SEARCHING FOR STRAINED CRATERS ON ENCELADUS. Noemie Goff-Pochat, Hannah B. di Cicco, Robert L. Michaud, and Geoffrey C. Collins; Physics and Astronomy Dept., Wheaton College, Norton Massachusetts 02766. gcollins@wheatoncollege.edu

Introduction:

Enceladus exhibits a remarkable array of tectonic features on its surface, now revealed in detail by the Cassini mission. One first step to take when confronted with an array of new tectonic features is to measure the amount of strain represented by the features. This can be done either by analyzing the geometry of individual faults, or by using strain markers of known initial shape. Impact craters provide convenient circular strain markers, and have been used on Mercury [1], Mars [2], Venus [3], and Ganymede [4]. In this project, we are examining craters on Enceladus which are cut by tectonic features in order to determine the strain.

Mapping:

We started by downloading all of the images in the PDS with resolutions better than 500 m/pixel. After processing them through ISIS, we imported them into ArcGIS and tied the high resolution images to the high resolution image mosaic by Roatsch et al. [5].

Our search of the images turned up the most promising concentrations of craters cut by faults in the cratered terrain east of Diyar Planitia. This area is well covered by high resolution imaging, with resolutions ranging from 68-274 m/pixel. Miller *et al.* [6] previously looked at interactions between craters and fractures in this same area, but they investigated the deflection of fractures, while we are investigating the geometry of the craters themselves in relation to the fracture sets.

We set out to map all of the craters, fractures, troughs, and ridges in this area in order to have a complete survey of the interaction between craters and tectonic features. The features were digitized directly on the controlled high resolution image mosaic, using higher resolution Cassini frames (<111 m/pixel) to double-check features where possible. The map of craters and fractures is shown in Figure 1.

Over 2000 fractures were mapped in this area, concentrating on the most recent, morphologically sharpest features, since these are the ones that are

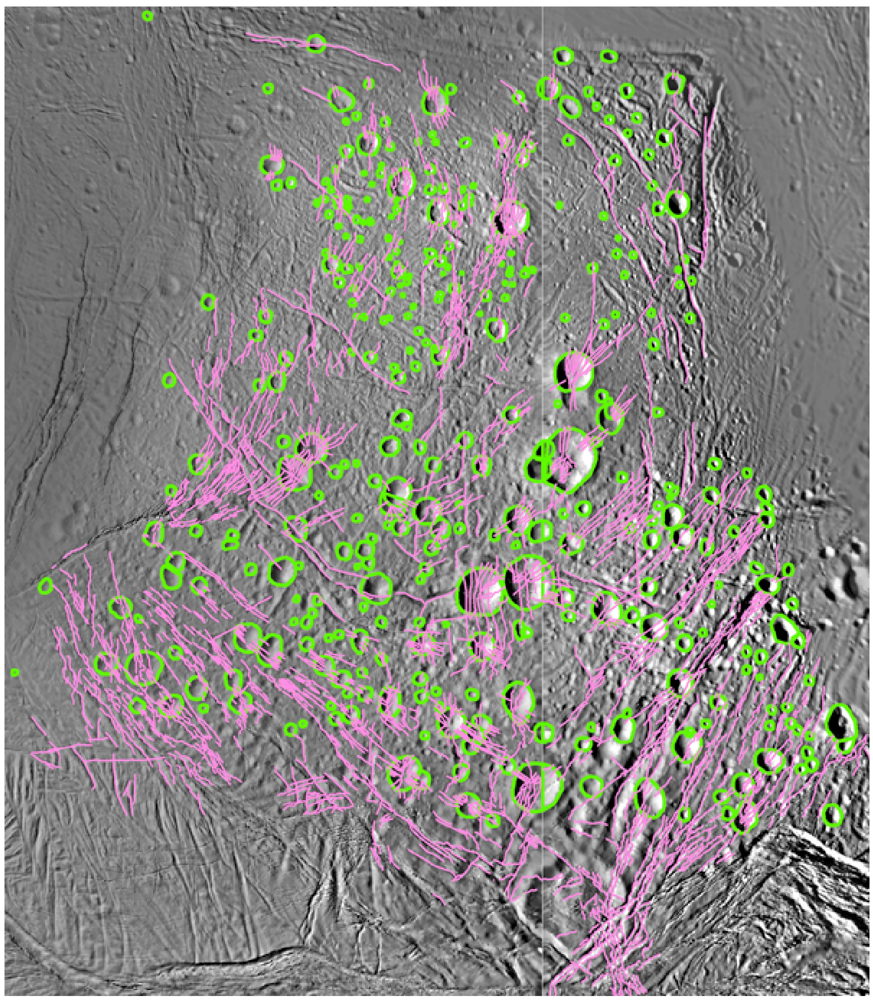

Figure 1. Map of old cratered terrain east of Diyar Planitia on Enceladus. The latitude ranges from 16°N to 47°S and longitude ranges from 145° to 205°E. The illumination is from the west. The pink lines represent the fractures (focusing on those that pass through craters), while the green circles represent the crater rims.

modifying the impact craters. The bottoms of the troughs (as inferred from shading) were digitized.

We digitized over 200 craters larger than 1 km in diameter. Points were carefully picked along the rim crest, at a density to most accurately represent the shape of the crater. Interruptions in the rim by younger features (e.g. other craters) were skipped over. Some topographically subdued (probably very old) craters were also skipped due to difficulty in defining the location of the rim crest.

Analysis of map data:

The azimuth was calculated for each line segment of each fracture mapped, and then an overall average azimuth (weighted by segment length) was calculated for each fracture. Figure 2 shows that the fractures are dominantly oriented NE and SE, with very few E-W oriented features.

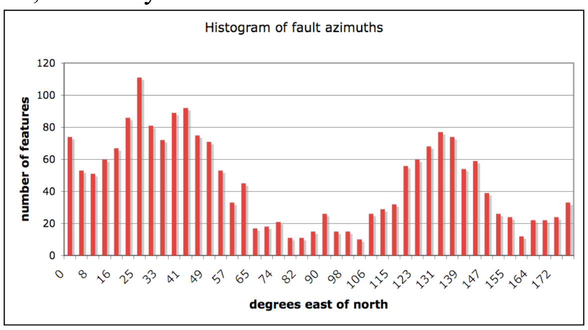

Figure 2. Histogram of fracture azimuths in map area.

Best-fit ellipses were calculated for all of the digitized crater rims, using the downhill simplex method [cf. 4]. Error analysis of this data is still underway, but the initial data does not show a clear trend of craters being stretched orthogonal to the fractures. Figure 3 shows the azimuths of the major axes of the best-fit ellipses to the crater rims.

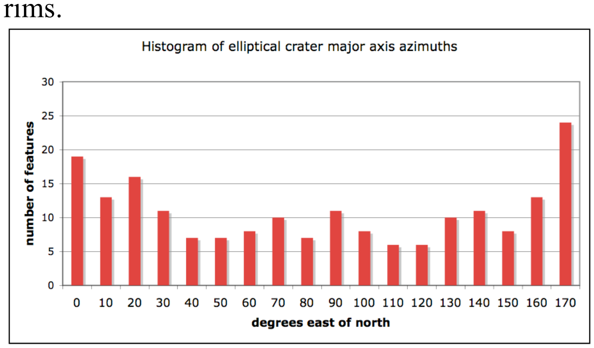

Figure 3. Histogram of best-fit crater rim ellipse major axis azimuths in map area.

Discussion:

If the fractures in this region of Enceladus were causing significant surface strain, many of the craters should be elongated orthogonal to the fractures. Instead, the elongations are in all directions (probably due to small natural variations in initial crater shape), with the only significant increase in the N-S direction (orthogonal to a conspicuous lack of fractures). The calculated ellipticity of the craters is fairly low overall (less than 1.1), and is similar for the craters that are cut by fractures and those that are not.

Our preliminary conclusion, backed up by analysis of pit chains [7] is that the tectonic features in this region of Enceladus exhibit very little strain and may be open tension fractures or widely spaced dilational normal faults.

Our next steps are to perform more rigorous tests on the data to look for statistical differences between the craters that are cut by faults and those that are not, and to investigate a few of the most fractured craters in more detail.

References: [1] Strom et al., *JGR* 80, 2478-2507, 1975; Dzurisin, *JGR* 83, 4883-4906, 1978; [2] Thomas and Allemand, *JGR* 98, 13097-13108, 1993; Golombek et al., *JGR* 101, 26119-26130, 1996; [3] Grimm, *JGR* 99, 23163-23171, 1994; [4] Pappalardo and Collins, *J. Struct. Geol.* 27, 827-838, 2005; [5] Roatsch et al., *PSS* 56, 109-116, 2008; [6] Miller et al., *Workshop on Ices Oceans and Fire*, 95-96, 2007; [7] Michaud et al., *LPSC* 39, #1678, 2008.

Acknowledgements: This work was supported by the Cassini Data Analysis Program through grant NNX07AJ70G