A REGIONAL ANALYSIS OF STRIKE-SLIP FAULT MORPHOLOGIES ON EUROPA. R. P. Perkins[1], C. M. Bailey[1], [1]The College of William & Mary, Williamsburg, VA, 23185. rperkins01@email.wm.edu.

Introduction: Strike-slip faults identified through the Galileo SSI images reveal two distinct morphological variations—band-like and ridge-like, with band-like faults likely forming due to global, diurnal stresses [1]. However, a stress mechanism accounting for the formation of ridge-like faults has yet to be determined. In addition to global stresses such as tidal (diurnal) motion and nonsynchronous rotation, various local sources of stress can cause deformation, including convection [2]. Convection is thought to drive diapirism leading to the formation of chaos terrains, one of an elliptical and circular-shaped Europan surface features known as lenticulae [3]. Secondary fractures known as tailcracks are visible at the margins of Europan strike-slip faults and can be used to determine the mode of fault propagation in terms of dilation and pure sliding motion [1].

Observed low-angle tailcracks at band-like faults indicate that the "tidal walking" model [4], involving an opening and closing of fractures by diurnal forces, is useful for explaining band-like fault formation, but does not adequately explain observed high-angle tailcracks at faults. Such high-angle tailcracks indicate that pure sliding motion would be dominant and rule out the opening and closing sequence suggested by the "tidal walking" model.

In order to analyze possible stress mechanisms behind the propagation of ridge-like faults on Europa, a survey of fault morphologies in six regions imaged by the Galileo SSI instrument was conducted, using a set of qualitative and quantitative criteria to classify a fault as either band-like or ridge-like, in order to determine if local sources of stress such as convection are responsible for stresses that would affect fault morphology distribution in each region.

Methods: Galileo SSI images were compiled from the PILOT database, with usable images having a resolution of ~250 m/pixel or higher, processed in the equirectangular projection. The six regions (Fig. 1) were selected based on image coverage and resolution. Tailcrack angles were measured for faults where tailcracks were observable, with lower tailcrack angles corresponding to band-like faults, and higher tailcrack angles corresponding to ridge-like faults, as modeled by linear elastic fracture mechanics [1]. Patterns in albedo were also used to determine morphology—ridges on Europa typically feature a high contrast between high albedo values on the margins and low albedo values in the center trough, which was used along with measurable offset to identify ridge-like faults. Similarly, bands on Europa feature much more uniform albedo values and no central trough, and offset was used to denote these as band-like faults. In situations were resolution didn't allow for easy classification based on albedo values but where tailcracks were measurable, tailcrack angle was used as the sole criterion of fault morphology. If no albedo values or tailcrack angles were observable, an offset lineament was not classified and left out of the survey.

Adobe Photoshop was used to measure offset, tailcrack angle, and the orientation with respect to north for the purposes of the initial survey. Images were subsequently imported into ArcMap to determine relative faulting sequences for regions and sub-regions of the same resolution, and cross-cutting relationships were noted so as to determine relative faulting events among fault morphologies within a given region.

As chaos terrain formation is thought to be driven by solid-state convection [3], chaos terrain areas were measured so as to analyze the possible relationship between convection as a local stress mechanism and the presence of ridge-like strike-slip faults. Ratios of ridge-like faults to band-like faults and chaos terrain areas were analyzed for statistical significance.

Status: The initial survey to determine ratios of ridge-like faults to band-like faults showed that ridge-like faults are more prevalent in 4 of the 6 regions (Agenor Linea, Argadnel Regio, Conamara Chaos, Tyre), with the highest ratio at greater than 8:1. In one region (Astypalaea Linea), the fault morphology ratio is 1:1, and in the remaining region (the Northern plains), the ratio is 4:7 (Fig. 2). Future work will involve a completion of a faulting sequence for all six areas surveyed, using cross-cutting relationships of both fault morphologies mapped in ArcMap. Additionally, areas of chaos terrain regions will be measured and compared to ratios of ridge-like faults to band-like faults to determine statistical significance.

References: [1] Kattenhorn, S. (2004) *Icarus, 172,* 182-202. [2] Collins et al. (2012) *Planetary Tectonics,* 264-335. [3] Belton et al. (1998) *Icarus, 135,* 107-126. [4] Brunt, K.M. (2014) *Earth and Planetary Science Letters, 401,* 275-283.

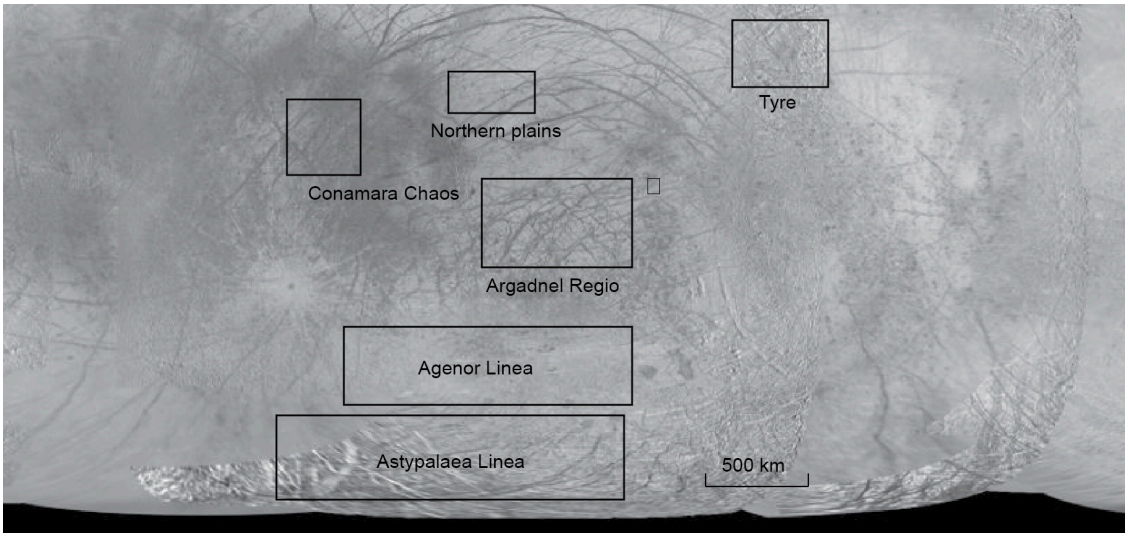

Figure 1. Global mosaic base map of Europa (USGS), edited to display six study areas surveyed for ratio of ridge-like to band-like strike-slip faults.

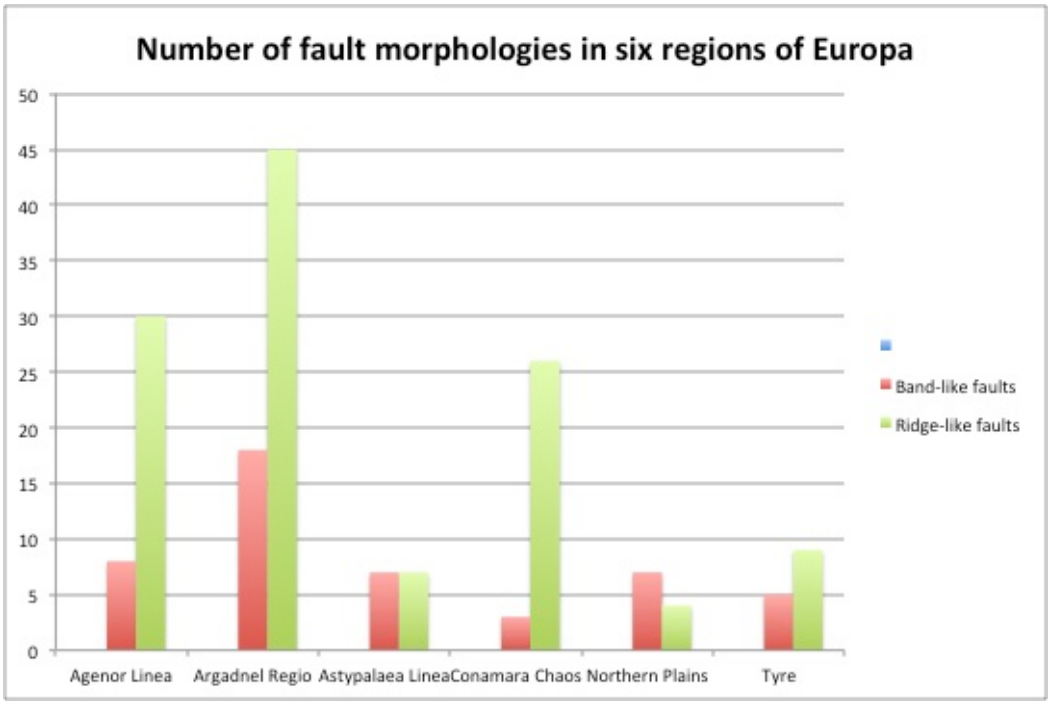

Figure 2. Histogram of surveyed ridge-like (red) and band-like (green) faults in six regions of Europa. Ridge-like faults are far more prevalent in four of the six regions.