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Complex Stress Histories in the East African Rift System, paleostress systems or complex new-stresses due to locallized uplift and block rotation?

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The Albertine Rift System in the East African Rift shows outstanding morphological features including the Rwenzori mountains, a 5000 m high basement block within the rift. Research in this area has shown that the Rwenzori mountains were uplfited during extension.

We used stress inversion studies based on fault slip data and numerical models to understand the stress in this region. We see that the stress field in the centre of the Rwenzori block is significantly different from the stress field of the rift flanks and the southern part of the Rwenzoris. In the central part of the mountain we find extension parallel to the main rift opening direction (NW-SE), two strike slip regimes and a NNW directed thrusting regime. In the south of the Rwenzoris we find only two orthogonal extension regimes indicating that sigma 3 and sigma 2 may have switched during the extension and activation of faults. North of the mountain extension seems to dominate with a minor strike slip component. In the NE of the mountain, where the Rwenzoris are still connected to the Tanzania craton, we find complex inclined strike slip and normal stress fields. The stress pattern suggests that the Rwenzori block and its connecting bridge contain unusual stresses probably related to block rotation and uplift. As an alternative explanation for the complex interference of strike slip. extension and even thursting one can consider the capturing of old pre-rift stress fields by the faults. However, this does not explain why the stress field varies dramatically between the rift flanks and the central mountains.

In order to understand these complex stress geometries we use a three-dimensional elasto-plastic model where we implement the rift geometry and stretch it. The resulting three-dimensional stress patterns do indeed show a transition from extension to strike slip and even thrusting within the central block. We therefore argue that the stress inversion technique may give you actual recent stress-fields and that these stresses may result from the unusual uplift of the mountain and its possible rotation within the rift setting.