Strain across ridges on Europa. J. H. McBee, D. Hartmann, and G. C. Collins, Physics and Astronomy Dept., Wheaton College, Norton MA 02766 (jmcbee@wheatonma.edu, gcollins@wheatonma.edu).

Introduction: Europa's surface is covered with double ridges and more complex ridge sets. Though their specific mode of origin remains mysterious (see [1] for a summary), several studies have shown that many ridges accommodate strike-slip motion [2,3] and extension [4]. Recently, a few ridges have been recognized which accommodate compression [3,5]. Strike-slip motion could be driven by shear from diurnal tidal stresses [2], and may also lead to melting and compression [6].

Since understanding the strain across these ridges is important for examining the way in which they are formed, we have been developing ways to rapidly determine the strain across Europan ridges. This study is motivated by the observation that some ridges which initially appear to have simple strike-slip deformation appear on closer inspection to have variable amounts of offset along the ridge. This appearance could be due to an element of extension or compression in addition to the horizontal shear. Here we present our results from analysis of a few ridges, including a feature in the E17 DISSTR area that exhibits strike-slip and compressional deformation.

Method: To determine strain across a ridge, we examine older structures which are cut by the ridges. By measuring the offset and azimuth of these structures, we can determine the strike-slip motion and any extension or compression accommodated by the ridge. Offset is measured as the distance between the projected extensions of the two halves of the older feature. Measurement of the azimuth of the older structures is important because older structures which have an azimuth parallel to the overall strain direction will not be offset by the new ridge. Offset increases as the azimuths of the older ridges deviate from the strain direction. Finding the strain azimuth is then a matter of finding the azimuth of minimum offset. For an extensional feature, lineaments clockwise of the strain azimuth will have greater left-lateral offset, while lineaments counter-clockwise of the strain azimuth will have greater right-lateral offset. The reverse is true for a compressional feature.

Results: As an example, figure 1a shows a prominent ridge in the E17 DISSTR area (30S, 218W). The strain direction is nearly parallel to the double ridge segments, and oblique to the two wide bends in the lineament. An older lineament nearly parallel to the main ridge shows almost no offset, demonstrating the strain direction (marked 3 in fig. 1b). Older structures clockwise of structure 3 are cut by the double ridge sections and show right-lateral offset. This means that the two wide bends in the ridge complex are compressional in origin, as they are restraining bends in this strike-slip fault. The morphology of these restraining bends shows many 100 m wide, lumpy, discontinuous ridges elevated as a plateau above the surrounding area (fig. 1c), much like the compressional band shown by Sarid *et al.* [3].

Two other ridges have also been analyzed so far. For an unnamed dark lineament that crosses Minos Linea at 46N 216W, imaged in E15 REGMAP01, there was no measurable offset among crosscut ridges in a variety of azimuths. It is very interesting to note that this prominent 3-5 km wide ridge appears to have formed essentially without strain, covering over or modifying the existing terrain in place. For Agave Linea, imaged in E6 DRKLIN near 15N, 275W the strain azimuth is NE-SW, slightly to the N-S of being perpendicular to the linea. Offset becomes more left-lateral clockwise of the strain azimuth, indicating a component of extension in creating this complex ridge system. With more analyses in the future, we will be able to make conclusions about typical strain on Europan ridges, and examine differences in strain for ridges with different morphologies.

References: [1] Pappalardo *et al.*, *JGR* 104, 24,015-24,055, 1999; [2] Hoppa *et al.*, *JGR* 105, 22,617-22,627, 2000; [3] Sarid *et al.*, *Icarus* 158, 24-41, 2002; [4] Tufts *et al.*, *Icarus* 146, 75-97, 2000; [5] Patterson and Pappalardo, *LPSC XXXIII*, #1681, 2002; [6] Nimmo and Gaidos, *JGR* 107, 10.1029/2000JE001476, 2002.

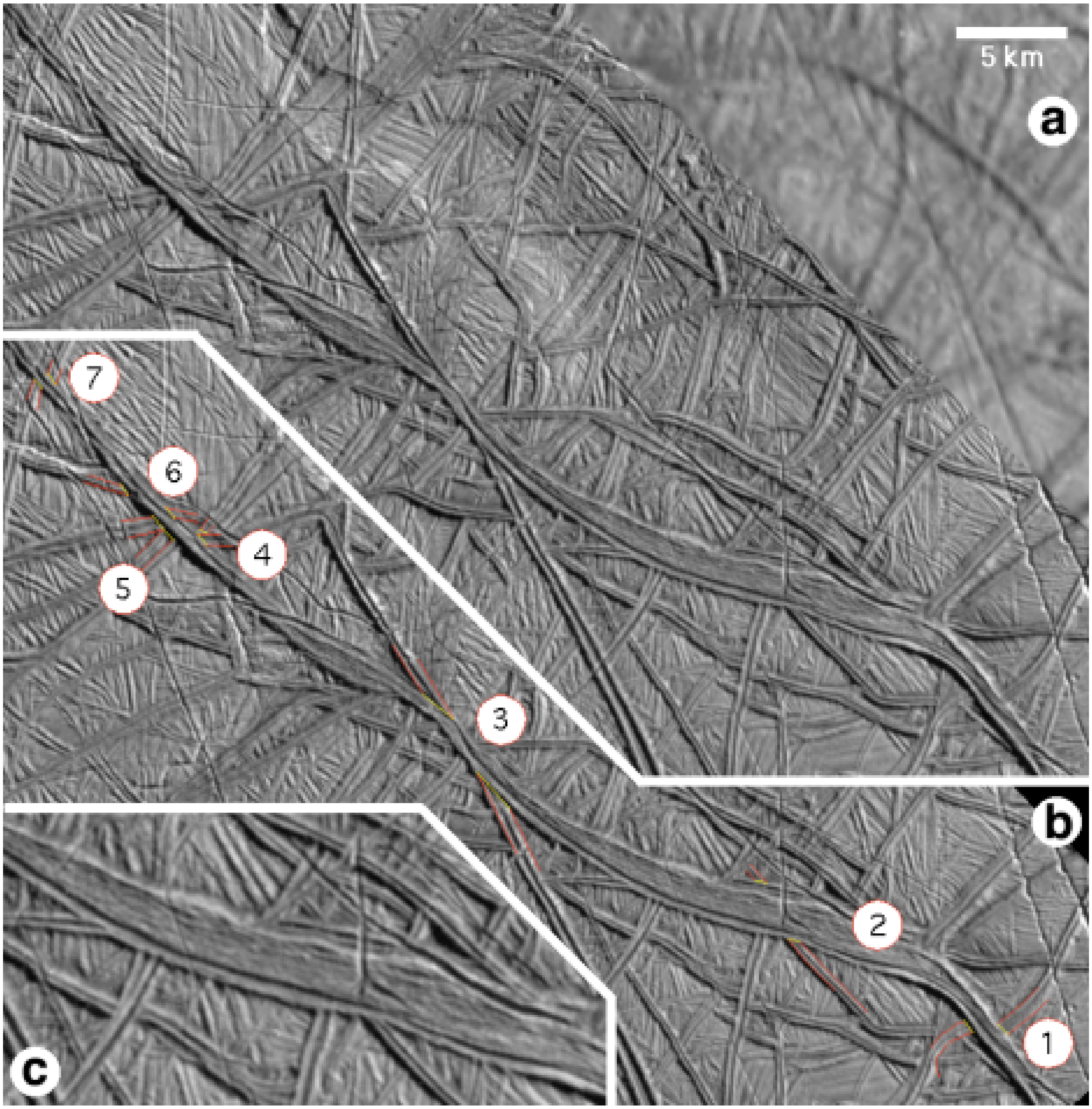

Figure 1: (a) Prominent ridge in E17 DISSTR area, oriented NW-SE. Structure is a double ridge along NW-SE sections, and becomes a wider plateau along two restraining bends oriented WNW-ESE. (b) Older structures used in offset analysis. (c) Closeup of structures at restraining bend, showing manifestation of compressional deformation.