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Modeling fault kinematics, segment interaction and transfer zone geometry as a function of pre-existing fabrics: the Albertine rift, East African Rift System.

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Abstract

This study focuses on the development of the Rwenzori Mountains, an uplift horst block within the northern-most segment of the western branch of the East African Rift System (EARS). Attention is drawn to the role of pre-existing crustal weaknesses left behind by Proterozoic mobile belts that pass around cratonic Archean shields namely the Tanzanian Craton to the southeast and the Congo craton to the northwest. We study how the southward propagating sub-segment of the rift that contains Lake Albert to the north interacts with the northward propagating sub-segment that contains the lakes Edward and George and how this interaction produces the structural geometries observed within and around the Rwenzori horst block. Analogue experiments are used to simulate behavior of the upper crust with pre-cut rubber strips of varying overstep/overlap, placed oblique and/or orthogonal to the extension vector. The points of connection to the basal sheet present velocity discontinuities to localize deformation below the sand. Surface geometry of the developing rifts and section cuts are used to study the kinematics that result from the given boundary conditions. In general we try to model two parallel rifts that propagate towards each other and interact. Results show that greater overstep of rifts produces an oblique shear-dominated transfer zone with deep grabens (max.7.0km) in the adjoining segments. Smaller overlap ends in extension-dominated transfer, offset rift segments without oblique transfer faults to join two adjacent rift arms and produces moderately deep grabens (max.4.6km). When overlap doubles the overstep (SbR5), rifts propagate sub-orthogonal to the extension direction in a rotation-dominated transfer and form shallow valleys (max.2.9km). Whether a block like the Rwenzori Mountains is captured and rotates, depends on the overlap/overstep ratio where the rotation direction of a captured block is determined by the sense of overlap (right- or left-lateral). Fault orientation, fault kinematics and block rotation (once in play) re-enforce each other, and depending on the local kinematics different parts of a captured block can be rotated by different amounts but in the same general direction. The results are compared with the natural scenario.

Keywords: Albertine rift; Analogue; Extension; Kinematics; Transfer zone