Geophysical Research Abstracts
Vol. 19, EGU2017-4846, 2017
EGU General Assembly 2017

Control of rift asymmetry and segmentation on the thermal architecture of hyperextended rift systems: insights from Pyrenean field observations and numerical modelling

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Mid-Cretaceous rift basins are exposed in the Pyrenees providing key information on rifted domain formation that is not available at present-day rift system. Substantial paleotemperature and thermochronological data have been collected and published in numerous recent papers. These data show a strong heterogeneity in the distribution of peak temperatures within the Cretaceous rift basins. Locations that experienced relatively high or low temperatures appear to cluster in specific areas along strike. These areas have been interpreted as either reflecting hot and cold conditions during rifting, or alternatively, a change in the polarity of a strongly asymmetric rift systems.

In this study, we test if the observed variability of peak temperatures can be explained by segmentation and a change in polarity of an asymmetrical upper/lower plate rift model. To this aim we restore the observed syn- to early post-rift peak temperatures to their paleo-location within sections across the evolving rift system. In the meantime, we conduct numerical models of rift migration leading to asymmetrical extension that are benchmarked with geological and geophysical observations from the Pyrenees. From the models, we extract thermal information at different stages of rifting that are finally compared to the thermal data from the Pyrenean Cretaceous rift basins.

This work employs a novel approach by comparing thermal output from numerical modelling with the distribution of peak temperatures and thermal gradient from field data. As such, these results may have substantial implications to further understand the pre-orogenic thermal evolution of the Pyrenean rift system and the role of segmentation. More generally, the results of this work may unravel the role of rift asymmetry and segmentation on the thermal architecture of hyperextended rift basins and margins.