STRATIGRAPHY OF TECTONIC FEATURES ON SATURN'S SATELLITE DIONE DERIVED FROM CASSINI ISS CAMERA DATA. R. J. Wagner[1], G. Neukum[2], K. Stephan[1], T. Roatsch[1], U. Wolf[2], and C. C. Porco[3]. [1]Inst. of Planetary Research, German Aerospace Center (DLR), Rutherfordstrasse 2, D-12489 Berlin, Germany, e-mail: roland.wagner@dlr.de; [2]Inst. of Geosciences, Freie Universitaet Berlin (FUB), D-12249 Berlin, Germany; [3]Space Science Institute, Boulder, CO., USA.

Introduction: Dione (1124 km in diameter) is a mid-sized icy moon of Saturn which shows a wide range in tectonic features across its surface revealing an intense geologic history. With the two highly evolved satellites Enceladus und Titan, Dione forms a set of three satellites whose surfaces have been shaped by tectonic activity on a global, not only on regional scale. Tectonic forms on Dione were first observed in Voyager camera data from the two flybys in 1980 and 1981 [1][2][3][4]. Troughs and lineaments were reported to be the most abundant type of tectonic features, scarps and ridges also occur [3][4]. During several flybys at Dione including a close flyby in Oct. 2005, the ISS NAC and WAC cameras aboard Cassini [5] have shown the tectonic features on Dione's surface in much greater detail. Especially, "wispy terrain" or "bright wispy material" observed in Voyager data which was interpreted as possibly cryovolcanic in origin [1][2][3] could be revealed as unequivocally tectonic by Cassini ISS [6][7].

Motivation and procedure: This work is focused on the stratigraphic sequence of tectonic events which created various sets of troughs, graben, ridges and lineaments, independent of the specific stress origins which is the topic of further work. The investigation is based on the global Cassini ISS image coverage at regional scale (150 – 500 m/pxl). For more detailed analysis, higher-resolution images from one targeted flyby at Dione and stereo imagery were used. Relative ages of these tectonic landforms are constrained by (1) crosscutting relationships, (2) by their degree of degradation, and (3) by superimposed crater frequencies. Absolute age estimates can be made with the two currently existing cratering chronology models [8][9]. Most of the tectonic features on Dione were recently named, or those with existing names as the "wispy material" (former *lineae*) were assigned new designators (*fossae* or *chasmata*) [10].

Tectonic forms: Tectonic landforms are abundant widely across Dione and occur even in the most densely cratered plains. The following forms are observed:

Troughs and graben. These features, associated with horsts in some places, are the spatially most abundant tectonic landforms on Dione. Troughs are several kilometers or a few tens of kilometers wide and up to several hundred kilometers long. Linear as well as arcuate or curved troughs, single or in parallel sets, occur. The most remarkable set of graben, horsts, and scarps is observed in the trailing hemisphere where these features form broad bands of densely spaced individual troughs and scarps. The bright albedo on these scarps is due to exposure of clean water ice which could be confirmed by Cassini VIMS high-resolution observations [11].

Ridges. Ridges are less common on Dione. A ridge complex, characterized by one prominent ridge associated with minor subparallel ridges and troughs is the approximately north-south trending *Janiculum Dorsa*, extending from 60° N to 20° S along 120 – 150° W longitude. East of this ridge complex, less densely cratered, smooth plains occur which were shown to be topographically higher than the adjacent densely cratered plains in stereo images [12].

Plateaus. A distinct (so far unnamed) plateau can be outlined in low-resolution images east of the 350-km Evander basin (*Fig. 1*). The eastern part of this plateau was seen in Voyager data and mapped as *lobate deposits* [3] but could not be investigated in detail due to lack of imaging data. With the currently available ISS imaging data, this plateau is only seen in low-resolution images. It is characterized by (a) a lower superimposed crater frequency, by (b) distinct scarps, and by (c) an oblong shape. The straight boundaries of this feature suggest a tectonic origin.

Lineaments. Bright lineaments are widely abundant across the surface of Dione, even in the most densely cratered plains. Some lineaments reach lengths of several hundred kilometers. In stereo, some of these lineaments could be shown to represent scarps with little vertical displacement [6][7]. The lineaments are either single, or occur in sets of densely spaced, subparallel lineaments. In one case these lineaments were interpreted as a bright ray crater (*Cassandra*) but could be verified as a system of radial lineaments and scarps [6][7]. Lineaments are seen at all image resolutions and suggest ubiquitious, though weak deformation of the uppermost icy crust.

Stratigraphy: Generally, densely cratered plains are the dominant geologic unit on Dione suggesting a high surface age on the order of ~3 – 4.2 Gyr according to cratering chronology models [6][7][8][9][13]. Early tectonic activity is recorded in degraded troughs and graben with a high superimposed crater frequency,

such as *Drepanum Chasma* in the southern latitudes at 265° W long., or the curved graben of *Arpi Fossae* east of Janiculum Dorsa in the high northern latitudes between 100° and 140° W.

The stratigraphy of the tectonic structures previously termed "wispy terrain" on the trailing hemisphere can very well be constrained by mutual cross-cutting. A stratigraphic map of these structures is shown in *Fig. 2*. *Clusium Fossae* (dark brown) and *Carthage Fossae* (light brown) are the oldest two sets of tectonic structures in this area. These sets are cut by a sigmoidal-shaped band of graben and horsts named *Eurotas Chasmata* (red). A second sigmoidal-shaped band, *Palatine Chasmata* (blue), is located south of Eurotas Chasmata, separated by an area of densely cratered plains which are less affected by tectonism. Both sets are cut by *Padua Chasmata* (green) which represent the youngest set of graben in this area. Sets of bright lineaments (yellow and white) cut all other structures and therefore represent the youngest tectonic features.

Time and duration of tectonic activity is difficult to determine because of the uncertainties in cratering models. Crater frequencies measured in the Eurotas Chasmata region suggest that tectonism may have been active until ~3 Gyr ago [8] or even until ~1 Gyr ago [9]. Currently, ISS images from selected orbits (016, 043, 050) are reprocessed for geologic mapping and further crater counts in the tectonized areas.

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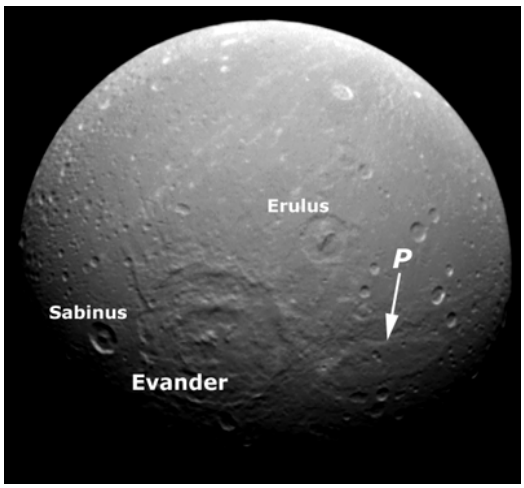

Figure 1: Oblong topographic plateau (***P***) near Evander basin in the high southern latitudes of Dione, seen in low-resolution ISS NAC image N1603020971 from orbit 089. Evander basin, featuring two rings and a central peak massif, is located at latitude 57° S and longitude 145° W and has a diameter of 350 km.

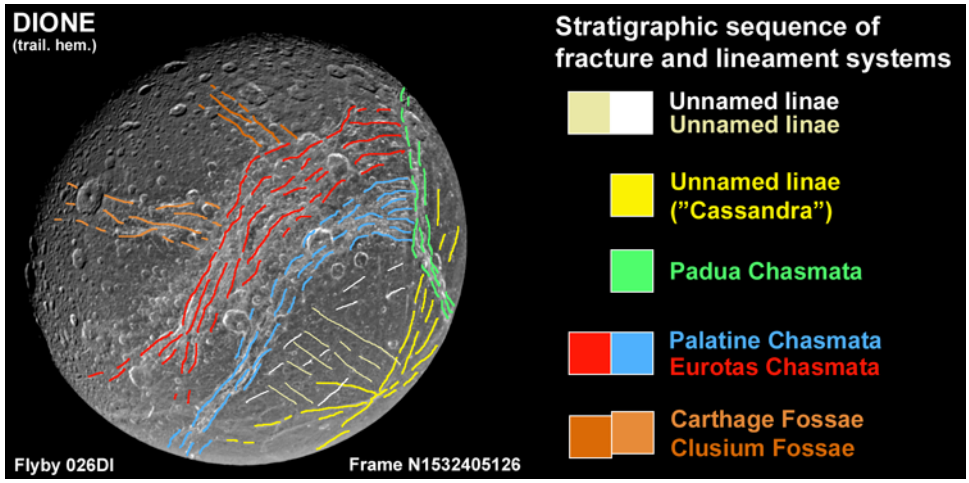

Figure 2: Stratigraphic map of (named and unnamed) tectonic features on the trailing hemisphere of Dione. Oldest units at the bottom, youngest at the top.