EGU22-2743
https://doi.org/10.5194/egusphere-egu22-2743
EGU General Assembly 2022

Investigating Rift-Rift-Rift triple junctions through analogue and numerical modelling

Daniele Maestrelli[1], Giacomo Corti[1], Sascha Brune[2,3], Derek Keir[4], and Federico Sani[4]
[1]Institute of Geosciences and Earth Resources, The National Research Council of Italy, Florence, Italy
[2]Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences, Potsdam, Germany
[3]University of Potsdam, Potsdam-Golm, Germany
[4]Department of Earth Sciences, University of Florence, Florence, Italy

Continental break-up at Rift-Rift-Rift triple junctions commonly represents the “prequel” of oceanic basin formation. Currently, the only directly observable example of a Rift-Rift-Rift setting is the Afar triple junction where the African, Arabian and Somalian plates interact to form three rift branches, two of which are experiencing oceanization (the Gulf of Aden and the Red Sea). The younger of the three (the Main Ethiopian Rift) is still undergoing continental extension. We performed analogue and numerical models simulating continental rifting in a Rift-Rift-Rift triple junction setting to investigate the resulting structural pattern and evolution. By adopting a parametrical approach, we modified the ratio between plate velocities, and we performed single-phase (all the three plates move) and two-phase models (with a first phase where only one plate moves and a second phase where all the three plates move). Additionally, the direction of extension was changed to induce orthogonal extension only in one of the three rift branches. Our single-phase models suggest that differential extension velocities in the rift branches determine the localization of the triple junction, which is located closer to the rift branch experiencing slower extension velocities. Furthermore, imposed velocities affect the distribution of deformation and the resulting pattern of faults. The effect of a faster plate is to favour the formation of structures trending orthogonal to dominant velocity vectors, while faults associated with the movement of the slower plates remain subordinate. In contrast, imposing similar velocities in all rift arms leads to the formation of a symmetric fault pattern at the triple junction, where the distribution of deformation is similar in the three rift branches. Two-phase models reveal high-angle faults interacting at the triple junction, confirming that differential extension velocities in the three rift branches strongly affect the fault pattern development and highlighting geometrical similarities with the Afar triple junction.