Rifting Archaean lithosphere: the Eyasi-Manyara-Natron rifts, East Africa

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Abstract

Long (>50km) normal faults bound one or both sides of narrow basins within the East African Rift System, but the dimensions and internal geometry of individual basins vary along its length. We examine basins in N Tanzania that developed in Archaean and Late Proterozoic (Pan-African) crust, and the relationship of Neogene-Recent faulting and volcanism to pre-existing lithospheric structure. In northern Tanzania the *c.* 50 km-wide Eastern (Gregory) Rift splays into three seismically active arms, with active extension distributed across a 200 km wide zone. We use new gravity and aeromagnetic data, and existing seismic, gravity, heat flow, and geochemical data to model lithospheric structure beneath the Archaean craton and Proterozoic orogenic belts, and its influence on rift development in N Tanzania. Depths to source bodies determined from Euler deconvolution of aeromagnetic data (1 km grid) indicate that *c.* 40 km wide basins are less than 3.5 km deep, with basin depths decreasing to the south, consistent with depths estimated from gravity anomalies. Asymmetric basins in the Archaean and zone of reworked Archaean and Proterozoic nappes are bounded by unusually long (100 km) border faults associated with seismicity to depths >25 km. Estimates of flexural rigidity, or effective elastic thickness *(TJ,* suggest that the lithosphere beneath the Tanzania craton, including the western rift arm, is stronger (64 ± 5 km) than that beneath the Proterozoic belt and the transition zone (30 ± 4 km), with the lowest T_e values found beneath the central rift arm (23^{+2}_{4}km). Heat flow, seismicity, and mantle xenolith data also indicate that the lithosphere beneath the Archaean craton was and is colder and stronger than the post-Archaean lithosphere. Geophysical and geochemical data suggest that (a) pre-existing heterogeneities in the Archaean crust influenced the orientation of border faults bounding basins, and (b) that topography at the base of the lithosphere guided the location of rifting in Tanzania, producing a broader rift zone. These results indicate the persistence of a deep cratonic root despite the impingement of a mantle plume in Cenozoic time.