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Investigation of the Selk Crater region of Titan Observed by Cassini VIMS

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Introduction

Observations obtained by the Cassini Visual and Infrared Mapping Spectrometer (VIMS) during the 38th and 40th close flybys of Titan, have revealed Selk crater, a bright-rimmed crater, ~80 km in diameter (Fig. 1). Selk crater is located at 7.0°N, 199.0°W, ~600 km north-northwest of the Huygens landing site, within the Belet dune field. An optically bright landform, similar in width to Selk crater, extends east-southeast from it ~300 km and is also the subject of this analysis.

Interpretation

Selk crater exhibits morphology similar to a number of craters identified as impact craters on Titan in Cassini data (e.g., Sinlap, Menrva, Ksa)[1,2,3] suggesting it too is an impact crater. Previous research using high altitude Cassini Synthetic Aperture RADAR (SAR) data has suggested that Selk crater, and two unnamed craters, are unlike any other impact crater on Titan in that they exhibit jagged rims and lack evidence of collapse[4]. The VIMS data show the inner rim of Selk crater is fluted, probably by eolian erosion and collapse (not unlike Victoria crater on Mars[5]). In addition, the outer flank and presumed ejecta blanket are dissected (in particular to the east), likely the result of fluvial erosion, similar to that seen elsewhere on Titan[6]. The VIMS data, which are of higher resolution than the high altitude SAR data, show what appears to be terraces inside the crater (visible on the western inner wall), consistent with initial collapse expected for a crater of this size. A central peak is also apparent in the VIMS data.

Multiple geneses of the optically bright landform extending to the east are investigated: cryovolcanic flow induced by the formation of Selk crater, similar to the bright crater outflows observed on Venus[7], wind shadowing from Selk crater preventing the encroachment of dunes, and a streamlined upland formed on the leeward side of Selk crater. One or more ancient impact craters (as many as three) are identified in the bright landform suggesting it is older than Selk crater and therefore discounts the outflow hypothesis. The possibility that this feature is a wind-shadowed surface free of dunes is discounted because the feature is not aligned with the average peak wind direction inferred from the dunes. Furthermore, because the dunes do not cover this feature, it must have some vertical relief. The remaining hypothesis is that this feature is a remnant island of old terrain carved by west-to-east fluid erosion.

Conclusion

Our research suggests that Selk crater formed as the result of an impact into an ancient highland crust. Aeolian and fluvial erosion have scalloped the inner rim and dissected the outer flanks of Selk crater. The flow of a fluid, either liquid or gas, from west to east, resulted in the erosion of material down stream from Selk crater creating a streamlined

island, preserving a section of the ancient highland in which at least one remnant impact is visible. The margin of the upland has sufficient relief to stand off the encroachment of dunes in the Belet dune field.

References: [1] Elachi et al. 2006, Nature 441, 709–713. [2] Soderblom et al. 2007, P&SS 55, 2025–2036. [3] Stofan et al. 2006, Icarus 185, 443–456. [4] Wood et al. 2009, LPSC XL, 2242. [5] Grant et al. 2008, JGR 113, E11010. [6] Jaumann et al. 2008, Icarus 197, 526–538. [7] Schaber et al. 1992, JGR 97(E8), 13,257–13,301.

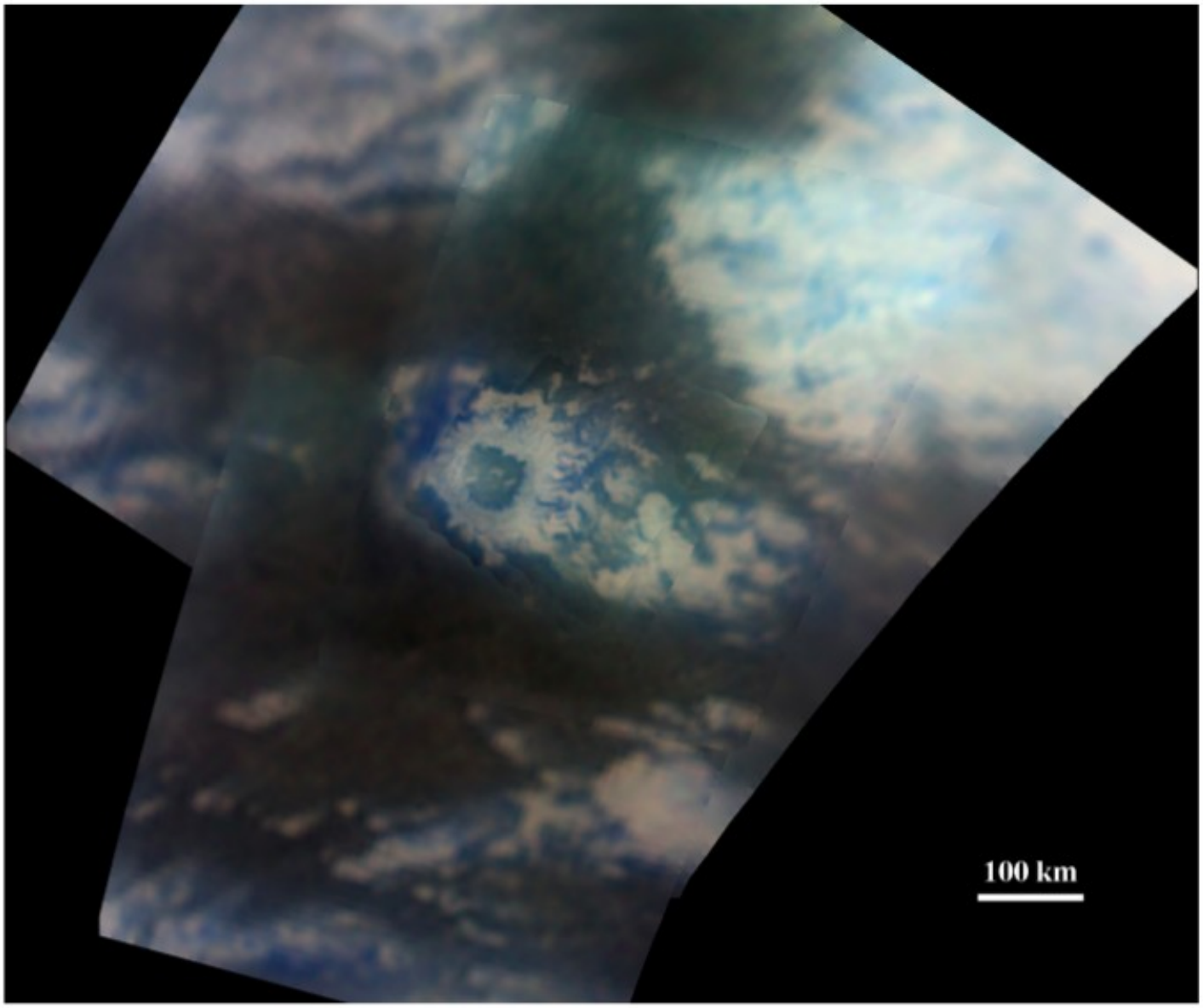

Figure 1. A color-composite image mosaic (RGB=2.0, 1.6, & 1.3 μm) of the Selk crater region of Titan from T38 and T40 Cassini VIMS observations.