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Structural evolution of continental rifting, quantitative analysis of fault populations: insights from the central Kenya rift

Ahmad Shmela, Douglas Paton, and Richard Collier
University of Leeds, Earth science, United Kingdom (eeaks@leeds.ac.uk)

This study investigates and compares fault scaling relations in three different fault populations within the central Kenya rift, the purpose of this study is to characterize the behaviour of fault growth and distribution of strain accommodation, and subsequently infer the evolution of continental rifting in this part of the Kenya rift. Digital Elevation Model DEM with 30m horizontal resolution and Google Earth images are the main data used in this study to produce a detailed dataset of the present day fault geometry for surface faults defined from DEM surface. 620 faults have been identified and mapped and therefore three fault population zones (zone1, zone2& zone3) have been defined based upon their average fault orientations as (NNE), (NNE to NNW) and (NNW) respectively. The idea is to conduct a quantitative and Statistical analysis on fault populations to uncover information about the growth of fault-populations. Estimations of extensional strain obtained from two different methods revealed a general increase of strain from south to north. The relationship between fault length and minimum throw for the picked faults did not show a good linear relationship, which may imply that the fault system is evolving in a non-linear relationship.Isolated faults in zone 3 seemed larger in throw comparing to that of zone 2 but fault trace length appear to be to some extent comparable in both zones. Moreover, fault length and throw populations exhibited a power-law distribution in the three zones, fractal dimension of fault throw populations showed a decrease with increasing strain from the southern zone (zone3) to the northern zone (zone1), which implies that the strain is increasingly localised onto larger faults as the fault system becomes more evolved as we move from south to north along the rift. On the other hand, fractal dimension of fault length populations remained almost constant in the three zones. Increasing fault throws with increasing strain while the fault length remains almost constant may indicate that the fault system could be evolving in accordance to the constant length fault growth model. Analysis of the spatial strain heterogeneity exhibited a relatively localized domain of deformation in the southernmost zone (zone 3), distributed domains of deformation in zone 2 in the centre and a domain of localized deformation towards the north at zone 1. The possible influence of the underlying Precambrian basement structures on the orientation of Cenozoic faults on the surface has been investigated in the light of existing experimental models, and that suggested the presence of a general influence from basement structure in this rift segment. Results of this study showed that this part of the central Kenya rift displays a range of variations, not only in fault orientation, but also in the total amount of strain, strain accommodation and fault evolution along the axis of the rift, this indicates that the processes of progressive fault system maturity and strain localization onto large faults could occur even at relatively small scale of fault populations within the rift system.