



**HAL**  
open science

## The Earthlike Shoreline Morphology of Titan's Ontario Lacus

S. Wall, A. Hayes, C. Bristow, R. Lorenz, E. Stofan, J. Lunine, Alice Le Gall, M. Janssen, R. Lopes, L. Wye, et al.

► **To cite this version:**

S. Wall, A. Hayes, C. Bristow, R. Lorenz, E. Stofan, et al.. The Earthlike Shoreline Morphology of Titan's Ontario Lacus. 41st Lunar and Planetary Science Conference, held March 1-5, 2010 in The Woodlands, Texas. LPI Contribution No. 1533, p.1466, 2010, Mar 2010, The Woodland - Texas, France. hal-00460497

**HAL Id: hal-00460497**

**<https://hal.science/hal-00460497>**

Submitted on 1 Mar 2010

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

**THE EARTHLIKE SHORELINE MORPHOLOGY OF TITAN'S ONTARIO LACUS.** S. Wall<sup>1,\*</sup>, A. Hayes<sup>2</sup>, C. Bristow<sup>3</sup>, R. Lorenz<sup>4</sup>, E. Stofan<sup>5</sup>, J. Lunine<sup>6</sup>, A. Le Gall<sup>1</sup>, M. Janssen<sup>1</sup>, R. Lopes<sup>1</sup>, L. Wye<sup>7</sup>, L. Soderblom<sup>8</sup>, P. Paillou<sup>9</sup>, O. Aharonson<sup>2</sup>, H. Zebker<sup>7</sup>, T. Farr<sup>1</sup>, G. Mitri<sup>1</sup>, R. Kirk<sup>8</sup>, K. Mitchell<sup>1</sup>, C. Notarnicola<sup>10</sup>, D. Casarano<sup>11</sup>, B. Ventura<sup>12</sup>

<sup>1</sup>Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA 91109 USA; <sup>2</sup>Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125 USA; <sup>3</sup>Department of Earth and Planetary Science, Birkbeck College, University of London, Malet Street, London WC1E 7HX UK; <sup>4</sup>Space Department, Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723 USA; <sup>5</sup>Proxemy Research, Rectortown VA 20140 and Department of Earth Sciences, University College London, UK; <sup>6</sup>Department of Physics, University of Rome Tor Vergata, Rome, Italy; <sup>7</sup>Stanford University, Stanford, California 94305 USA; <sup>8</sup>US Geological Survey, Flagstaff, AZ 86001 USA; <sup>9</sup>Université de Bordeaux, Observatoire Aquitain des Sciences de l'Univers UMR 5804 - LAB / UMR 5218 - IMS, 2 rue de l'Observatoire 33271 Floirac Cedex France; <sup>10</sup>EURAC-Institute of Applied Remote Sensing 39100 Bolzano Italy <sup>11</sup>CNR-IRPI (National Research Council Institute for Geo-Hydrological Protection) 70126 Bari Italy; <sup>12</sup>DIF Bari University 70126 Bari Italy

**Introduction:** Using recent Cassini radar synthetic aperture radar (SAR) images at 350 – 500 m resolution, we report and interpret features on and near the shoreline of Ontario Lacus, near Titan's S pole, revealing morphological evidence for active material transport and erosion. Asymmetry in the two longer shorelines of the lake provides evidence for preferred wind direction; the northeastern shore is dominated by a gently sloping, possibly wave-generated beach, while the southwest shore shows Earthlike rivers, deltas and flooded topography, indicative of very low slopes. We show numerous comparisons with terrestrial analogs to conclude that Ontario is a dynamic lake, similar in many ways to terrestrial lakes, with active shoreline processes.

**Lakeshore Features:** Several hundred lakes have been identified on Titan [1], with more in the N hemisphere [2]. Ontario Lacus, at 74S, 180W, has an area of 14000 km<sup>2</sup>, making it the largest in the S hemisphere. The gross aspects of its shoreline, and evidence for changes to it, have been reported [3]. Ontario's northeastern side (Fig. 1) has a constructional wave-dominated shoreline with a raised beach, with indications of former lake shorelines at multiple levels. Beach development along the northeast shore suggests onshore winds and wave activity, consistent with global prediction [4]. In contrast, the southwestern shore is an indented coastline with ria-like flooded valleys and local delta development at the river mouth. Here the morphology lacks wave-formed sedimentary structures, rather suggesting a drowned coast indicative of a relative rise in lake level -- possibly due to off-shore winds. The different shoreline morphologies suggest a tilting of the basin floor towards the west and an epoch of winds from the south to southwest.

All of these morphologies characterize a dynamic lacustrine environment on Titan, and all are familiar, even though the working fluid is almost certainly an ethane-methane mixture. The Indus, Mississippi, Irrawaddy, and Song Hong (Red) Rivers have deposi-

tional deltas similar to Ontario's but with areas nearly two orders of magnitude larger, indicating sediment flux into Ontario is comparatively smaller than that for similar-sized transportation systems on Earth. Similar flooded valleys appear in Utah, USA and along the south coast of England. Wave-dominated beaches dominate the E Lake Michigan and New Jersey (US) shores.

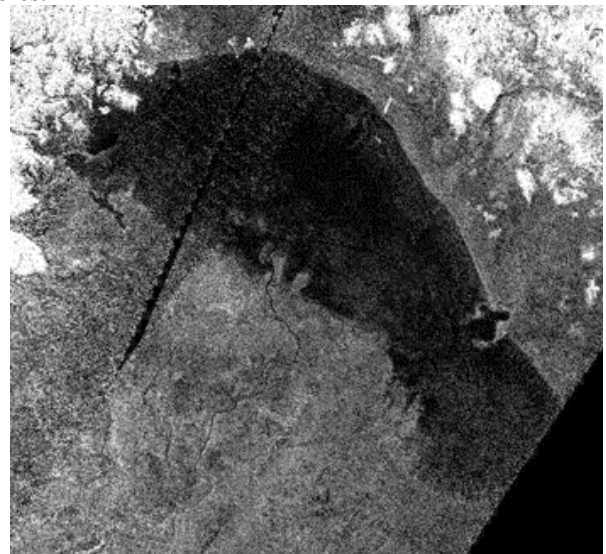


Figure 1.- Mosaic of SAR from Titan passes T57 and T58; north is up. Left portions of lake and shore contain processing artifacts in this preliminary version.

The depth profile of Ontario Lacus is poorly constrained, but if we extrapolate from the shore topography the lake is likely to be relatively shallow and thus could accommodate a large delta. The lobate morphology of the delta is consistent with a shallow-water delta, suggesting low sediment discharge and thus probably low sediment supply, slow flow velocity and a low sediment transport capacity.

As shown here, Ontario presents one more piece of evidence for the Earthlike balance of geological processes that are modifying Titan's surface. As Cassini's

proposed second extended mission continues to study Titan, we expect to see further examples of the dynamic nature of its surface and the liquid bodies on it.

Portions of this work were performed at Jet Propulsion Laboratory, California Institute of Technology, under a contract with NASA.

**References:** [1]Stofan, E. et al, The lakes of Titan. *Nature* 445, 61–64, 2007. [2] Barnes, J. et al., Shoreline features of Titan's Ontario Lacus from Cassini/VIMS observations. *Icarus* PII: S0019-1035(08)00458-2 DOI: 10.1016/j.icarus.2008.12.028 [3]Aharonson, O. et al., Titan's asymmetric lake distribution and its potential astronomical evolution. *Nature Geoscience*, submitted, 2009. [4]Tokano, T., Dune-forming winds on Titan and the influence of topography. *Icarus* 194, 243-262, 2008, doi:10.1016/j.icarus.2007.10.007.