Geophysical Research Abstracts
Vol. 20, EGU2018-7051, 2018
EGU General Assembly 2018

3D modeling of fault linkage during continental rifting: the role of crust-mantle coupling and active erosion

Nicolas Riel (1), Ritske Huismans (1), Dave May (2), Jean Braun (3), and Tristan Cornu (4)

(1) Department of Earth Science, University of Bergen, Norway, (2) Department of Earth Sciences, University of Oxford, United-Kingdom, (3) GFZ German Research Centre for Geosciences, University of Potsdam, Germany, (4) Total, Recherche et Développement, Pau, France

How faults propagate and link during continental rifting is primarily controlled by the offset of pre-existing structures. Although previous numerical studies have investigated the role of such offset at crustal scale, little is known on the rheological coupling between crust and mantle, and, the interplay between fault linkage and surface processes. The redistribution of mass related to surface processes is, however, crucial to explore as it affects the gravitational stress field of the system and by extension strain localization and fault distribution.
In this study we present high-resolution 3D numerical modeling results obtained from coupling long-term tectonic (using pTatin3D) and surface processes (FastScape). Our modeling geometry is a 1200x1200x250 km box made of a 35 km thick crust, a 85 km thick lithosphere, and a 130 thick asthenosphere. Weak seeds placed at the Moho within the mantle lithosphere are used to simulate rift linkage and oblique rifting with relay zones. We explore the role of crustal rheology by the means of a factor applied to the wet quartz rheology. We vary the factor from 0.02to 30 in order to cover weak ductile (fully decoupled from the mantle) to strong brittle (fully coupled to the mantle) behavior for the crust. Additionally, we investigate the role of erosion for each model by varying the erosion efficient from low to high (10-6 to 10-5).
We find that the style of rift linkage depends strongly on crustal rheology and erosion efficiency. Strong crust rheology leads to efficient rift linkage and fault migration, resulting in the formation of pull-apart basin bounded by transform faults. In contrast, weak crust rheology leads to more complex linkage system with the formation of a secondary graben system. Independently of crustal rheology, high erosion efficiency increases strain localization and fault migration, leading to deeper and better defined pull-apart basin for the strong crust case and more complex fault systems for the weak crust case.