IMAGING AND SPECTROSCOPY OF TITAN'S DUNES IN THE NEAR-INFRARED. Jason W. Barnes, *NASA Ames Research Center, M/S 244-30, Moffett Field, CA 94034-1000, USA, (Jason.W.Barnes@nasa.gov).*

Abstract:

Cassini's Visual and Infrared Mapping Spectrometer (VIMS) instrument is able using infrared light to see through the haze that envelops Saturn's moon Titan within 8 spectral windows. The 64 VIMS spectral channels that show some surface expression form a hyperspectral imaging system capable of spatial resolution as fine as 250 meters per pixel (though in practice the best yet achieved is 500 meters/pixel). VIMS has studied Titan's clouds [1], surface composition [2], and spectral variability [3, 4, 5]. It has also made important contributions regarding Titan's craters [6], mountains [7], erosion [8], channels [7], and candidate extrusive features [9, 10].

Cassini's RADAR revealed Titan to be the fourth planetary body known to have sand dunes on its surface [11]. The dunes are longitudinal, like most of Earth's, but not most of Venus' or Mars'. [12] showed that areas where RADAR sees dunes are correlated with areas that VIMS sees as "dark brown" within its spectral windows (showing low albedo with a shallow red slope relative to the rest of Titan). Based on this correlation, a whopping 20% of Titan's surface area is covered by dunes. All of the dunes lie within Titan's tropics, within 30 degrees of the equator (Figure 1).

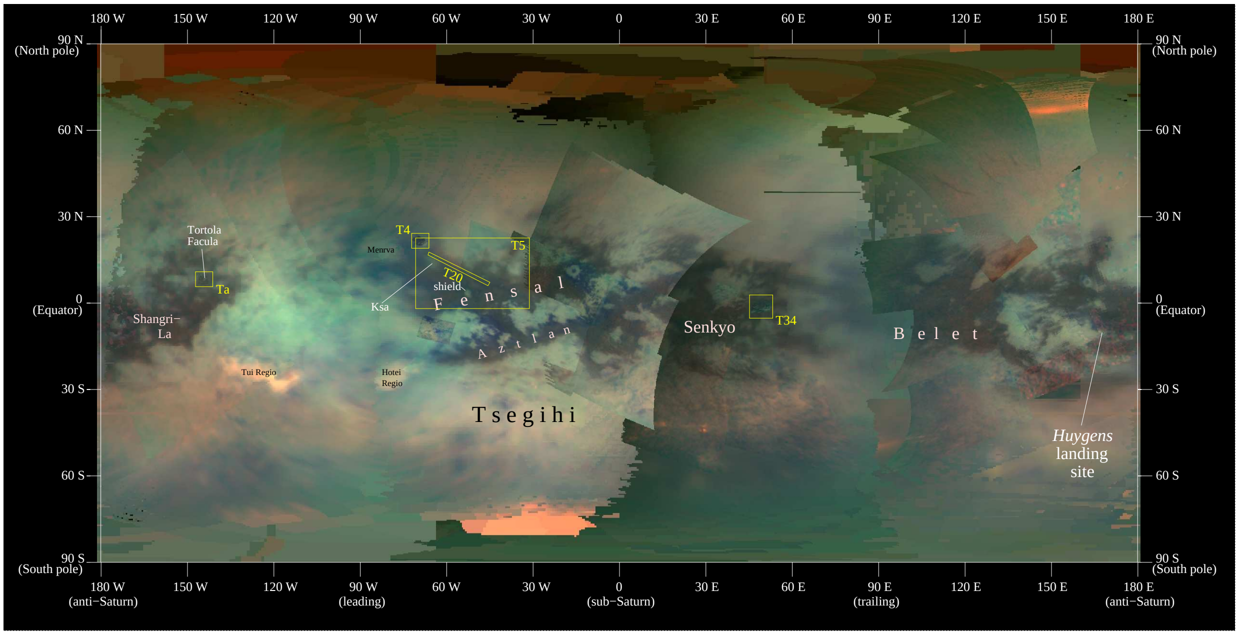

Figure 1: Simple cylindrical global map of Titan in infrared color from *Cassini*/VIMS. Sand seas appear dark brown in this color scheme, and lie entirely girding the moon's equator.

VIMS was first able to resolve Titan's dunes in retrospect during the fourth close flyby of Titan made by *Cassini*, T4 [4]. Photoclinometry of the T4 observation revealed the dunes' heights to be between 30 and 70 meters [13]. The dunes' separations as measured by VIMS are between 1 and 3 km, consistent with the values measured with the RADAR [14].

Very fine spatial resolution from the T20 flyby (2006 October 25) revealed that some of Titan's dunes are separated by sand-free interdune regions [13] (Figure 2). The spectrum of these interdunes corresponds to the dunes' substrate unit. Generalizing to coarser spatial resolution data, these unresolved spectra must consist of a linear mixture of dune and interdune spectra, which will allow global mapping of the dunes' substrate. The fact that these interdunes remain sand-free in Titan's actively eroding environment implies that they are either presently active or were so in the geologically recent past.

Spatially resolving the sand dunes allows us to more precisely constrain their composition. Surprisingly the dunes' sand does not appear to be composed of water-ice, as might be expected from liquid methane erosion of Titan's icy crust. Instead the spectra are consistent with that of solid hydrocarbons. The ultimate source of the dune material might therefore be reasonably expected to be the atmospheric haze particles raining down over time. However, the mechanism by which to create sand-sized particles from the tiny ($\sim$ 1 micron) haze particles has not yet been established.

Near-infrared imaging of the dunes, with complementing RADAR observations, hold the promise to help us understand Titan's sand cycle and to thereby allow us to use something that we think we understand somewhat, Titan's dunes, to help us understand those parts of Titan that we know that we don't understand: everything else.

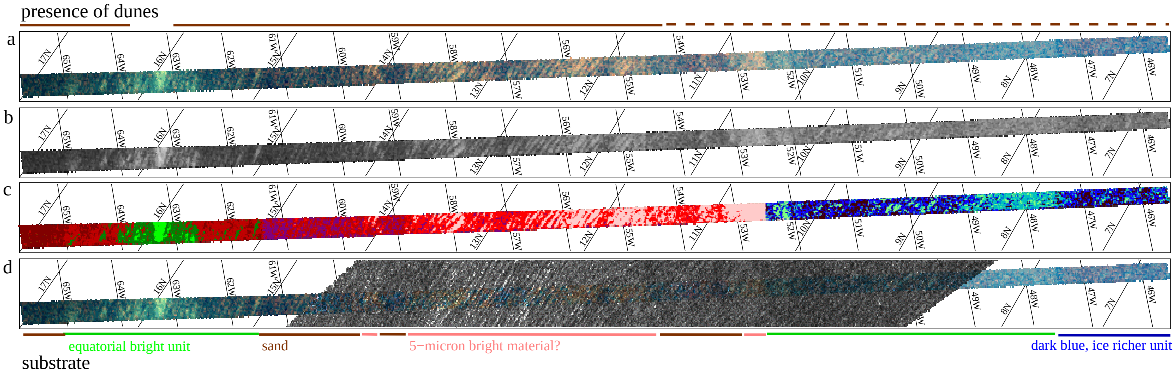

Figure 2: 500 meter per pixel strip showing both dunes and sand-free interdunes on Titan.

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