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The Case for Cryovolcanism on Saturns Moon Titan

R. M. Nelson and the Cassini Titan Surface Variability Team

Jet Propulsion Laboratory, Earth and Space Sciences Division, Pasadena CA, United States (robert.m.nelson@jpl.nasa.gov, +1 818 354 0966)

Two regions on the surface of Saturn's satellite Titan have been observed to change reflectance during the Cassini spacecraft's four-year, orbital tour of the Saturnian system. These changes were documented by Cassini's Visual and Infrared Mapping Spectrometer. Titan's atmosphere is opaque at visual wavelengths due to methane, but VIMS is able to image the surface through "windows" at infrared wavelengths where the methane is relatively transparent[1,2]. Cassini RADAR images show that at least one of these regions, Hotei Arcus (26S,78W), exhibits lobate "flow" forms, consistent with the morphology of volcanic terrain [3]. Here we report the discovery of additional lobate "flow" patterns on Titan's surface at Hotei Arcus, based on VIMS images recently obtained during close flybys by Cassini. This new evidence, combined with the previous evidence from RADAR images, together with the earlier brightness variability seen at these same locations by VIMS, supports the hypothesis of volcanic eruptions. If so, then Titan is presently geologically active on the surface, and in its interior.

Cassini encountered Titan at very close range on 2008-11-19-13:58 and again on 2008-12-05-12:38. These epochs are called T47 and T48. The slant distance from the spacecraft to Hotei Arcus was 27,051 and 31,787 km. for T47 and T48 respectively. We report changes that occurred since the T5 flyby (2005-04-16-13:17; range 117042 km). Previously, VIMS was able to see brightness changes but not morphological change. Now, comparison of earlier higher-resolution data (T5) with the recent T47 and T48 data reveal changes of the surface reflectance and morphology in the Hotei region. This is the first evidence from VIMS that shows that Hotei Arcus is morphology consistent with volcanic terrain.

If Titan is currently active then these results raise for discussion the following questions: What is the full extent of current geologic activity? What are the ongoing processes? Are Titan's chemical processes today supporting a prebiotic chemistry similar to that under which life evolved on Earth?

References: [1]R. M. Nelson et al., 2008a accepted in Icarus [2]R. M. Nelson et al., 2008b accepted in GRL. [3]S. D. Wall et al. 2009 accepted in GRL. This work performed at JPL under contract with NASA.