Geophysical Research Abstracts
Vol. 20, EGU2018-14976-1, 2018
EGU General Assembly 2018

Analysis of hiatal surfaces and the stratigraphic framework for the plume mode in the East African Rift System (EARS): progress and limitations

Roland Neofitu and Anke M. Friedrich

Ludwig-Maximilians-Universität München, Geology, Earth and Environmental Sciences, München, Germany (friedrich@lmu.de)

The plate mode and plume mode describe the modern understanding of mantle convection and its vertical surface expression. In order to comprehensively understand the temporal and spatial dimensions related to the plume-mode, we mapped Cretaceous and Tertiary interregional-scale unconformities and constructed hiatus maps at continent scales for Africa, in particular the EARS. The results of our hiatus mapping at the temporal resolution of geological series, show a 2000-km-long, well constrained, low-intensity, NW-SE trending hiatal surface in the Afar region at the base of the Tertiary. This hiatal surface is largely absent in the Cretaceous. Between the Paleocene and the Neogene, there is a low-intensity, 3000-km-scale NW-SE-trending hiatal surface in southern Africa. A 2500-km-long W-E trending, hiatus area occurs at the base of the Early Cretaceous in NW-Africa. The Eocene and Neogene time slices reveal a low-amplitude, 2500-km-long, NE-SW-trending hiatus in NE-Africa. The positions of these major hiatal surfaces correspond to the previously mapped extent of the uplifted regions associated with the plume mode (e.g., Sengör 2001, GSA Memoir 254). In the context of the plume-mode, they indicate dynamic vertical surface uplift associated with plume ascent. We then tested the usability of published continental-scale geological maps to extract quantifiable parameters related to the plume-mode and applied the stratigraphic framework for the plume mode to the EARS (cf. Friedrich, EGU2018-13382) by distinguishing between central, marginal and distal zones in the affected regions. This required a first guess at the duration of plume ascent resulting in uplift. Because this quantity is unknown at present, we picked the three shortest ascent durations permitted by the input geological map: these were based on estimated plume ascent duration (assuming an ascent velocity of 50 km/Ma), results of the hiatus mapping (assuming the plume impacted the surface at the base of the Paleocene, as shown by hiatus maps; corresponding to a plume ascent rate of c. 90 km/Ma), as well as having no plume ascent (assuming the extreme case of the plume having impacted the surface as soon as it initiated), to observe the affects these changes would have on the resulting maps. For the three approaches, respectively, results show Late Cretaceous, Paleocene, or no rocks as the youngest permissible syn-ascent sediments. We mapped a 800x2500-km-sized plume centre and a 4000-km-long NNE-SSW trending plume margin. It is absent south of the Afar region for an instantaneous plume-rise time. Comparing the results to predictions made by the model, assuming a plume ascent velocity of 50 km/Ma, resulted in the closest match. However, our analysis and these results are preliminary and severely hampered by the limited temporal resolution of the input geological maps, which were not designed for this purpose. This limitation may be removed by compiling interregional-scale geological maps at a temporal resolution of geological stages wherever possible. Additional geological criteria that allow us to further characterize the nature of the hiatal surfaces and to determine their true spatial dimension are also needed in compiling the new generation of interregional geological maps of plume-modes.