Geophysical Research Abstracts
Vol. 14, EGU2012-4885, 2012
EGU General Assembly 2012

3d Numerical Modeling of the Equatorial Atlantic Break-Up

S. Brune (1) and C. Heine (2)

(1) GFZ-Potsdam, Geodynamic Modeling Group, Potsdam, Germany (brune@gfz-potsdam.de), (2) EarthByte Group, School of Geosciences, The University of Sydney, Australia

The Equatorial Atlantic conjugate margin system is a classical example of a major continental transfer zone, which developed at an oblique angle relative to the South Atlantic rift. The onset of separation of the South American and African lithospheres along the Equatorial Atlantic rift, however, was preceded by 20-25 Ma of progressive crustal thinning and subsidence in the South Atlantic, Central and West African intra-continental rifts systems.

We investigate the succession of events by integrating quantified plate reconstructions with 3d thermo-mechanical modeling using the elasto-visco-plastic finite element code SLIM3D. Our setup allows to compute the dynamic evolution of a three-dimensional lithospheric segment involving realistic 4-layered rheology and time-dependent extensional boundary velocities. Our modeling shows that oblique extension is energetically more efficient than orthogonal rifting. Thus, of two competing rifts with different orientation but otherwise identical properties, the one with higher obliquity accumulates more strain. We argue that after about 20 Ma of normal extension in the South Atlantic and West African rifts at relatively low velocities, deformation started to localize in the Equatorial Atlantic domain, effectively terminating major lithospheric extension related to the South Atlantic opening in the Benoue and linked Central and West African Rifts. Within a time span of a few million years, lithospheric weakening due to hot upwelling in the rift center resulted in an dramatic increase of extensional velocities that is in very good agreement with the kinematic interpretation. We conclude that this process had severe effects on the rift velocities and margin evolution of South American and African conjugate margins.