GEOLOGY OF ONTARIO LACUS ON TITAN: COMPARISON WITH A TERRESTRIAL ANALOG, THE ETOSHA PANS (NAMIBIA). T. Cornet[1], O. Bourgeois[1], S. Le Mouélic[1], S. Rodriguez[2], C. Sotin[1,3], J. W. Barnes[4], R. H. Brown[5], K. H. Baines[3], B. J. Buratti[3], R. N. Clark[6], P. D. Nicholson[7], [1]*Laboratoire de Planétologie et Géodynamique, Nantes, France.* [2]*Laboratoire AIM, CEA Saclay, Gif/Yvette, France.* [3]*JPL, Pasadena, USA.* [4]*University of Idaho, Moscow, USA.* [5]*Department of Planetary Sciences, University of Arizona, Tucson, USA.* [6]*USGS, Denver, USA.* [7]*Department of Astronomy, Cornell University, Ithaca, USA. (thomas.cornet@univ-nantes.fr).*

Introduction

In June 2005 (rev09), the Imaging Science Subsystem (ISS) onboard Cassini's spacecraft detected a large and dark feature near Titan's South Pole that has been interpreted as a liquid-filled basin and named Ontario Lacus [1, 2]. In December 2007 (T38), the Visual and Infrared Mapping Spectrometer (VIMS) imaged Ontario Lacus [3, 4]. This data allowed the potential identification of liquid ethane in the basin interior [3], light hydrocarbon deposits on its margins [5], and concentric features resembling shorelines along the basin boundary [4]. In March 2009 (T51), VIMS acquired new cubes of Ontario Lacus at a similar spatial resolution. In June and July 2009 (T57-58), the Radar in SAR mode acquired its first data set of the lake [6]. The VIMS and Radar observations are shown in Figure 1.

Because Titan's hydrocarbon cycle is in many ways similar to the water cycle in arid/semi-arid regions [7, 8], we chose to develop a comparison between Ontario Lacus and terrestrial landforms in the Etosha basin in Namibia (Southern Africa) (Figure 2). This region is composed of several flat-floored basins called pans that develop by regressive dissolution of a permeable substratum (calcrete layer), lying in an extremely flat depression resembling Ontario's region [9]. By comparing Ontario's and Etosha's remotely-sensed data, we produced an interpretative geomorphological map of Ontario Lacus (Figure 3).

Ontario Lacus: a partially liquid-covered basin

In all imaging data sets, Ontario's interior appears dark (Figure 1). However, in the Radar image, some parts are uniformly dark (corresponding to very smooth areas) while others are brighter (corresponding to rougher areas). This difference has been previously interpreted as reflecting the sensing of the lake floor by radio waves through a deepening liquid medium [10].

However, in the T38 data, channels can be seen inside the southern part of the basin. These channels, visible in infrared images, which document the composition of the few upper microns below the surface, indicate that Ontario Lacus is not covered by a liquid layer in this part. Their presence in the Radar T57-58 image of the basin confirms this conclusion.

Besides, the boundary between the basin interior and the basin exterior does not appear sharply in the Radar image, as it would be the case for a transition between a rough solid surface and a smooth liquid coverage. The significance of the radar signal of Ontario's interior can be assessed by comparison with the radar and infrared images acquired during the dry season in the Etosha region (Figure 2).

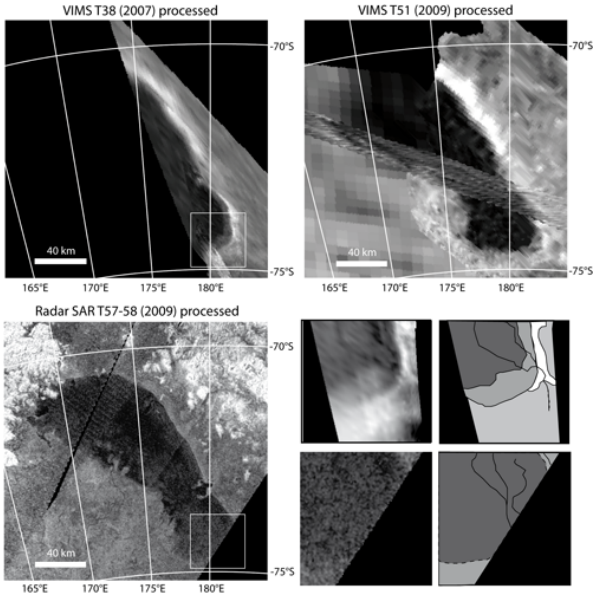

Figure 1: Top left to bottom left: infrared/SAR observations of Ontario Lacus on Titan. Bottom right: zoom and interpretation on the southern part of Ontario where channels are seen in the VIMS T38 and the SAR data.

On the radar image, the Etosha pans are darker than their surroundings. The portions of the pans that are covered by liquid appear as uniform black areas, whereas the flat and smooth portions of the pans that are not covered by liquid display a salt-and-pepper texture. Accordingly, areas that appear uniformly black in SAR images of Ontario Lacus would correspond to liquid-covered portions of the depression, whereas the salt-and-pepper radar signal recorded in some parts of Ontario Lacus is consistent with the sensing of an extremely flat and smooth surface, free of any liquid layer coverage. The dark signal in the VIMS images might indicate that this liquid-free surface is constituted of absorbing sediments.

The bright strip along the eastern margin: an aeolian dune system ?

A distinct geomorphological unit appears on VIMS images in the form of a bright strip located only on the eastern border of the basin. It has been previously interpreted as a system of shorelines [4, 5] or wave-generated beaches [6].

This unit corresponds to a series of concentric topographic ridges, 2-4 km-wide and 7-14 m-high visible in altimetry data acquired at T49. Similar concentric topographic ridges of a

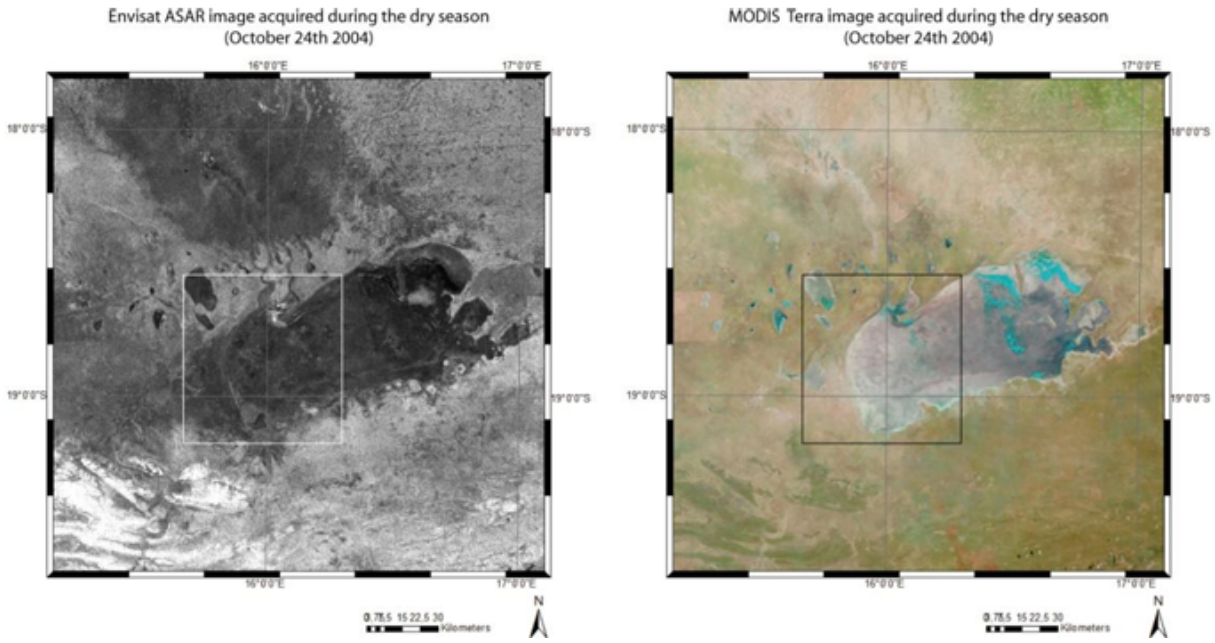

Figure 2: Observation of the Etosha region in October 2004 during the dry season. Left: Envisat ASAR image. Both liquid-covered and liquid-free portions of the pans are darker than their surroundings. Data provided by the European Space Agency ©ESA 2004, ESA ®; right: RGB MODIS color composite provided by the National Aeronautics and Space Agency NASA/GSFC, MODIS Rapid Response.

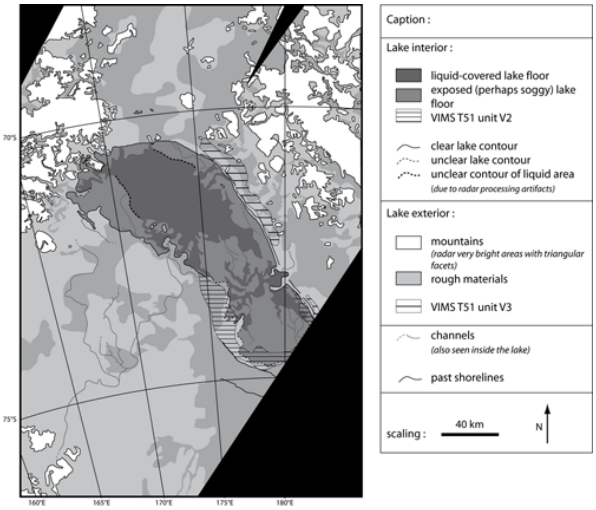

Figure 3: Interpretative geomorphological map of Ontario Lacus.

few km-wide and a few m-high are also seen at the western border of each pans in ASTER Global Digital Elevation Model (GDEM) data of Etosha.

In Namibia, these ridges correspond to dunes formed by aeolian deflation of the pan floors and borders, with an E-W wind direction, and then deposition on the downwind side of the pans. If the same process is responsible for the formation of the bright strip along the eastern border of Ontario Lacus, it implies that the dominant wind direction is SW-NE over the basin, which is consistent with directions inferred from previous studies [11, 6].

Conclusion

The discovery of channels in both VIMS T38 and Radar T57-58 data sets indicates that Ontario Lacus is not completely covered by a liquid layer. The comparison between the infrared and radar images of Ontario Lacus on Titan and of the Etosha Pan on Earth area leads us to interpret Ontario Lacus as a flat basin only partially filled by liquid hydrocarbons (Figure 3). If this interpretation is correct, the rest of the basin would be a flat (perhaps soggy) absorbing surface.

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