AGU FALL MEETING
San Francisco | 12–16 December 2016

T44C-06: Integrated Numerical Model for the East African Rift System: Plume-induced Rifting and Continental Break-up from Lake Malawi to Red Sea

Thursday, 15 December 2016
17:15 - 17:30
Moscone South - 304

We present numerical experiments that target to reveal the role of active mantle plume, far-field tectonic forces and pre-existing lithospheric heterogeneities in structural development of the East African Rift system (EARS).

Starting with models capturing the essential geophysical features of the central and southern parts of the EARS (two «cratonic» bodies (Tanzanian craton and Bangweulu block) embedded into a «normal» surrounding lithosphere) we show that development of the magmatic Eastern branch, the amagmatic Western branch and its southern prolongation (Malawi rift) can be the result of non-uniform splitting of some hot plume material that has been initially seeded underneath the southern part of Tanzanian craton.

The second series of experiments has been designed in order to investigate northern segment of the EARS where Afro-Arabian plate separation is supposed to be related with the impact of Afar mantle plume. These models permit us to reproduce observed orientation and relative position of two spreading axes (Red Sea, Gulf of Aden) and rifting (Main Ethiopian rift) one. All are joining at Afar triple junction.

Finally, for laterally extended experiment we have used parameters of the best-fit models for the southern and northern segments of the EARS in order to define the position of Kenyan plume and the velocity boundary conditions. This model cover all rifting and spreading structure associated with both Afar and Kenyan plumes: Red Sea Rift and the Aden Ridge to the north of the Afar Triple Junction; Main Ethiopian Rift running to the south that continues as the Kenyan Rift; Western Rift and its southern prolongation corresponding to Malawi rift.We argue that main features of the EARS can be reproduced in a relatively simple context of the interaction between two mantle anomalies corresponding to Afar and Kenyan plumes and pre-stressed rheologically stratified continental lithosphere containing only first-order structural heterogeneities (such as Tanzanian and Bangweulu cratons).

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Session: T44C One Rift, Two Rift, Magma-Rich Rift, Magma-Poor Rift: Deformation, Magmatism, Volatile Fluxes, and Their Consequences in the East African Rift System III

Program: Tectonophysics

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