INTERACTIONS BETWEEN IMPACT CRATERS AND TECTONIC FRACTURES ON ENCELADUS AND DIONE. D. J. Miller[1], A. N. Barnash[1], V. J. Bray[2], E. P. Turtle[3], P. Helfenstein[4], S. W. Squyres[4], and J. A. Rathbun[1], [1]University of Redlands (1200 East Colton Ave., Redlands CA 92373, USA), [2]Imperial College London (Exhibition Road, London, SW7 2AZ, United Kingdom), [3]Johns Hopkins University Applied Physics Laboratory (11100 Johns Hopkins Rd., Laurel, MD 20723-6099), [4]Cornell University (Ithaca, NY 14853-6801); *julie_rathbun@redlands.edu*.

Introduction: The majority of features observed on the icy satellites of Saturn are due to impact cratering and tectonics, so how those processes interact is important in the outer solar system. However, the morphology of the interaction is different on different Saturnian satellites. On Enceladus, the impact features appear to control the orientation of nearby linear tectonic features. On Dione, however, the impact features are substantially altered and extended by the action of linear tectonic features.

Enceladus: The surface of Enceladus can be divided into cratered and tectonic terrains (Rathbun et al., 2005). In the cratered terrains, tectonic features (that appear to be fractures) still occur. However, the orientation of the fractures appears to be controlled by the preexisting impact features (figure1), suggesting that the existence of the impact feature is affecting the fracturing process. One possibility is that the stress due to the impact crater's topography is interacting with the stress causing the tectonics. If that is the case, the stresses should be of similar magnitude and the fracture stress can be approximated by the topographic stress (Turtle and Melosh, 1997).

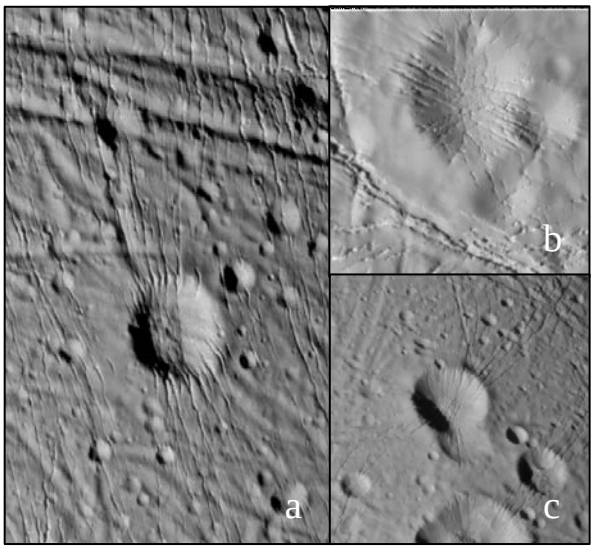

Figure 1: Three impact craters on the anti-Saturn hemisphere imaged during the 04EN close approach. All three have been disrupted by tectonics and the tectonic features deflect across the crater. Panel b shows graben occurring in perpendicular sets while panel c shows nearly radial defection of the fractures. In all cases, the craters remain circular throughout the deformation.

We have identified more than a dozed relevant impact craters and mapped the fractures and crater rims. Using the Interactive Data Language (IDL), we measured the trend of fractures in the region and calculated the angle of reorientation expected if each fracture's direction were to be radial near the crater (figure 2). We then measured the directions of fractures overlapping the crater and compared the actual direction to the expected direction. We found that approximately half of the fractures were reoriented in the expected way indicating that the impact features are influencing the orientation of fractures that overlap them.

The craters identified are all located at low latitudes on the anti-Saturn hemisphere of Enceladus. We will compare the size distribution and morphology of the identified craters to the general population (Bray et al., 2007) to see if any crater factors affect the observed reorientation.

Dione: Most of Dione's surface is heavily cratered. However, Cassini images have revealed that the ambiguous "wispy terrain" is actually composed of tectonic fractures (Wagner et al., 2006). We have made a preliminary map of these fractures (figure 3)

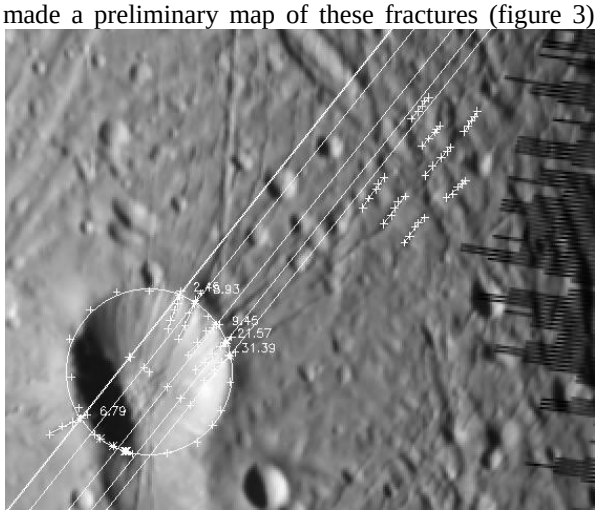

Figure 2: An example crater showing the mapping of fractures and the crater rim. Points along the crater rim are marked and a circle is fit to the points. Points along each fracture are marked and a line is fit to each. The angle of each fracture to both the radial direction and the regional fractures is calculated.

and have noticed that most of Dione's tectonics lie along two great circles. When the tectonic fractures in the wispy terrain interact with impact features, the crater's morphology is altered by the fracture. In several cases, the crater is split and extended in a way similar to interactions observed on Venus (Solomon et al., 1992; Rathbun et al., 1999) and Ganymede (Pappalardo and Collins, 2005). In these cases, the extension across the fracture can be derived by measuring the elongation of the impact crater's rim. We will present results of these measurements and estimates of the regional strain based on the measured extension. We will further test if the different tectonic sets affect the amount of extension or strain observed.

References:

Bray, V.J., D.E. Smith, E.P. Turtle, J.E. Perry, J.A. Rathbun, A.N. Barnash, P. Helfenstein, C.C. Porco (2007) Impact crater morphology variations on Enceladus, LPSC, 38, abs. 1873.

Pappalardo, R.T., and G.C. Collins (2005) Strained craters on Ganymede, J. Structural Geology, 27, 827-838.

Rathbun, J.A., D.M. Janes, S.W. Squyres (1999) Formation of Beta Region, Venus: Results from measuring strain, J. Geophys. Res., 104, 1917-1927.

Rathbun, J.A., E.P. Turtle, P. Helfenstein, S.W. Squyres, P. Thomas, J. Veverka, T. Denk, G. Neukum, T. Roatsch, R. Wagner, J. Perry, D. Smith, T.V. Johnson, C.C. Porco (2005) Enceladus' global geology as seen by Cassini ISS. Eos Trans. AGU, Fall Meet. Suppl., Abstract P32A-03.

Solomon, S.C., S.E. Smrekar, D.L. Bindschadler, R.E. Grimm, W.M. Kaula, G.E. McGill, R.J. Phillips, R.S. Saunders, G. Schubert, S.W. Squyres, E.R. Stofan (1992) Venus tectonics: An overview of Magellan observations, J. Geophys. Res., 97, 13,199-13,255.

Turtle, E. P. and H. J. Melosh. (1997) Stress and flexural modeling of the Martian lithospheric response to Alba Patera, Icarus, 126, 197-211.

Wagner, R., G. Neukum, B. Giese, T. Roatsch, U. Wolf, T. Denk, and the Cassini ISS team (2006) Geology, ages, and topography of Saturn's satellite Dione observed by the Cassini ISS camera. LPSC, 37, abs. 1805.

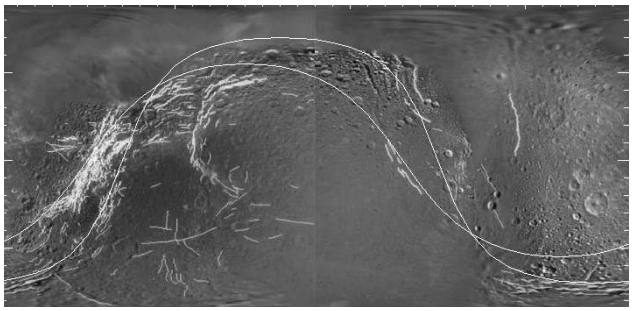

Figure 3: Cylindrical projection of a Dione global mosaic showing mapped tectonic fractures. Two great circles are superimposed which trace out the general directions of most of the tectonic features.