THE GEOLOGY OF RHEA: A FIRST LOOK AT THE ISS CAMERA DATA FROM ORBIT 121 (NOV. 21, 2009) IN CASSINI'S EXTENDED MISSION. R. J. Wagner[1], G. Neukum[2], B. Giese[1], T. Roatsch[1], T. Denk[2], 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: Since Cassini's insertion into orbit about Saturn on July 1, 2004, the ISS narrow and wide angle cameras (NAC and WAC) [1] aboard the spacecraft have revealed that Rhea's surface is not only dominated by densely cratered plains, as the data from the two Voyager flybys suggested [2][3], but also shows areas with extensive tectonism, preferentially on its trailing hemisphere [4].

Rhea is Saturn's second-largest satellite (1528 km diameter). The low average density of 1.233 gcm^{-3} [2] implies a more-or-less icy body. The high geometric albedo (0.65) and the presence of H_2O absorption bands imply that water ice is also the dominant surface constituent [e.g. 3]. During a close flyby of the Cassini spacecraft at Rhea, the axial moment of inertia could be determined, which showed that this satellite is more or less a homogeneous, undifferentiated body composed of approximately 75% ice and 25% rock and metal [5].

In this paper we present a first look at geologic features in ISS camera data obtained in orbit 121 on Nov. 21, 2009, in Cassini's extended mission.

Note on feature nomenclature: A large number of surface features in the areas not imaged by Voyager, including, e.g., features shown in ***Fig. 1-3***, have been selected to be assigned names. An updated nomenclature of so far unnamed surface features on Rhea, e.g. craters, basins, crater chains, and tectonic structures, is in preparation [6].

Geologic features in orbit 121 ISS data: In orbit 121, several regions of Rhea's trailing hemisphere were captured by the ISS NAC camera at resolutions from approximately 300 m/pxl to 140 m/pxl.

Tectonic features: Rhea's trailing hemisphere was imaged only at very low resolution by Voyager. These data, taken at high sun, showed bright linear markings, similar to those seen on Dione's trailing hemisphere [e.g., 7]. Cassini ISS data revealed that, on both satellites, these are tectonic features, mostly troughs and graben, with bright ice exposed along steep scarps responsible for the bright albedo [4][8]. The new ISS data from orbit 121 show at least two major sets of troughs trending approximately north-south, separated by an area showing less deformation. Graben widths range from several kilometers up to 30 km in the area covered by imaging sequence 121RH_REGMAP001. Minor graben structures occur within major troughs, and also in the area between major troughs. This tectonically deformed region is located approximately between latitudes 72° N to 45° S, and between longitudes 20° W to 310° W, but images of the 121RH_EQUATCOL001 sequence taken at high sun suggest that tectonic deformation extends further eastward, showing bright lineaments several tens to a few hundred kilometers long which intersect at various angles. These features most likely represent scarps exposing bright ice, as found on Dione [8].

Modifications of cratered plains: Rhea's cratered plains show modifications which were also observed on Dione [9]. Inter-crater plains between some large craters, or groups of large craters, as well as the floors of these craters, appear more or less smooth and have a low density of small craters. As on Dione, this variety is preferentially found in or near the tectonized areas [9], implying a so far unknown process of resurfacing, possibly connected to tectonic processes.

Deposits: In some parts of graben floors, topography seems to be subdued. This could have been caused by material moving downslope along scarps and accumulating on graben floors, forming a deposit which is rather thin (a few meters or so) but thick enough to subdue underlying morphologic features. The deposits show more-or-less indistinct boundaries. Dark deposits with a more distinct boundary occur in craters such as the one in ***Fig. 2***.

Stratigraphy: The globally abundant densely cratered plains indicate that most of Rhea's surface is several billions of years old [10][11][12]. The low state of differentiation of Rhea [5] implies that endogenic processes most likely were active early on and ceased a long time ago. However, graben in the region covered in orbit 121 transect fresh craters with a low superimposed crater frequency, as shown in **Fig. 2**, providing evidence that tectonic activity may have lasted for a much longer period of time.

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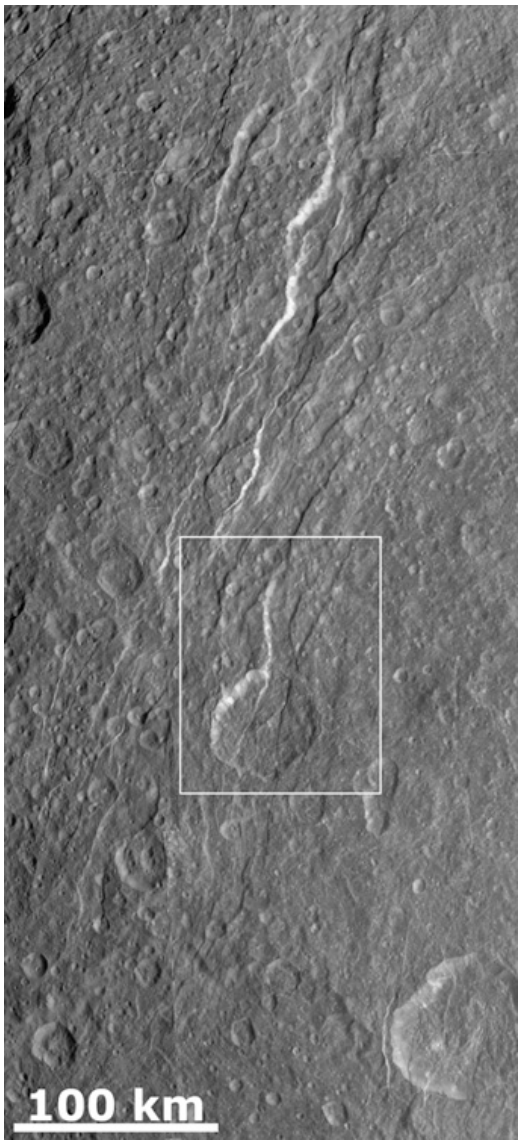

Fig. 1: Part of a preliminary ISS mosaic with data from the imaging sequence 121RH_REGMAP001, approximately ranging from 35° N to 1° N lat., and 287° W to 267° W long. Map scale of the orthographic projection is 140 m/pxl. The white rectangle indicates the area shown in *Fig. 2* at higher resolution.

Fig. 2: Detailed view of the area shown in *Fig. 1*. Troughs transect a crater whose low superimposed crater frequency implies a stratigraphically young age.

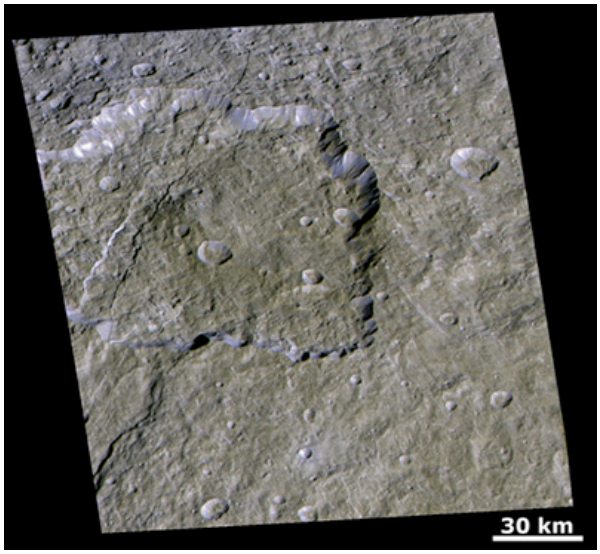

Fig. 3: False color image, combining images taken through the ultraviolet, green, infrared, and clear filters of the 121RH_REGMAP001 imaging sequence, showing color variations on crater floor and outside the crater. A dark deposit near the center of the crater is also detectable in band ratios, and thus is not caused by shadows cast by the central peak.