CASSINI/VIMS OBSERVATIONS OF TITAN: GEOLOGICAL IMPLICATIONS. C. Sotin[1], S. Rodriguez[1], S. Le Mouélic[1], G. Tobie[1], B.J. Buratti[2], R.H. Brown[3], R. Jaumann[4], R.N. Clark[5], K.H. Baines[2], T.B. McCord[6], R.M. Nelson[2], and the VIMS Science team, [1]Laboratoire de Planétologie et Géodynamique, 2 rue de la houssinière, 44300 Nantes, France, [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA. [3]Lunar and Planetary Lab and Stewart Observatory, University of Arizona, Tucson, USA. [4]Institute of Planetary Exploration, DLR, Germany. [5]U.S. Geological Survey, Denver, USA. [6]Department of Earth and Space Sciences, University of Washington, USA., [Christophe.Sotin@univ-nantes.fr]

Introduction: The origin of methane in Titan's atmosphere is one of the main questions that observations by the Cassini-Huygens mission will try to answer. Mapping the surface reveals the features that will enable us to draw the geological history of Saturn's largest moon. Several instruments onboard the Cassini spacecraft are able to map the surface. Among those instruments, the Visual and Infrared Mapping Spectrometer (VIMS) onboard Cassini [1] has already observed Titan during 9 flybys since its orbit insertion around Saturn on July 1st 2004. Despite scattering by haze particles and strong absorption of light by methane contained in the atmosphere, there are several infrared windows that allow observations of its surface. We report on the observations obtained so far.

Observations : Scattering by haze particles makes observations of Titan's surface very difficult in the visible. Although the ISS camera onboard Cassini has an excellent spatial resolution [2], the haze particles in Titan's atmosphere limits the resolving power of surface features to several kilometers. On the other hand, the VIMS has a much lower nominal spatial resolution (1 km at 2,000 km from Titan) but is less affected by scattering in the infrared windows (Figures 1 and 2). The best compromise between signal to noise and scattering is obtained at 2.03 µm.

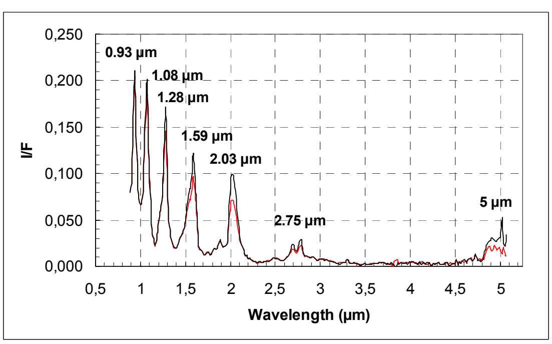

Figure 1 : I/F over dark and bright surfaces.

During the first close Titan flyby on October 26th 2004, the VIMS was able to take images a few tens of minutes before closest approach and observed a feature that is interpreted as a cryovolcanic dome (Figure 2). If confirmed, this feature would agree with the hypothesis that methane is released in the atmosphere by the destabilization of methane-clathrates contained in the crust and brought close to the surface by sub-solidus convection in the outer ice crust [4].

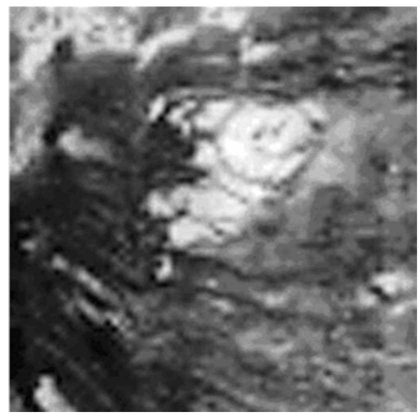

Figure 2 : High resolution image obtained during TA. This feature is interpreted as a cryovolcano [3].

The image above is one of the few high-resolution images obtained so far at closest approach (Figure 3). Several other images have been obtained between 2 and 1 hour before closest approach (spatial resolution between 20 and 10 km per pixel). Among those observations is the Huygens landing site [5] that helps us understand Titan's composition by comparing the information of the VIMS with that obtained in situ by the Huygens probe.

A global map at 2.03 µm is obtained by merging all observations obtained until T8 (figure 4). Among the observations, one can note very few impact craters, which implies a very young surface. The composition of the bright and dark areas look very similar at first order, with possible local enrichments in water ice. Geological implications of these observations and comparison between VIMS and radar images are currently under investigation.

Conclusion and Perspectives : More VIMS images will be acquired during 2006 and will allow us to test the different hypothesis concerning Titan's evolution and the fate of methane in its atmosphere.

Bibliography : **[1]** Brown R.H. et al (2003), *Icarus, 164, 461*. **[2]** Porco C.C. et al. (2005), *Nature* 434, 159-168. **[3]** Sotin C. et al. (2005), *Nature, 435, 786-789*. **[4]** Tobie g. et al. (2006), Nature, in press. **[5]** Rodriguez S. et al., *P&SS, accepted*.

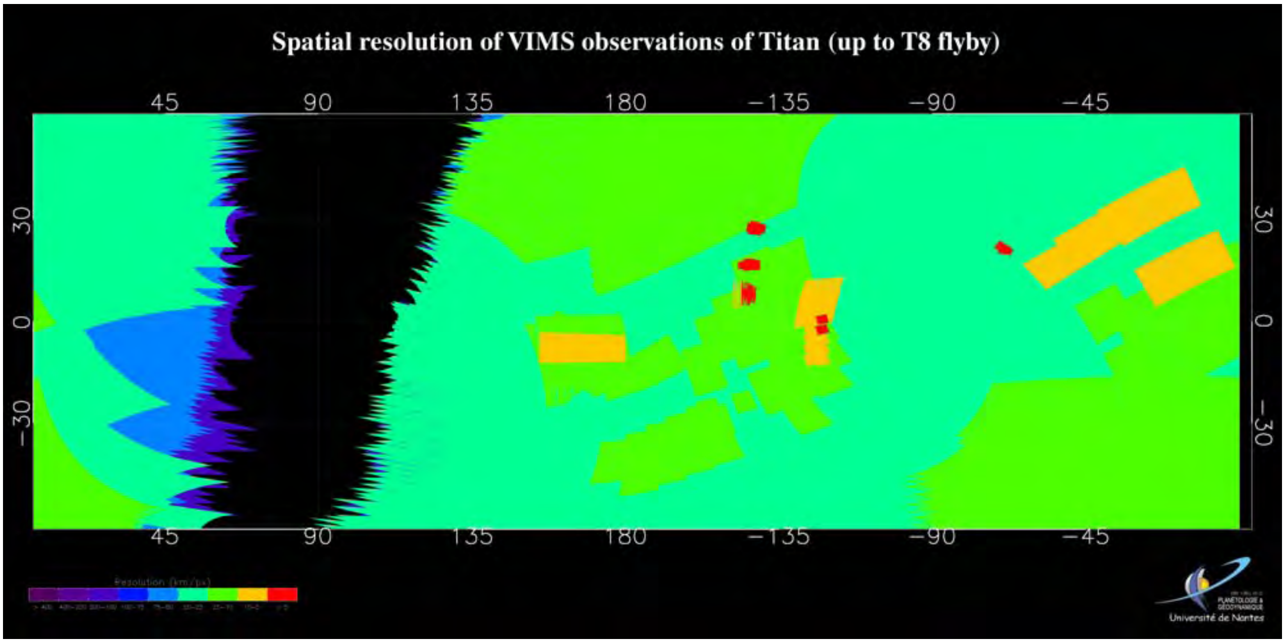

Figure 3 : Spatial resolution of VIMS observations (red < 5 km/pixel, yellow from 5 to 10, green from 10 to 25, light blue from 25 to 50 km per pixel, deep blue and purple > 50 km/pixel).

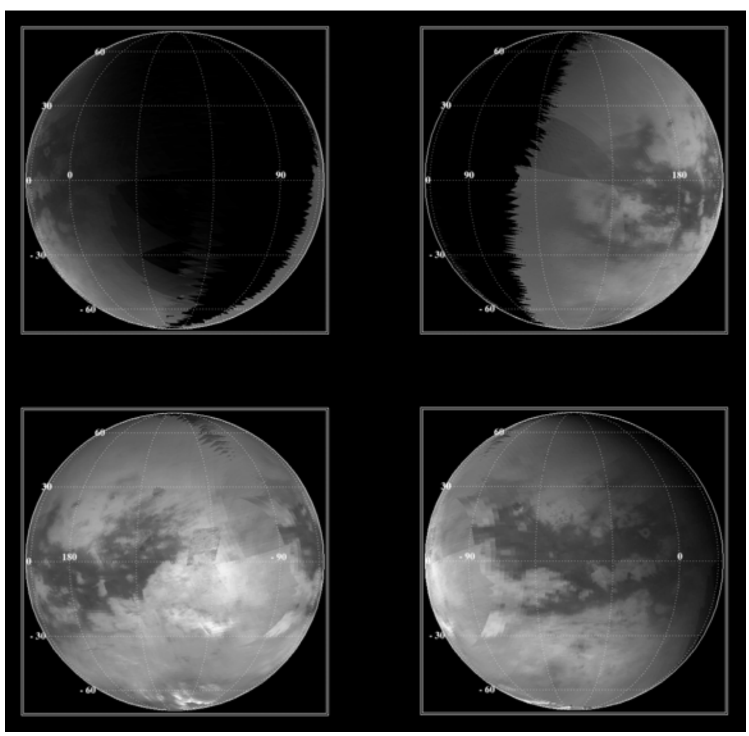

Figure 4 : Mosaics of all images obtained by VIMS/Cassini at 2.03 µm up to T8 (end of 2005).