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From surface observations to in depth structures and plate kinematics in oblique rifts. Insights from the Main Ethiopian Rift.

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The Main Ethiopian Rift (MER) is the oblique NE-SW trending plate boundary between Nubia and Somalia that developed above an inherited lithospheric-scale weak zone, the Mozambique Ocean Suture Zone (MOSZ). In this area, plate's kinematics has been estimated from various sources including: GPS and seismic data, spreading rate estimates, magnetic anomaly & paleostress reconstruction from field and seismic data. These various data sets give a range for the orientation of the stretching direction between N105° and 115°. However, in the MER, it is shown that strain is strongly partitioned between boundary and internal faults. Far field stress is re-oriented along the boundary faults that are activated in pure extension. This observation questions the use of paleostress reconstructions based on fault slip data and focal mechanisms to estimate the direction of plate motion.

Detailed analysis of fault orientation and fault kinematics in analogue model illustrates that strain partitioning is triggered by the geometry of the deep-seated weak zone and that fault orientations give a better insight on the direction of stretching than paleostress tensors. Moreover, our model allows the recovering of the far field stress direction and the orientation of the weak zone in depth from surface observation of fault trend data. Applying this model to surface data of the MER give a different stretching direction for the formation of the boundary and the internal fault suggesting a clockwise rotation of Somalia. Also the model gives major constraints on the direction of the deep-seated weak zone. Its orientation is evolving from N62° in the Northern MER, to N18° in the Wide Rifted Zone (passing from N35° and N25° for the Central MER and the Southern MER).