Breaking-up an old continent : Was the propagation of the East African Rift impacted by structural inheritance, plate kinematics or both?

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Résumé

Rifts propagate across continent by a combination of segment growth and linkage. These processes and their interactions are now fairly well understood when a rift develops through a homogeneous continental crust and under constant extension direction. However, the influence of structural inheritance remains to be determined, in particular in terms of segment and linkage zone geometries and kinematics. The geometry of linkages zones is key for geothermal exploration, as their 3D fault network may enhance crustal-scale permeability and facilitates large-scale fluid circulation

To constrain the influence of structural inheritance, we mapped, using published geologic data, the detailed geometry of 26 linkage zones within the Neogene East African Rift System (EARS), as well as the surrounding inherited structures of the Precambrian basement, in order to identify and analyze deformation structures of every pair of rift segments and associated linkage zones. We also compiled, the timing and kinematics of each rift segment from the reconstructed displacement of the Somalia plate with respect to a fixed Nubia.

We identified 10 characteristic structural configurations grouped in two categories: either weakly or strongly controlled by structural inheritance. Although the Precambrian ductile shear zones are scattered over EARS, we found that only 25% of the rift segments and linkage zones are strongly controlled by inherited structures. In these cases, the ductile shear zones have controlled the localization of deformation and have even prevented the linkage between paired segments. We also found that most of the rift segments developed under oblique extension varying significantly during the Neogene in both amplitude and orientation. Consequently, the deformation field of most of the linkage zones shows a significant strike-slip component. Our study demonstrates a complex propagation history of the EARS, controlled both by time varying obliquity impacting the segment growth and by specific Precambrian inherited structure impacting the linkage processes.

Mots-Clés: rift propagation, rift linkage, structural inheritance, oblique extension

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