Strain Measurement Across Fault Scarps on Dione. Noemie Goff-Pochat, and Geoffrey C.Collins; Physics and Astronomy Dept., Wheaton College, Norton Massachusetts 02766.
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Introduction: Dione is one of Saturn's many icy satellites. In the late 1970's Dione was imaged by Voyager and in the past four years by the Cassini spacecraft. The images from Voyager displayed wispy features on Dione's surface interpreted to be of cryovolcanic origin. Cassini images showed the wispy features to actually be fault scarps of tectonic origin [1].

The presence of tectonic features leads us to questions concerning Dione's interior. Surface strain that produces faults may be due to a combination of different processeses occurring in the interior of the icy satellite [e.g., 2]. Quantitatively determining the amount of strain a surface has undergone is a vital measurement for discrimanting between different possible processeses occurring in the interior. In this project we are measuring the horizontal displacement of selected faults on Dione's surface to analyze the overall surface strain.

Procedure: In order to do a geometric measurement of fault scarps with a minimum amount of error we need high resolution images. We started by downloading all of the images of Dione in the PDS with resolutions better than 500 m/pixel. After processing them through ISIS, we selected the images that had at least 3 or more faults that could be measured, resulting in approximately thirty-five images to choose from. From these images we selected the best target areas with fault scarps at least 3 pixels wide.

The measurement we wanted to make was the throw of the fault, this is the distance from the top of the fault scarp to the bottom. However, when measuring the distance from the top to the bottom of the fault scarp on the image we are actually measuring the projected width of the fault scarp onto the camera plane. Fault scarp width was measured orthogonal to the fault strike at every 10-15 pixels along the fault. We had to correct these measurements based on the fact that the surface of interest is not flat, but is tilted with respect to Dione's surface. To account for the tilt of the fault, the relation between the measured and actual widths had to be geometrically determined.

We determined a correction factor, which is the ratio of the projected width to the actual width. (see figure 1) A surface parallel vector along the strike of the fault was obtained by measuring the latitude and longitude of two points along the fault, this is the vector on the actual fault. We found a vector that is simultaneously orthogonal to the fault strike vector and making an angle of 90-α to the surface normal vector (α is the assumed fault dip). This vector is in the plane of the fault scarp along the direction of the throw of the fault. Finding the projected length of this fault scarp vector on the plane of the camera provided the correction factor for the measured widths.

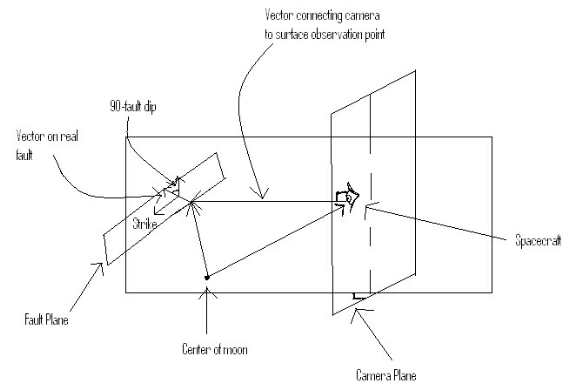

Figure 1. This figure shows the throw of the fault scarp projected onto the camera plane.

To determine the overall displacement over a given fault, the mean and standard deviation of each fault scarp throw was calculated. The mean and standard deviation were both multiplied by the cosine of the fault dip to find the actual horizontal displacement of the faults.

Results: The fault sets on Dione vary from small spaced out parallel fractures, like those found in the targeted area of Carthage Fossae, to large tightly spaced parallel faults like those found in the targeted area of Palatine Chasmata. The faults in the area of Carthage Fossae were found to have a strain of approximately 5% (see figure 2), while those in Palatine Chasmata were found to have a strain of approximately 38%. Another targeted area was Aurunca Chasmata, fault sets found there had a strain of approximately 21%.

We mapped out the area of Dione that was covered by fault sets similar to the ones we measured at high resolution. This area covers approximately 17% of Dione's surface (see figure 3). If this area is typically strained by an average of our measured values, then about 3.5% extensional strain has been accommodated on the surface of Dione.

Future Work: The preliminary numbers that we presented in this abstract were based on the analysis of individual faults. In the future we will look at sets of faults and how the total displacement of an entire fault zone varies along strike. This analysis will give us a much more accurate idea of how much overall surface strain has been accommodated over the fault zones of Dione.

References: [1] R. Wagner et al. (2006) *LPSC XXXVII*, #1805; [2] J.C. Castillo et al. (2006) *LPSC XXXVII*, #2200;

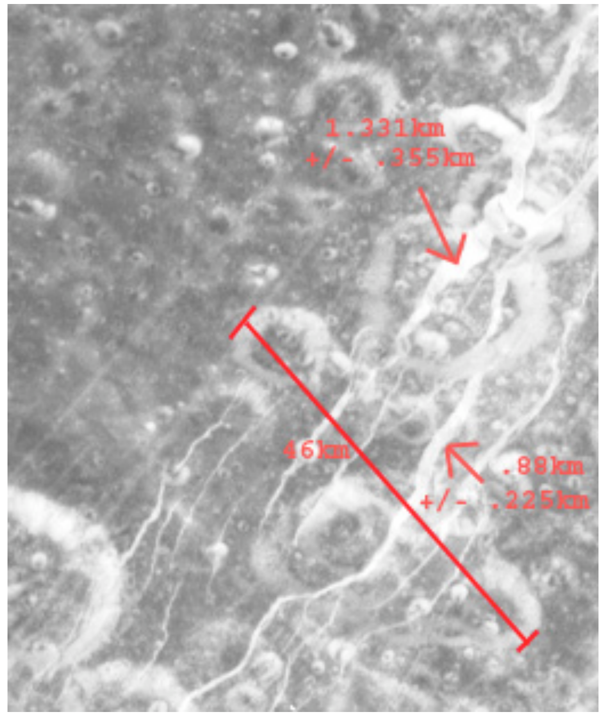

Figure 2. Faults in the area Carthage Fossae target area accommodate extension of about 5%.

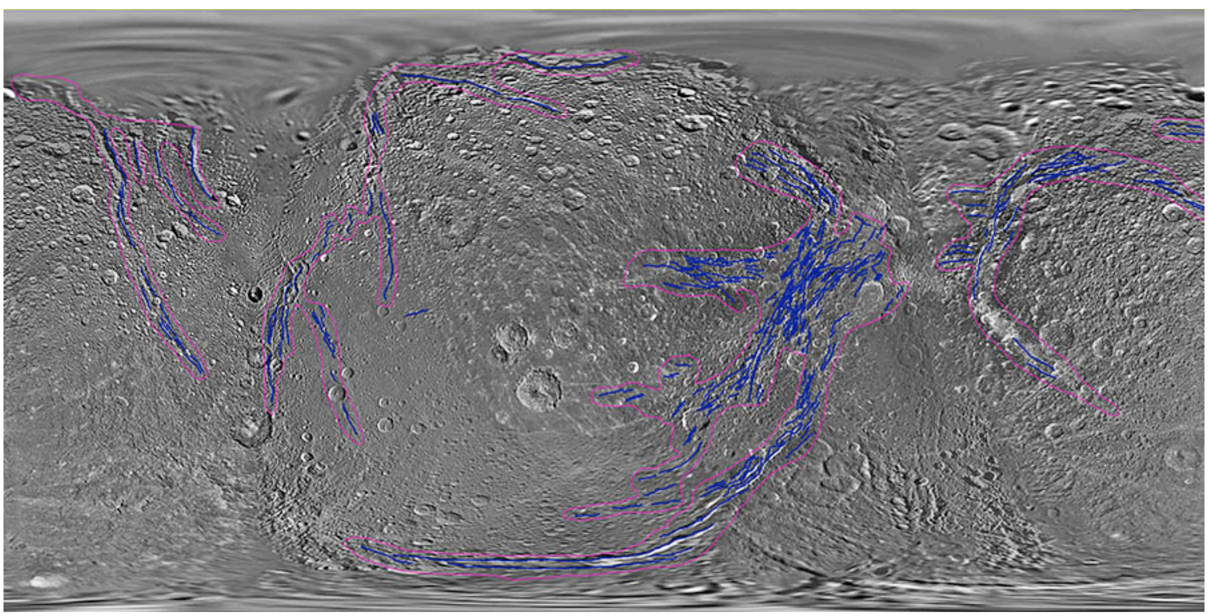

Figure 3. Outlined sets of fault zones makes up approximately 17% of Dione's Surface area.