EQUATORIAL FACULAE ON TITAN: DISTRIBUTION AND ORIENTATION. J. E. Perry[1], A. S. McEwen[1], E. P. Turtle[1], S. Fussner[1], and Cassini ISS Team, [1]Planetary Image Research Laboratory, University of Arizona, 1541 E. University Blvd, Tucson, AZ 85721; perry@pirl.lpl.arizona.edu.

Introduction: Since shortly before Saturn Orbit Insertion in July 2004, the Imaging Science Subsystem (ISS) onboard the Cassini spacecraft has been mapping the surface of Titan and monitoring cloud features in Titan's atmosphere [1]. Prior to the arrival of Cassini, the only information on the distribution of albedo patterns on the surface of Titan came from HST [e.g. 2], ground-based adaptive optics [e.g. 3], and re-analysis of Voyager Orange filter images [4], all at effective resolutions of 200 km or greater, revealing a pattern of large-scale, bright-dark albedo patterns along Titan's equatorial region. Cassini images show these same patterns at much higher resolution, revealing finer-scale mottling within the larger bright and dark equatorial regions.

In particular, Cassini has revealed smaller scale (<500 km) bright features, faculae, within the equatorial dark regions. Examples of several prominent faculae can be seen in Fig. 1. These features have been observed best in the dark regions Shangri-la (near the center of Titan's anti-Saturnian hemisphere; all names used herein have provisional status), Fensal, and Aztlan (both near the center of the sub-Saturnian hemisphere), where Cassini's highest resolution near-IR observations have been located [5].

Morphology: Titan's faculae have a range of margin and interior morphologies, based on the near-IR albedos observed by ISS. Many of the largest faculae have margin and interior morphologies similar to those seen for the much larger scale bright features like Xanadu and eastern Quivira, like Shikoku Facula (Fig. 1B) and Elba Facula (Fig. 1F). Like the western margin of Xanadu, the margins of these faculae appear scalloped with relatively uniform interiors (though Shikoku Facula does appear to have dark lineaments crossing east-west across the feature, which may represent channels). Other faculae actually appear to be tight groups of bright features, like Vis Facula (upper right in Fig. 1D), Kerguelen Facula (above center Fig. 1I), and Crete Facula. These features have much more irregular margins with intermediate albedo material separating the individual constituents. These types of faculae are rare to non-existent in Fensal and Aztlan, but are common in Shangri-la. Finally, several faculae are centered on a circular dark feature. Examples include: Santorini Facula (bottom left of Fig. 1D), Veles (right center of Fig. 1D), Bazaruto Facula (Fig. 1E), and Guabonito (below center of Fig. 1I).

Distribution: We have measured the size distribution of faculae using mosaics from four Titan encounters: Ta (October 26, 2004; over Shangri-la), T7 (September 7, 2005; over Fensal and Aztlan), T8 (October 28, 2005; over Shangri-la), and T9 (December 26, 2005; over Fensal and Aztlan). 58 faculae were measured in Aztlan, 212 in Fensal, and 489 in Shangri-la. Much of the difference in the total numbers results from the prevalence of tight groups of 20 or more faculae in Shangri-la. In all three regions, small, <20 km wide faculae dominate with frequency decreasing with size.

Orientation: In addition to sizes, the orientations with respect to the east-west direction were also analyzed. For Fensal and Shangri-la, the distributions of orientations peak in the east-west direction. This is consistent with facula shapes being related to aeolian deposition of dark, hydrocarbon particulates that appear to dominate the equatorial regions [cf. 6]. The orientation distribution in Aztlan also peaks at approximately northwest-southeast, consistent with the orientation of bright "tendrils" along the southern margin of west Quivira, again suggesting a link with the local prevailing wind direction.

Interpretation: Due to Titan's atmosphere, ISS can only detect surface albedo with no shadows due to topography. This limits how much we can say about the formation of an individual feature on the surface of Titan without additional data from other instruments. Fortunately, the Cassini RADAR, Visual and Infrared Mapping Spectrometer (VIMS), and the Huygens Descent Imaging Spectral Radiometer have also examined some of these faculae. VIMS examined Tortola Facula (top center of Fig. 1D) at 1-2 km/pixel during Ta and interpreted it as a cryovolcano [7]. The ~30-km-wide facula in western Shangri-La over which the Huygens probe descended (upper left in Fig. 1C), was observed to be heavily channeled and to stand ~100-200 meters above the dark plain where Huygens landed [8]. Cassini RADAR, in SAR mode, has observed faculae in eastern Fensal and in western Shangri-la, as well as similar features in the central part of Belet and southeastern Senkyo [6]. Many of the features, as observed by RADAR, consist of groups of hills, 100-

200 meters tall, surrounded by radar-dark terrain [6]. The Huygens and RADAR results regarding these faculae suggest that they are associated with topographic highs and consist of different types of material (rougher, icier, larger grained) compared to the lower dark terrain that surrounds them.

We consider several mechanisms for the observed differences in distribution. First, erosion rates may differ, i.e. higher erosion rates within Aztlan may have removed more of the pre-existing topographic highs. However, each of these three regions exists within the same latitude range, therefore many factors that affect erosion rates are not expected to vary, terrain steepness being a possible significant exception. Second, the mechanisms by which these topographic highs are produced could vary by region. Considering the differences in morphology between faculae in Shangri-la and in Fensal/Aztlan, this possibility seems the more likely of the two.

Topographic highs on a planetary surface can be produced through several different mechanisms: tectonism, volcanism, and impacts (e.g. crater rims and central peaks). Currently, only Bazaruto Facula can be associated with an impact structure [9]. Three other faculae or clusters (Santorini Facula, Veles, and Guabonito) are centered around dark circular features; however, without topographic information over these features whether the bright circular patterns represent the raised rims of impact structures cannot be determined.

Given the present resolution, it is difficult to assess the possibility of a cryovolcanic origin for many faculae, though some (e.g., Fig. 1G) do bear a resemblance to Ganesa Macula, interpreted by the RADAR team to be a cryovolcanic "pancake" dome [10]. Tectonic activity may therefore be responsible for many of the faculae seen in Titan's dark equatorial regions. Clusters like Crete Facula and chains like Antilia and Nicobar Faculae (Figs. 1C and 1D) in Shangri-la, are prominent examples that may suggest tectonic origins. Differences in tectonic processes, and material properties could also result in regional differences in large-scale topographic roughness, which, by affecting parameters such as total topographic variation and slope, could also contribute to difference in erosion rates.

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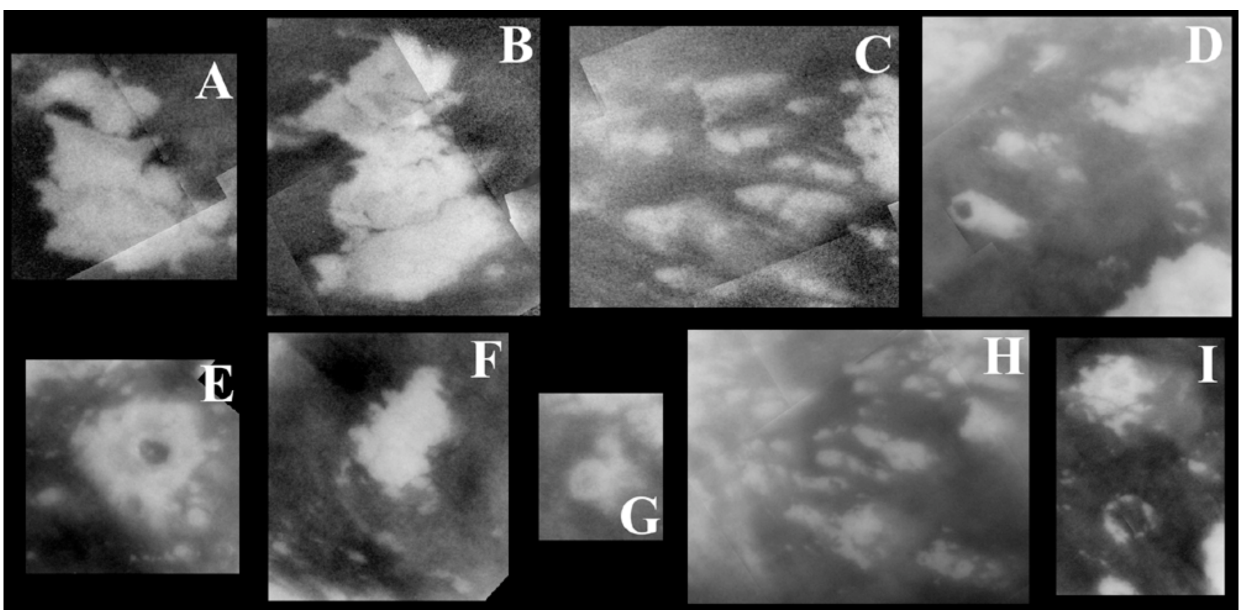

Figure 1: Examples of faculae within the dark equatorial regions Shangri-la, Fensal, and Aztlan, as observed by Cassini's ISS instrument. A-D, H, and I were taken during the Ta and T8 encounters over the Shangri-la region of Titan. E-G were taken during the T9 encounter over the Fensal-Aztlan region.