How preexisting lithospheric heterogeneities and mantle upwellings affect Victoria’s rotation in the East African Rift System

Anne Glerum1 and Sascha Brune1,2
1Geodynamical Modelling, GFZ Potsdam, Potsdam, Germany (acglerum@gfz-potsdam.de)
2Institute of Geosciences, University of Potsdam, Potsdam-Golm, Germany

The Victoria plate in the East African Rift System (EARS) is one of the largest continental microplates on Earth. The partly overlapping eastern and western EARS branches encompassing Victoria follow the inherited lithospheric weaknesses of the Proterozoic mobile belts. Multiple lines of evidence show that Victoria rotates counter-clockwise with respect to Nubia, in striking contrast to its neighboring plates. Previous numerical modeling (Glerum et al., under review) has shown that this rotation is induced through the ‘edge-driven’ mechanism (Schouten et al., 1993), where stronger lithospheric zones transmit the drag of the major plates along the edges of the microplate, while weaker regions facilitate the rotation.

The current work enhances the previous 3D box models with a spherical domain, detailed data-driven lateral thickness variations and the inclusion of mantle structure in terms of temperature and density. Crustal and lithospheric thickness variations are taken from recent geophysical datasets of the present-day African continent (Tugume et al., 2013; Globig et al., 2016). Mantle structure is either scaled from seismic tomography models or generated through the addition of thermal upwellings mimicking the East African Superplume (e.g. Ebinger and Sleep, 1998). Preliminary results show that the counterclockwise rotation of Victoria, its rotation pole and its angular velocity as observed through GPS are consistently reproduced through the data-driven lithospheric strength distribution. With subsequent models we will demonstrate the effect of mantle structure on dynamic topography, strain localization and stress distribution in the EARS.


