AGU FALL MEETING
San Francisco | 12–16 December 2016

T32C-06: Anomalous Lower Crustal and Surface Features as a Result of Plume-induced Continental Break-up: Inferences from Numerical Models

Wednesday, 14 December 2016
11:35 - 11:50
Moscone South - 103

Anomalous features along the South American and African rifted margins at depth and at the surface have been recognised with gravity and magnetic modelling. They include high velocity/high density bodies at lower crustal level and topography variations that are usually interpreted as aborted rifts. We present fully-coupled lithosphere-scale numerical models that permit us to explain both features in a relatively simple framework of an interaction between rheologically stratified continental lithosphere and an active mantle plume.

We used 2D and 3D numerical models to investigate the impact of thermo-rheological structure of the continental lithosphere and initial plume position on continental rifting and breakup processes. Based on the results of our 2D experiments, three main types of continental break-up are revealed: A) mantle plume-induced break-up, directly located above the centre of the mantle anomaly, B) mantle plume-induced break-up, 50 to 250 km displaced from the initial plume location and C) self-induced break-up due to convection and/or slab-subduction/delamination, considerably shifted (300 to 800 km) from the initial plume position. With our 3D, laterally homogenous initial setup, we show that a complex system, with the axis of continental break-up 100's of km's shifted from the original plume location, can arise spontaneously from simple and perfectly symmetric preliminary settings.

Our modelling demonstrates that fragments of a laterally migrating plume head become glued to the base of the lithosphere and remain at both sides of the newly-formed oceanic basin after continental break-up. Underplated plume material soldered into lower parts of lithosphere can be interpreted as the high-velocity/high density magmatic bodies at lower crustal levels. In the very early stages of rifting, first impingement of the vertically upwelled mantle plume to the lithospheric base leads to surface topographic variations. Given the shifted position of the final spreading centre with respect to initial plume position, these topographic variations resemble aborted rifts that are observed on passive margins. Lastly, after continuous extension and transition to the spreading state, strain rate relocalizations develop that can be interpreted as ridge jumps that are commonly observed in nature.

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