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Rayleigh and Love Wave Tomographic Imaging of Heterogeneous Crust in a magmatic rift: the Turkana Depression, East Africa

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Theory and geoscientific observations demonstrate that plate stretching, heating, faulting, active and frozen magma intrusions, and extrusive eruptive products are consequences of mantle upwelling mechanism driving continental rifting. Problematic to this picture is the lack of consensus on how, when and where these processes modify the crust's thermal and mechanical structure. We use data from East Africa's 300-km wide Turkana Depression to investigate how the superposition of these rift processes and the spatial migration of the active plate boundary through time within one geodynamic setting modify the crust's structure. Utilizing ambient noise seismic methods and data from the 34 station Turkana Rift Arrays Investigating Lithospheric Structure (TRAILS) seismic network, we invert for Rayleigh and Love tomographic models and overlay results with our local earthquakes crustal splitting results. Preliminary results show that regions that experienced Eocene flood magmatism have localized high Vs of > 3.4 km/s at mid-lower crustal depths implying that flood magmatism is fed by unknown localized centers and/or dike swarms. Quaternary eruptive centers with Vs < 3.4 km/s at mid-lower crustal depths are punctuated and irregularly spaced suggesting that bottom-up mantle upwelling influence their location. Regions with superposed Cretaceous-Paleogene and Miocene-Recent rift phases have persistent low velocities (Vs ≥ 3.8 km/s) to the mid-crust with thinner crust (~ 20 km); the active Miocene-Recent rift structures are oblique to the largely inactive Cretaceous-Paleogene rift structures implying no reactivation of pre-existing structures during modern-day rifting.