The United Kingdom Rockall Trough, Northeast Atlantic: An Extinct Young Ocean Basin or a Failed-Breakup Basin?*

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Abstract

We have investigated the crustal structure and crustal type of the United Kingdom Rockall Trough using the Rockall seismic data made available by the UK OGA. The Rockall Trough lies to the west of the UK and Ireland. It is one of several basins formed by high-extension Mesozoic rifting, prior to formation of the Atlantic Ocean (Early Tertiary). Comparable basins of similar age include the Porcupine and Orphan Basins (Ireland and Newfoundland) to the south, and the Møre and Vøring Basins (Norway) to the north. An impediment to analysis of the UK Rockall Trough is the extensive post-rift magmatism which masks much of the underlying basin structure. We have interpreted seismic top-basement/base-sediment and used the resulting map as input to an integrated analysis, combining two techniques: (1) 3D-backstripping has been used to investigate subsidence history and the magnitude of lithosphere stretching/thinning, and (2) 3D-gravity-inversion has been used to investigate the magnitude of stretching/thinning, Moho-depth, crustal structure and crustal type and to produce whole-crustal cross-sections.

Our analysis shows that the crustal-basement thickness of the Rockall Trough reduces rapidly from the flanks (20-25 km) into the basin centre (5-10 km), with only a narrow zone of terraces in between. The prediction of thin crust (<10 km) in the basin centre is comparable with published seismic estimates. An important question is whether this thin crust is hyper-extended continental crust or proto-oceanic crust. Our interpretation is that the Rockall Trough formed in a magma-poor extensional environment, probably as the result of time-dependent extension. Extension stopped prior to continental breakup. We therefore interpret the Rockall Trough as a failed-breakup basin, underlain by highly-thinned continental crust, rather than an extinct young ocean basin. We believe this conclusion applies to the other basins of similar age listed above. Our analysis of crustal structure and crustal type allows us to make predictions of heat-flow history for the Rockall Trough. In the basin centre, where thinning-factor is ~0.6-0.8 (β ~3-5), heat-flow history is dominated by cooling of the rift-related transient heat-flow component. On the much less-highly stretched basin flanks, where thinning-factor is ~0.2-0.3 (β ~1.25-1.5), heat-flow history is dominated by the steady-state radiogenic component from relatively thick crust. This has important implications for any future petroleum-systems analysis in the area.