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Contrasting influences of cross-cutting, pre-existing structural fabrics on the propagating and evolution of normal fault arrays: North basin, Malawi Rift, Africa

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The development of normal faults in regions of extension is relatively well-documented, and models that describe their evolution based on field, analogue and numerical observations are becoming increasingly familiar in their application. However, the growth of normal faults in regions where there is an inherited structural fabric has been the focus of only a few recent investigations, which have identified a modification to traditional fault-growth models as pre-existing structural fabrics are utilised, enhancing fault-length propagation. Whether a pre-existing structural fabric will be utilised has been related to its obliquity to the extension direction. These models however do not consider the role of cross-cutting inherited structural fabrics, in particular where one or more may not be orientated favourably i.e., close to perpendicular, to the extension direction. The Malawi rift is an exceptional location to investigate the role of cross-cutting structural fabrics on the evolution of normal faults. It comprises a series of half grabens with opposing asymmetry separated by regions of structurally complex transfers. The North basin, Malawi rift, exhibits a strong association with underlying Proterozoic structural fabrics, in particular the location and orientation of the basin-bounding fault. To the south it is bound by a region of transfer toward the Central basin. This region of transfer follows a close association with W-E oriented Permo-Triassic Karoo grabens. We investigate a data set of high-resolution seismic reflection profiles collected by project PROBE, and combine this with DEM analysis of the onshore basin-bounding fault. From our analysis of the seismic reflection data, we identify 11 intra-basin structures, of which 8 are long (>70 km) faults that have acquired their length early-on in the fault history. Such a length enhancement and later displacement accumulation is characteristic of an enhancement by the underly-

ing structural fabric oriented approximately perpendicular to the extension direction. Furthermore, within the offshore region we find that there are basin-wide regions of sediment accumulation (depocentres) separated by regions of relatively low displacement, and low sediment accumulation. We have mapped the spatial distribution of fault tips, and displacement accumulation and demonstrate that these regions of accommodation minima remain static throughout the depositional history. We hypothesise that the development of these long-lived displacement minima are caused by the influence of inherited basement anisotropies oriented perpendicular to, or parallel to, the extension direction. In the first case the structural trend enhances fault propagation, but the other acts as a significant barrier to rupture, which may cause local strike-slip and transfer faulting where extension is transferred to normal faults that have a different orientation.