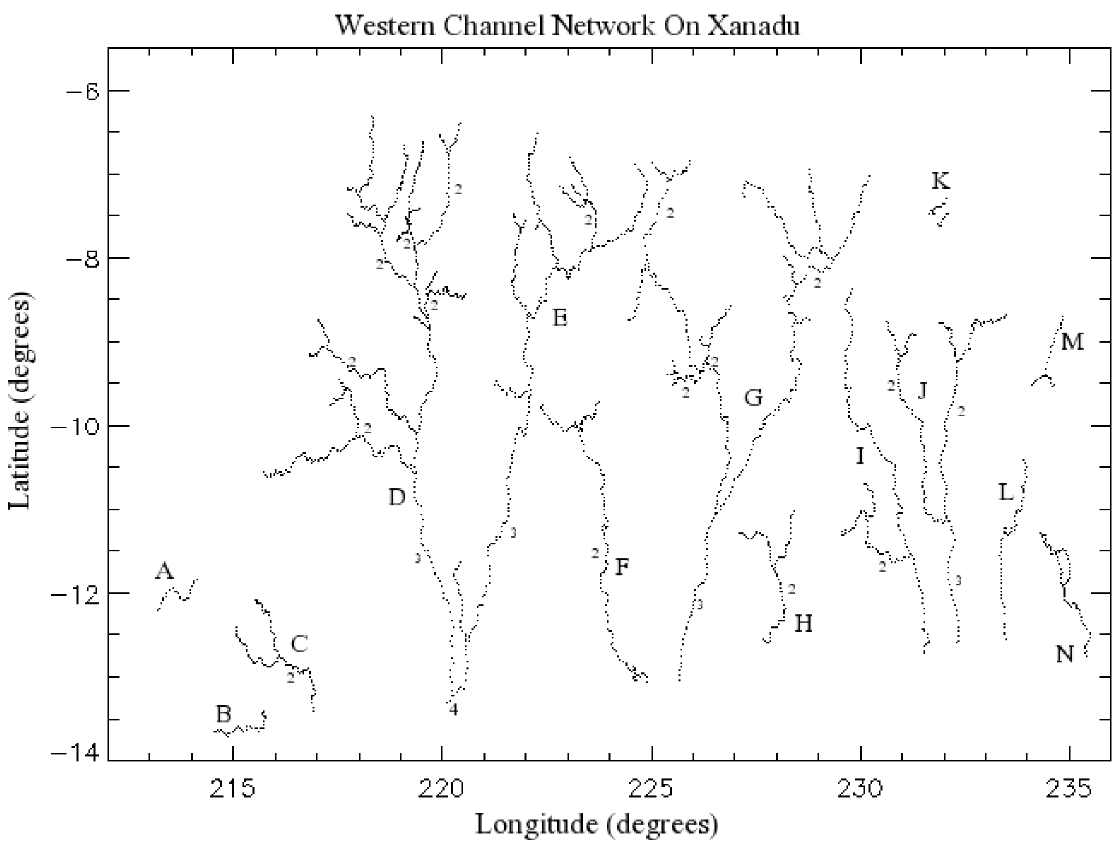

Fig 2. Channel network from the western edge of Xanadu, plotted without background image for clarity. Features A-C, F, H and K-N are not incorporated into a high-order stream. Second- through fourth-order streams are labeled as such; all unlabeled channels are first-order.