DETECTION OF THERMAL EMISSION FROM ENCELADUS' TIGER STRIPES WITH CASSINI VIMS.

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Introduction: The 'tiger stripes' fissures on Enceladus, the source of water dominated plumes and extensive thermal emission [1,2], were certainly not envisioned prior to the launch of *Cassini*. Until now, most of what is known about the thermal emission from Enceladus' south pole comes from *Cassini* CIRS spectra that cover wavelengths longer than 7 μm. The CIRS team has provided a wealth of information about this emission [1,3] and its total radiated power [4]. Even though the *Cassini* VIMS instrument covered a portion of the spectrum (4-5 μm) that should show the short wavelength, rising edge of the thermal emission based on CIRS models, no compelling detections in the VIMS data have been published. We announce the clear detection of thermal emission from Baghdad Sulcus very near the location of the source of Plume I reported in [6]. These new 4-5 μm VIMS spectra define the shape of the rising edge of the emission spectrum and put strong constraints on the emitting area at the hottest temperatures. We have also identified similar thermal emission sources along Damascus and Cairo in the VIMS data.

Detection and Data Analysis: A strong detection came from the E11 VIMS spectral image cube of Baghdad shown in Fig. 1 (on next page). The E11 encounter was particularly favorable because: 1) the ~2500 km closest approach distance was a good compromise between maximizing spatial resolution while avoiding smear, and 2) much of the active tiger stripe region was observed at night eliminating reflected sunlight from the VIMS spectra. The raw VIMS cubes in this study were calibrated to I/F and then projected onto a polar stereographic projection of the south pole to compare the locations of the thermal source with the fissures. Bands in the 4-5 μm range were summed to reduce noise. It should be noted that the signal strength is in I/F in these figures since the instrument is mostly used as a reflectance spectrometer; conversation to the normal intensity units for thermal emission is accounted for in our fissure model (Fig. 2).

Discussion: Brown et al. [5] summarized VIMS measurements of Enceladus through the July 14, 2005 encounter. They concluded that the average tiger stripe pixel cannot exceed 140 K and that a sub-pixel fissure at 173 K cannot exceed 135 m wide. These upper limits are not violated by our detection (Fig 2), and they are also consistent with the fissure model parameters deduced from analysis of CIRS spectra [3] based on measurements of the thermal emission at the longer CIRS wavelengths.

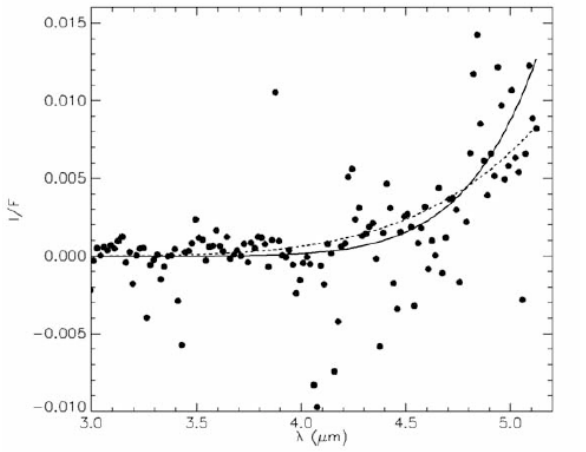

Figure 2. Isothermal calculations (lines) and the VIMS nighttime spectrum (dots) of the brightest pixel in the bottom spot at Baghdad (same as that in fig. 1c). The solid line is the emission spectrum of a T=170 K model fissure that is 100 m wide, similar to the parameters derived from CIRS tiger stripe spectra. The dashed line is the spectrum of a T=273 K fissure that is 0.15 m wide. An 0.5 m wide, T=273 K fissure would have I/F a factor of ~3 larger than the dotted line model and is clearly incompatible with the VIMS spectrum. The shape of the rising edge of the emission spectrum promises sensitive constraints on the hottest emitting area.

References: [1] Spencer et al. (2006) *Science*, *311*, 1401-1405. [2] Porco C.C. et al. (2006) *Science*, *311*, 1393-1401 [3] Abramov O. and Spencer (2009) *Icarus*, *199*, 189-196. [4] Howett C.J.A. et al. (2011) *J. Geophys. Res*., *116*, E03003. [5] Brown et al. (2006) *Science*, *311*, 1425-1428. [6] Spitale J.N. and Porco, C.C. (2007) *Nature*, *449*, 695-697.

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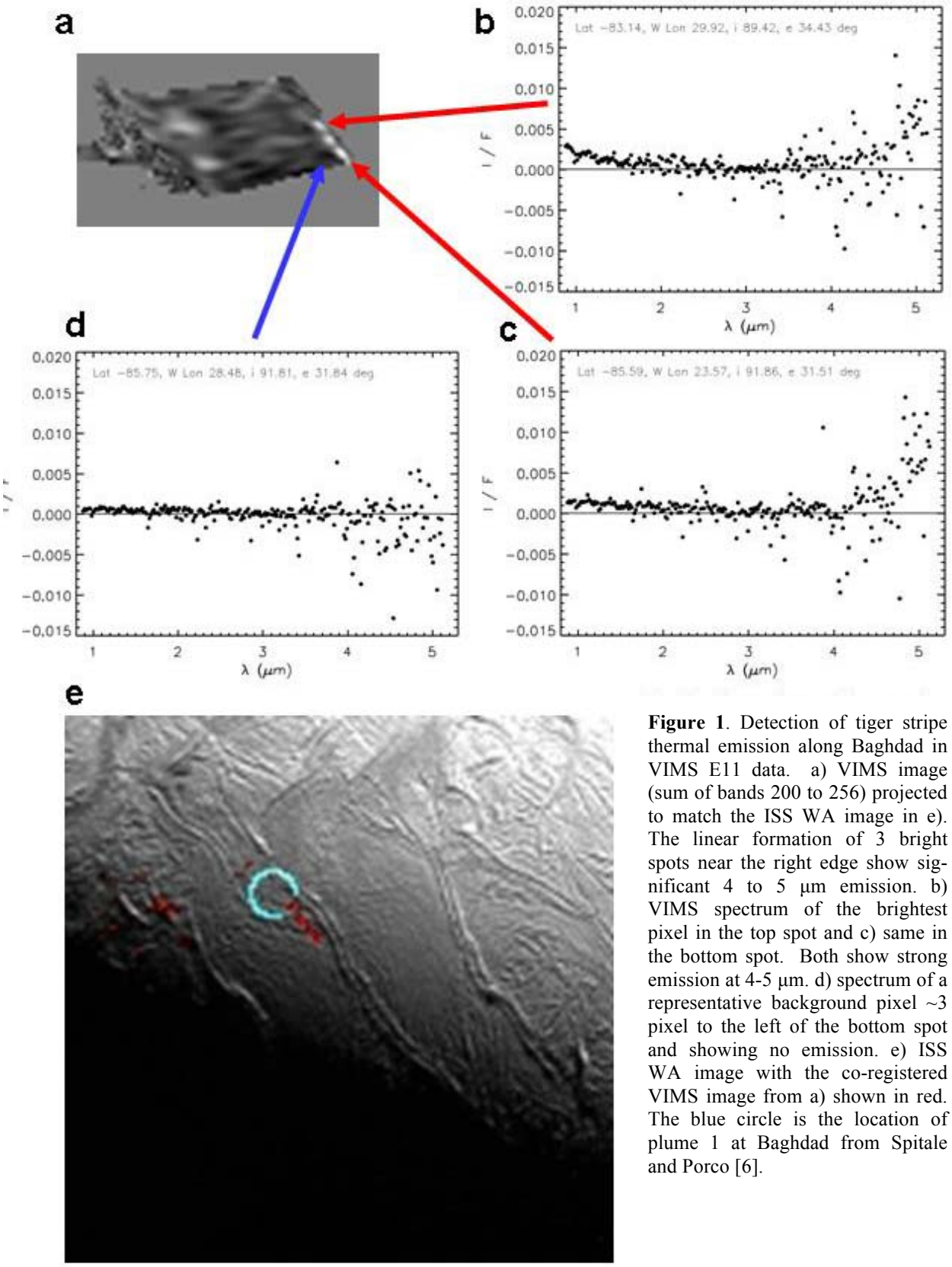

Figure 1. Detection of tiger stripe thermal emission along Baghdad in VIMS E11 data. a) VIMS image (sum of bands 200 to 256) projected to match the ISS WA image in e). The linear formation of 3 bright spots near the right edge show significant 4 to 5 μm emission. b) VIMS spectrum of the brightest pixel in the top spot and c) same in the bottom spot. Both show strong emission at 4-5 μm. d) spectrum of a representative background pixel ~3 pixel to the left of the bottom spot and showing no emission. e) ISS WA image with the co-registered VIMS image from a) shown in red. The blue circle is the location of plume 1 at Baghdad from Spitale and Porco [6].