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The Crust and Uppermost-Mantle Structure of the Turkana Depression: Insights from Surface-Wave Analysis

Rita Kounoudis[1], Ian Bastow[1], Cynthia Ebinger[2], Christopher Ogden[1], Atalay Ayele[3], Rebecca Bendick[4], Nicholas Mariita[5], Gladys Kianji[6], Martin Musila[2], and Garrett Sullivan[2]

[1]Imperial College London, Department of Earth Science and Engineering, London, UK
[2]Tulane University, Department of Earth and Environmental Sciences, New Orleans, LA, USA
[3]Addis Ababa University, Institute of Geophysics, Space Science and Astronomy, Addis Ababa, Ethiopia
[4]University of Montana, Department of Geosciences, Missoula, MT, USA
[5]Dedan Kimathi University of Technology, Geothermal Energy Training and Research Institute, Nyeri, Kenya
[6]University of Nairobi, Department of Geology, Nairobi, Kenya

Multiple geoscientific studies along the Main Ethiopian and Eastern rifts have revealed that extension via magma intrusion now prevails over plate stretching as the primary mechanism for strain accommodation throughout the crust and mantle lithosphere. However, problematic in this picture is where the Main Ethiopian and Eastern rifts meet, across the low-lying, broadly-rifted, and as-yet poorly-studied Turkana Depression which separates the elevated Ethiopian and East African plateaus. We have so far revealed through body-wave tomography (Kounoudis et al., 2021), that the Depression does not lack mantle dynamic support in comparison to the plateaus, suggesting a significantly thinned crust, resulting from superposed Mesozoic and Cenozoic rifting, most likely explains its low elevations. Slow uppermost-mantle wavespeeds imply the presence of either melt-intruded mantle lithosphere or ponded asthenospheric material below lithospheric thin-spots induced by the region's multiple rifting phases. To better illuminate the Depression's lithosphere-asthenosphere system, we conduct a surface-wave analysis to image crust and uppermost-mantle structure using data from the NSF-NERC funded Turkana Rift Arrays Investigating Lithospheric Structure (TRAILS) project broadband seismic network. In particular, we investigate the presence of melt, whether the lithosphere is melt-rich, melt-poor, and/or if ponded zones of asthenosphere exist below variably thinned lithosphere. Group velocity dispersion curves, measured using data from local and regional earthquakes, yield the first high resolution fundamental mode Rayleigh-wave group velocity maps for periods between 4 and 40s for the Turkana Depression. In collaboration with the ongoing TRAILS GPS project, we explore how these results relate to present-day versus past episodes of extension.

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