

THE OLDEST TERRAIN ON TITAN. C. A. Wood, Planetary Science Institute, 1700 East Fort Lowell, Tucson, AZ 85719-2395, tychocrater@yahoo.com.

Introduction: Titan has very few impact craters [1], a likely result of multiple efficient processes that removed them/resurfaced the planet. Looking at the region of Titan with the highest impact crater density may give clues to the most ancient types of landscapes, and perhaps the processes that modified them.

Eastern Xanadu: My previous mapping of 50 impact craters [1] showed that the greatest concentration, by factors of 2 to 9, occurs in the eastern third of Xanadu. These craters are not only numerous but they are among the best largest and best preserved of the non-pristine craters on Titan. Unfortunately, there is only one Cassini Radar image of this region, the T13 pass of 2006; fortunately, it is excellent.

The Background Terrain: Eastern Xanadu is broadly expansive, nearly uniform radar bright and mountainous. It is penetrated and embayed on the east end by often straight-sided, radar-dark, smooth material that appears to be of lower elevation. The dark material is more pervasive to the north and east, has no impact craters and seems to have invaded the mountainous bright material. Close-up looks show that the bright material is often deeply dissected by stream valleys. Overall, this bright material differs from all other Titan terrains in having a combination of nearly unique characteristics – it is continuous, extensive and rough. It is not isolated roughly linear ridges as most mountains are, nor is it featureless like mid-latitude “blandlands”.

The Craters: There are 7 apparent impact craters in Eastern Xanadu, ranging in diameter from 20 to 63 km. compared to the average diameter of Titan’s craters which is about 10 km. Small craters that must have formed on eastern Xanadu are not preserved.

All of the craters are eroded, but enough of each remains to leave little doubt as to its origin; again, this is different from many of Titan’s craters. Most of the craters have nearly complete to remnant elevated rims, and are circular in outline – no compressional forces have distorted their shapes. Most of the crater rims have been breached, in some cases a river channel exits the crater. The floors are all relatively smooth and all but two are intermediate in radar brightness, the odd

two have the same smooth dark material that is pervasive to the east and north. The dark floored craters occur near the edges of Xanadu, near the surrounding dark terrain. The wall of one dark-floored crater is breached, and dark material may have entered by moving across the surface; the other dark-floored crater does not have a breached rim, so its dark material came from below or above.

Ancient Terrain: We have no idea how typical Eastern Xanadu may be of an earlier period of Titan. It could be a relict of a bright and rough global crust that has been destroyed everywhere else. Or it may be preserved because it was unique in being erosion / modification resistant.

The fact that Eastern Xanadu is essentially mountainous everywhere (except where it have been embayed by dark material) provides an end member model of what Titan’s earlier global crust might have been. Because the mountainous terrain is not just roughly parallel ridges it was not created by global compression. If there were more crust like this it has been largely eliminated on a timescale of less than a few hundred million years – the estimated surface age of Titan according to [1] or billions of years, according to others.

Modification Processes: Eastern Xanadu appears to be extensively modified by disaggregation/ embayment by dark material to the east and north. It has also been cut by erosion that has caused hundreds of apparent river channels. Downslope movement has deposited radar-light debris/talus at the bases of some crater rims. And yet the erosion has not been so severe as to remove crater rims. Additionally, the observation of sharp topographic and radar brightness boundaries argues against any significant depth of atmospherically deposited material, which would be expected to have uniformly coated everything, although rain might wash it off hillslopes. The various degrees of radar brightness of the floors of most of the 7 craters suggests that these enclosed basins were not uniformly covered.

References: [1] Wood C. A. and others. (2010) *Icarus*, 2006, 334-344.