BAND TOPOGRAPHY ON EUROPA. G.W. Patterson[1], L.M. Prockter[1], P.M. Schenk[2], [1]Planetary Exploration Group, Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723, Wes.Patterson@jhuapl.edu, [2]Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058

Introduction: Bands on Europa are commonly recognized by a distinct texture with respect to the surrounding terrain and the specific morphological characteristics of several types of bands have been identified [1]. Regardless of variations in morphology, bands have universally been interpreted as having formed by separation of the crust of Europa along fractures and infilling by material from below [e.g., 2].

Several distinct morphologic characteristics, observed in association with some bands, have been used to suggest that the formation of these features is analogous to terrestrial mid-ocean ridges [3,4]. In this scenario new material is created at a central axis, which then cools and cracks as the band opens and the material is transported outward. An alternative view of band formation was proposed by [5]. They suggested that bands formed as a consequence of opening and closing of ice fractures in contact with a liquid water ocean less than a few km below the surface. This scenario would occur in a manner analogous to the formation of 'leads' in terrestrial sea-ice [e.g. 6].

One key way to distinguish between these scenarios for the formation of bands on Europa is through the use of topography. Put simply, if bands form in a manner analogous to terrestrial mid-ocean ridges, the upwelling material is most likely solid-state ice and would likely lead to high standing topography being associated with bands. In the alternate scenario band topography would be at or below the level of the surrounding terrain.

Analysis: Work done by [7] suggests that band topography is high standing and persistent through time. However, their analysis was confined geographically and investigate only 3 bands. To get a more complete understanding of the nature of formation of bands on Europa we have examined the topography and stratigraphic relationships of 9 additional bands found in 5 observations scattered across the surface of Europa (Table 1).

Topography. We utilize orthographically projected DEMs derived using photoclinometric and stereogrammetric techniques described in [8] in this analysis. From these data, we extract a series of profiles perpendiular to the strike of a given feature (Fig. 1). These profiles are used to determine the average difference in elevation (Δh in Table 1) between the feature with respect to the surrounding terrain. To get an accurate measure of this change in elevation we are careful to consider the effects of high and low standing features within the background terrain that could skew our determination of the average elevation for that terrain. These include regions of chaos and lenticulae and prominent ridges within the background terrain.

Stratigraphy. Analyses of Galileo images of the anti-Jovian hemisphere indicate that the stratigraphically oldest bands have the same high albedo as the ridged plains and are distinguishable only on the basis of their morphology, while intermediate aged bands are gray, and the youngest bands are relatively dark [e.g., 9]. Brightening with age is consistent with the observed stratigraphy inferred over most of the anti-Jovian region [10]. Therefore, young bands can be easily identified, while older bands must be discriminated from the background plains. However, since bands have distinctive morphological features, this is not a difficult task, as has been demonstrated [e.g., 1,4]

More than one distinct band can be found within 3 of the observations in table 1. In those cases, crosscutting relationships are used to determine the relative age of the features with respect to each other. The relative ages of the bands found in the other two observations are either sparsely crosscut by younger features and dark with respect to the surrounding terrain (E17STRSLP01) or densely crosscut and indistinguishable in albedo with respect to the surrounding terrain (E6DRKLIN01). This allows us to generally conclude that the former is relatively young and the latter relatively old.

Due to the incomplete coverage of the surface of Europa at consistent resolution, it is generally only possible to make relative comparisons of stratigraphy within each study area, rather than absolute comparisons between different areas. However, we have noted the orientations of prominent features within each observation in order to compare their stratigraphy to models of formation based on non-synchronous rotation (Table 1). Lineaments on Europa are predicted to be oriented according to the prevailing stress field at the time of formation, as a result of non-synchronous rotation of the shell about the interior [e.g., 11, 12]. Thus orientations of linear features can and have been used to determine approximately when in time they formed [e.g., 1,13-14].

Results: Preliminary results for the bands examined suggest that, in general, bands are elevated with respect to the surrounding terrain. The range in relative elevations of bands with respect to their surroundings is greater (20-150m) then that determined by [7]. This may suggest thermal buoyancy plays a larger role in the support of band topography then suggested by the analysis of [7]. Two of the bands found in the E17THRACE01 observation appear to lie at or below the level of the surrounding terrain. It is currently not clear if this is a unique phenomena, or whether their elevation is influenced by the adjacent chaos feature Thrace Macula.

With the exception of the two anomalous bands associated with Thrace Macula, variablility in the relative elevation of the bands with respect to their surroundings appears to be related to age, with younger features being more high standing. This also suggests that thermal buoyancy (passive) may play a role in supporting band topography.

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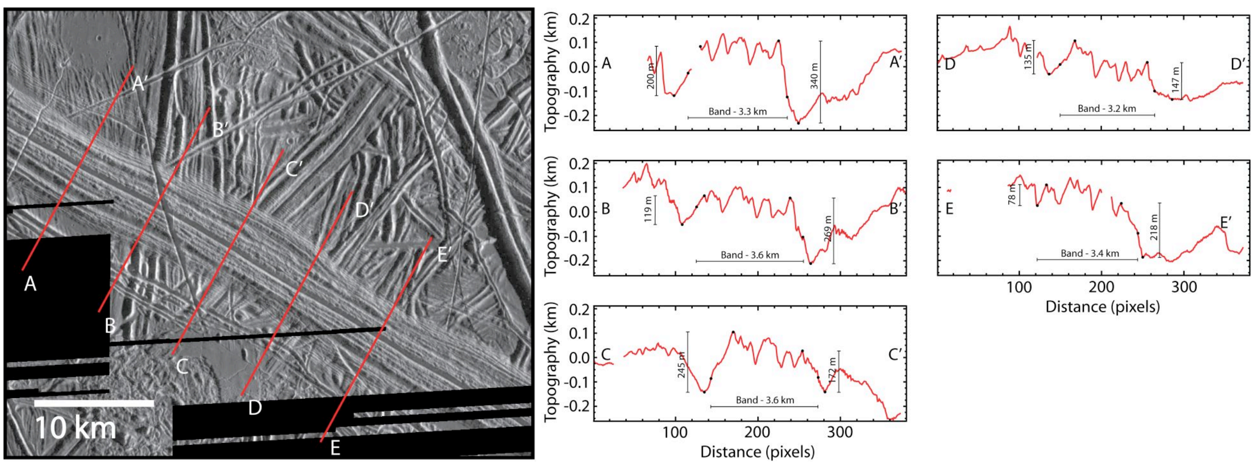

Fig. 1. Image taken from mosaic acquired during the E4DRKMAT01 encounter of the Galileo mission at ~28 m/pixel and located at 5.25N/326.5W. Topographic profiles were taken from a DEM of the mosaic and are shown as red lines labeled A-E.

Galileo Observation	Res. (m/pix)	Location (lat/lon)	Δh[a] (m)	T[b]	θ[c]	Morphology[d]
E4DRKMAT02	28	5N/326W	150	Young	NW/SE	Plateau
			80	Old	NE/SW	Swell
E6DRKLIN01	220	12N/272W	21	Old	ENE/WSW	Ridged/Plateau
E17STRSLP01	50	65S/194W	150	Young	NE/SW	Plateau
E17SOUTHP01	52	79S/129W	94	Intermediate	NW/SE	Plateau
			46	Intermediate	NNE/SSW	Plateau
E17THRACE01	46	46S/172W	58	Old	N/S	Plateau
			-1	Intermediate	NE/SW	Ridged
			-68	Intermediate	ENE/WSW	Ridged

Table 1. [a]Represents the average change in elevation between each band with respect to the surrounding terrain; [b]Indicates the relative age of the band within the imaged area; [c]Inidcates the orientation of each band; [d]Descriptors indicate the 'shape' of the band based on the profiles. 'Swell' and 'plateau' correspond to terms used by [7] to describe bands analyzed in the wedges region of Europa. 'Ridged' describes a morphology in which the dominant topographic signal of the band is represented by its interior ridges.