Geophysical Research Abstracts
Vol. 20, EGU2018-2843, 2018
EGU General Assembly 2018

Lithospheric density structure of the North Iberian margin along the southern Bay of Biscay from constrained 3-D gravity inversion

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The Bay of Biscay is a failed rifted arm of the southern North Atlantic rift system that opened during the Mesozoic and was subsequently partially closed due to convergence between the European and the Iberian plates from the Late Cretaceous to Cenozoic, during the Alpine orogeny. Along the southern Bay of Biscay, the North Iberian margin is tectonically unique in the region as it encompasses the classic features of a hyperextended magma-poor rifted margin while also exhibiting evidence of a distinctive compressional reactivation. Controlled-source seismic methods and multidisciplinary approaches have revealed significant complexity in the lithospheric structure along the North Iberian margin, with features such as highly thinned crustal domains, exhumed mantle, crustal blocks, and an accretionary wedge, all identified within a small region. Seismic reflection data coverage is significant over the margin but deeper constraints from wide-angle seismic reflection/refraction surveys are sparser and often unreversed.

Constrained 3-D gravity inversion provides a methodology for bridging between sparse seismic lines and capturing regional trends in lithospheric density structure to enhance and complement seismic interpretation and broad-scale understanding of complex tectonic environments. Using bathymetric constraints and updated depth to basement constraints from seismic reflection interpretation, a 3-D lithospheric density model has been constructed for the central and western North Iberian margin. From this model, crustal thickness and depth to Moho can be inferred and compared with previous estimates and deep seismic constraints. The model reveals regions of anomalously high density lower crust beneath a crustal block (Le Danois High), and upper crustal zones of low density that track known offshore faults. Regional crustal thickness variations within the model agree well with previous estimates and support the significant compartmentalization previously acknowledged along-strike of the margin. Overall, this study provides a regional overview that complements existing seismic coverage, bringing new insights to help further constrain the major structures along the margin, and upon which a more thorough understanding of the region's complexity can be obtained.