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Spatial heterogeneity of the stress field in the current development of the East African Rift System : update from new focal mechanism data and comparison with the latest geodetic strain rate model

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Kinematic and sismotectonic models of the East African Rift System (EARS) have greatly evolved since 1990 when only very few earthquake focal mechanism solutions were available, limited field work done, no digital topography and no GPS geodesy available. Since the early global models of rift opening that were developed mainly using the first Landsat images covering the entire rift, considerable advances have been made. We use a review of the neotectonics, sismotectonics and stress field of the East African Rift (using formal inversion of focal mechanisms) and compare them with the latest geodetic strain rate model available to present an updated view of the East African Rift.

We evidenced in previous studies (Delvaux and Barth, 2010; Saria et al., 2014) spatial variations of stress field along the EARS and locally significant deviations between GPS velocity and stress fields as in the Rukwa rift, Mbeya triple junction between the eastern and western rift branches, Kivu rift, Manyara-Natron area and in the Tanzanian craton. Using an larger database of focal mechanisms for the EARS (255 instead of 191 in Delvaux and Barth, 2010) and a larger number of inversion boxes (29 instead of 14), and comparing it with the new geodetic strain rate model of Stamps (2018), we obtain a better match between the GNSS velocity azimuths and the horizontal minimum stress orientations (SHmin) as well between the stress regime and the geodetic stress style. Anomalous zones detected by the two different approaches also match rather closely. In addition, we image a markedly different stress field outside the two rift branches, in the Kivu region and in the Tanzanian carton, with a rapid lateral change in stress orientations and regime.

This illustrates in more details the 2nd to 3rd order spatial heterogeneity of stress and strain fields in the current development of the EARS.

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