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Rift nucleation, rift propagation and the creation of basement micro-plates within active rifts

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The 5000m high Rwenzori mountains in Uganda, Africa, are situated within the western branch of the East African rift system. They are surrounded in the north-west by the lake Albert-Semliki valley rift and in the south-east by the lake Edward-George rifts. The Rwenzori mountains represent a captured basement block within the rift and can thus be termed a micro-plate. The Rwenzori micro-plate is exhumed during rift extension.

Recent fieldwork in the Rwenzori mountains has shown that rift-related brittle faults are arranged in complex networks with normal but also strong strike-slip components. Thus deformation within the uplifted basement block was complex and included wrench movements that may have enhanced the extreme uplift within an overall extensional setting.

In order to study the creation of such micro-plates within developing rift zones we use a numerical model. In this model the upper crust is represented by an elastic sheet consisting of elements that may fracture depending on tensile stresses. The sheet is attached to a visco-elastic base that represents deeper parts of the crust.

We show how rifts nucleate depending on strain rates, material properties and heterogeneities in the crust. In addition we study the interaction of approaching rift segments and how these can capture basement blocks or small micro-plates. Our model suggests that the stress field within captured micro-plates is relatively complex due to rotations during successive rift opening. This complex stress field can explain wrench tectonics and complex fault networks that are found in the Rwenzori mountains and may explain parts of the extreme uplift within an extensional setting.