

IMPACT CRATERS ON TITAN? CASSINI RADAR VIEW. Charles A. Wood¹, Rosaly Lopes², Ellen R. Stofan³, Flora Paganelli², Charles Elachi² and the Cassini RADAR Science Team². ¹Planetary Science Institute, Managua, Nicaragua Branch. cwood@psi.edu, ²Jet Propulsion Laboratory, Mail Stop 183-601, Pasadena, CA 91109, ³Proxemy Research, 20528 Farcroft Lane, Laytonsville MD 20882, ellen@proxemy.com

Introduction: Titan is a planet-size (diameter of 5,150 km) satellite of Saturn that is currently being investigated by the Cassini spacecraft. Thus far only one flyby (Oct. 26, 2004; Ta) has occurred when radar images were obtained. In February, 2005, and approximately 20 more times in the next four years, additional radar swaths will be acquired. Each full swath images about 1% of Titan's surface at 13.78 GHz (Ku-band) with a maximum resolution of 400 m. The Ta radar pass [1] demonstrated that Titan has a solid surface with multiple types of landforms. However, there is no compelling detection of impact craters in this first radar swath. Dione, Tethys and other satellites of Saturn are intensely cratered – there is no way that Titan could have escaped a similar impact cratering past; thus there must be ongoing dynamic surface processes that erase impact craters (and other landforms) on Titan. The surface of Titan must be very young and the resurfacing rate must be significantly higher than the impact cratering rate.

Radar Imaging: Radar images of Titan are not as crisp as those of Venus, probably because the radar pulses are scattered directly by the Titan surface (as on Venus), and penetrate it and ultimately re-emerge. This so-called *volume scattering* slightly diffuses the image. We assume that the volume scattering occurs within some sort of organic material which coats Titan's surface. Volume scattering is also likely caused by radar penetration into surface ices.

Crater Structures: The only crater structures that appear to definitely exist are a handful of 15-30 km wide, bright-rimmed circles (Fig 1). We interpret

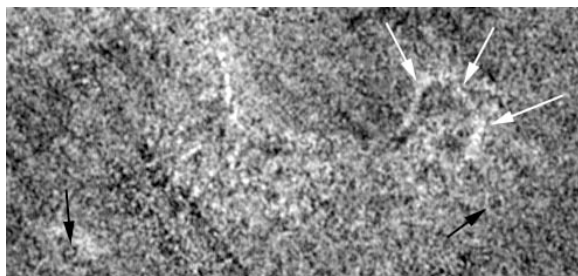


Fig 1. White arrows = rim of volcanic crater that is source to flow curving up and to the left. Small black arrows = small, dark-floored, bright-rimmed craters.

these features as volcanic craters because they have associated bright flows emanating from them [1]. Two smaller, bright-rimmed and dark floored structures (black arrows in Fig. 1) could be impact

craters or volcanic craters. Because they seem similar to larger craters with flows, we tentatively interpret such small bright-rimmed features as volcanic.

Impact Craters? No impact crater has been detected with any certainty on Titan. There are a dozen or so, 1-10 km wide, poorly defined features that might be impact craters, but could just as easily be random noise. At the 20-50 km scale, where volume scattering should be less effective at masking features and where resolution is clearly not a problem, there are no circular features that look like fresh or degraded impact craters. The best-defined possible crater is a 160 degree-long arc (Fig. 2) that occurs on the edge of the image swath east of the dark patches informally called Cici's Cat. This arcuate feature has a sharply defined radar bright "rim" and a gray floor. There is no evidence of a central peak, terraces or exterior deposits, but there may be a smaller bright-rimmed crater on the west side of its floor.

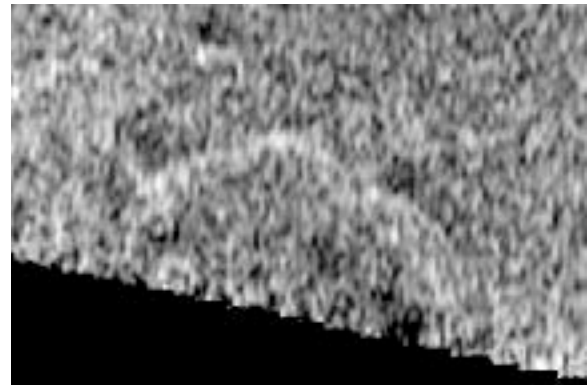


Fig. 2. Half an impact crater?

Another speculative impact crater is a dark-rimmed circular feature with a bright floor and the hint of a dark central areas. This could be a central peak crater, but there is absolutely no compelling evidence that it is even a crater.

An Impact basin? The most intriguing possible impact feature (Fig 3) is a 100 km plus wide dark rimmed circle. An inner dark arc suggests a concentric inner ring about 45% of the larger diameter. The moat area between the rims is generally lighter hued and the area inside the inner ring is darker. This looks like double ring impact basin. If Titan has or had the same crater diameter distribution as Rhea and Iapetus, one or two 100 km scale craters would be expected in a swath covering



Fig.3. A double ring impact basin?

1% of Titan's surface [2].

Implications: The lack of impact craters on the 0.6% of Titan that has been imaged by Cassini radar suggests that the craters that must have formed have been completely or nearly completely removed or

buried. Possible crater obliteration processes include burial by organic sludge from the atmosphere and/or burial and disruption by cryovolcanism. Because we have not observed a sequence of sharply defined to poorly defined craters we infer very rapid resurfacing rates for Titan. If the double ring basin feature is real, its existence with the absence of smaller craters, suggests that some process selectively removes features smaller than about 100 km. And if 100 km scale craters are formed as infrequently on Titan as in the inner solar system, the existence of such a large basin implies preservation of some parts of Titan's surface for $10^7 - 10^8$ years.

References: [1] Elachi, C. and RADAR team (2005) Cassini Radar's First Views of The Surface of Titan. *Science* (submitted). [2] Lorenz, R. and RADAR Team, (2004) AGU presentation.