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Structure, subsidence and thermo-mechanical evolution off central West Iberia

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We use high quality, 2-D multi-channel seismic data, together with combined backstripping and gravity modelling techniques to constrain the rift geometry and model the subsidence and thermo-mechanical structure of the central West Iberia margin through time.

The 285 km long seismic transect extends between the continental slope and the peridotite ridge at approximately 40.50 latitude. The data provides good constraints on the sediment coverage and basement structure and we identify three distinct sectors along the transect: (1) the lower continental slope, characterized by sub-vertical normal faults delimiting large depocenters (> 5 km thick); (2) the continental rise, characterized by faults with listric geometry delimiting small sedimentary accumulations; (3) the distal margin, where detachment-like faults eventually exhume the upper continental mantle at the surface. The high quality and wide coverage of the profile also allowed improving the consistency between the stratigraphy interpreted in the continental slope and rise and that constrained by ODP drilling in the distal margin.

Backstripping and gravity modelling (Process Oriented Gravity Modelling - POGM) shows that the gravity signature along the central West Iberia margin can be largely explained from the combined effects of rifting and sedimentation, and that the lithosphere effective elastic thickness (Te) varies laterally between continental and oceanic basement. In the continental slope and rise, Te increases from <10 km during rifting to >15 km during Late Cretaceous and Tertiary sediment loading, in good agreement with the predictions from dynamic models of continental extension.

The stretching factors (β) recovered from POGM have subsequently been used as input in a lithosphere kinematic rift model. The model takes into account the sequence of rift pulses which affected the West Iberia margin and calculates the subsidence and thermal structure through time, sediment loading and basement flexure. We show, for example, that the total tectonic subsidence, recovered from sediment backstripping, can be reproduced assuming depth-uniform stretching, and that the increase in the bathymetry in the distal margin decreases exponentially from the Early Cretaceous onwards, similar to the predictions of a cooling plate model. We further investigate the implications of the distinct conceptual rift models proposed for the West Iberia margin for the heat flow and subsidence histories. In particular, we compare the kinematic model predictions with those of a recently developed finite element numerical model which considers that during the late stages of rifting extension is accommodated over a sequence of normal faults cutting into progressively thinner crust (Ranero and Pérez-Gussinyé, 2010).