KINEMATIC RESTORATION OF GANYMEDE´S DARK TERRAIN. M. Fabi[1], T. Kenkmann[1], G. Wulf[1], N. R. Baby[2], K. Stephan[2], R. Wagner[2]. [1]University of Freiburg, Freiburg, Germany; [2]Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany (Email: Thomas.kenkmann@geologie.uni-freiburg.de).

Introduction: Ganymede´s surface can be subdivided into dark and light terrain [1]. The dark terrain covers 35% of the surface, is composed of relatively low albedo material and high crater density. The 65% light terrain is characterized by higher albedo and a lower crater density indicating a relatively younger age [2]. Omnipresent morphotectonic structures such as grooves within the light terrain suggests a more recent activity of this terrain with respect to the dark terrain. The assemblage of lineated grooves has been interpreted as extensional zones similar to the Earth continental rifts, resulting from a global expansion that affected the satellite crust in the past [3].

Objectives: Neighboring dark terrains often show obvious fitting pattern with respect to their external shape, suggesting that the areas have drifted apart by extension. We intend to reconstruct magnitude and orientation of the finite extension between adjacent dark terrains by restoring their original shape. The kinematic restoration allows to better understand the global tectonic movement pattern and may ultimately help to address the issue whether the individual dark terrains once formed a single terrain covering the entire, smaller moon surface.

Methods: We used the global Ganymede image mosaic that was compiled by using a combination of Voyager 1 and 2 and Galileo images [4-6]. The mosaic from the USGS can be found at the Annex of the PDS Cartography & Imaging Sciences Node (SIM 3237). Using ESRI's ArcMap 10.7 software polygons of all dark terrains were created in accordance to the geological mapping by [1] (Fig. 1a). When translating and rotating dark terrain polygons, there is the fundamental problem of distortion according to the projection in use. We therefore defined 32 regions, where dark terrains are particularly abundant and centered the stereographic projection upon every of these regions to minimize the distortion

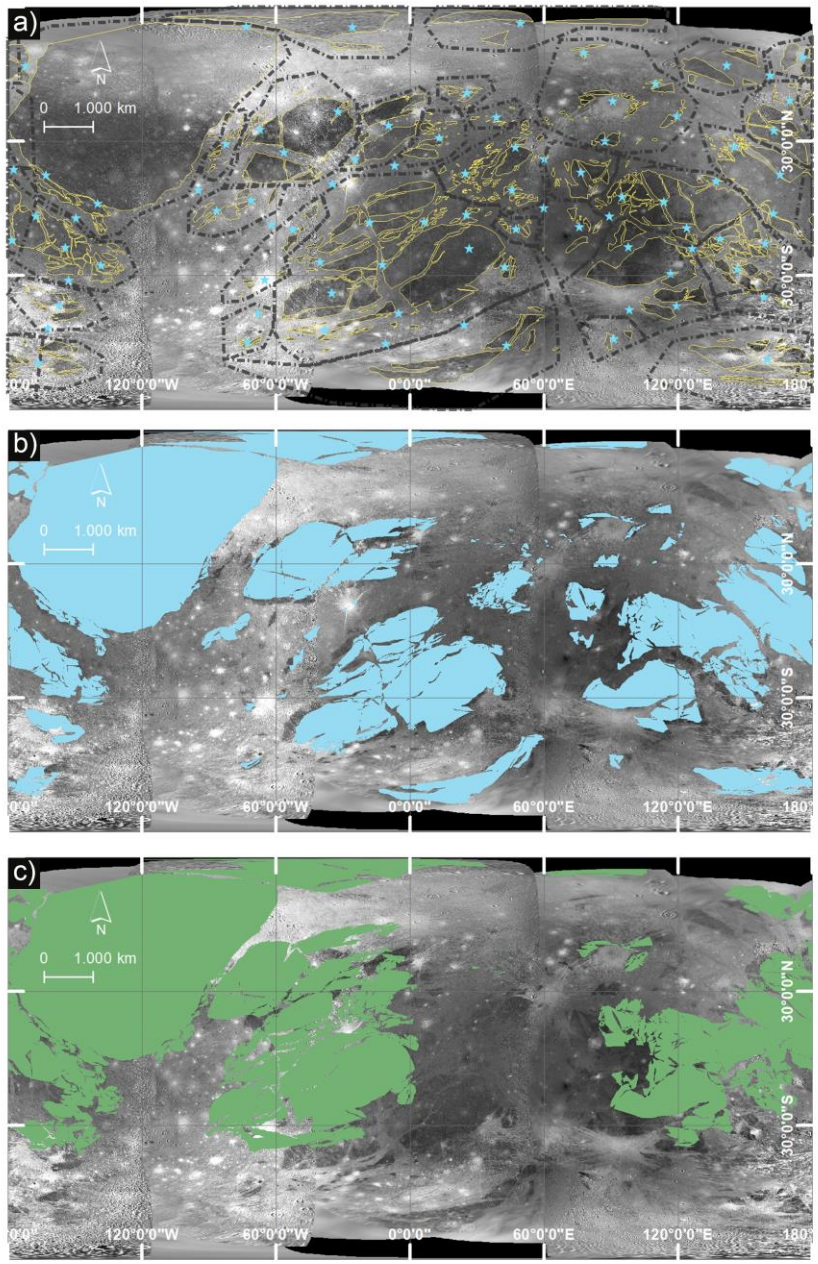

Fig. 1: Palinspastic restoration of Ganymede´s dark terrains.(a) Present day distribution of dark terrains indicated as yellow polygones with local projection centers indicated as blue stars (b) Restoration and closure of smaller rift zones, (c) Merging dark terrains towards a single “super dark terrain”.

and maintained the angles when shifting the polygons (Fig. 1b). For every patch a repetitive procedure is chosen to reverse the extensional movements and shift the polygons back together. This repeats until finally all of the dark terrains more or less match up along their borders. The relative movement vectors on the sphere can then be computed by taking the centroid of each polygon both in the original and the final shape file (Fig. 2). The resulting vectors represent magnitude and direction of the extension of dark terrains since its break-up.

Results and Discussion: Figure 1 shows the preliminary results of the shifting and fitting procedure of the dark terrain polygones. Figure 1a shows the distribution of dark terrains in their present-day position. Blue asterisks and dashed lines show the center points and extents of the particular patches with same projection, respectively. Figure 1b shows the regional closure of smaller rift zones in each of the patches. Figure 1c shows the shift of larger dark terrains towards a “super dark terrain” based on visible fitting pattern between the larger dark terrains. With increasing distance between the dark terrains, the reconstruction becomes more difficult and is not always unambiguous. Figure 2 shows the translation vectors centered to the midpoint of each dark terrain polygone. Vectors are color-coded with respect to the displacement between the present-day position (arrow origin) and the position after restoration (arrowhead). As our palinspastic restoration is still in progress, Figures 1 & 2 should be considered preliminary. The restoration movements as shown in Figsures 1 & 2 are not yet completed to form a single coherent dark terrain (“super dark terrain” in analogy to “super-continents” in the Earth´s history). Vectors show a complex displacement pattern that is not solely the result of a ballooning effect but also indicates movements by intrinsic forces.

At present, our reconstruction gives no indication of the timing of the rift events because the tectonic signatures of the light terrains have not yet been considered. In addition, the movements are to be understood as relative movements, since an absolute reference system is missing. Due to the uneven spatial resolution of the available data, reconstructions are inaccurate or impossible in some areas. The planned JUICE mission [7] will remedy this situation.

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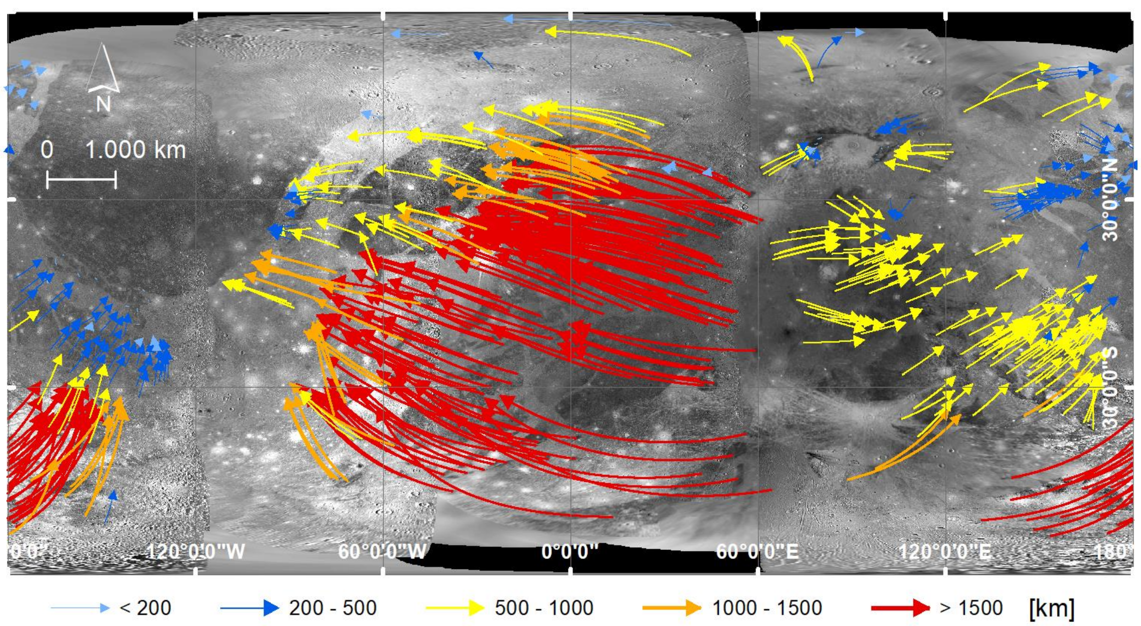

Fig. 2: Translation vectors for each dark terrain polygon. The origin of each arrow marks the present-day position of a polygon, while the arrowhead indicates the position after restoration. The displacement magnitude is color-coded as indicated.