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Evolution of the Rockall Trough and the impact of thermal anomalies: A numerical modelling approach

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The Rockall Trough is one of the largest basins forming the north-east Atlantic margin, however despite being the dominant bathymetric and geological feature of the region it is relatively unexplored and much of its evolution remains poorly understood. In part, this is due to the Paleocene lavas associated with the opening of the North Atlantic Margin and the Icelandic Hotspot which inhibit high resolution imaging of the underlying sediments and basement structure. Debate continues regarding the age and nature of the rifting and the timing of subsidence and uplift events that control the basin's evolution as classic McKenzie Uniform Stretching Models (1978) do not satisfactorily explain the subsidence observed within the basin. In addition there are notable differences between the northern and southern parts of the basin. The northern Rockall Trough is characterized by the presence of the large igneous centres and extensive Paleocene lavas whilst the southern Rockall Trough is characterized by highly extended crustal lithosphere.

The aim of this study is to apply numerical, lithosphere-scale models to the Rockall Trough in order to gain insights into the complex evolution of this passive margin basin. Model cross-sections of the basin have been produced in order to determine the interplay of geological and geodynamic processes that have controlled the evolution of the Rockall Trough. These models are used to test different hypotheses regarding the timing and nature of extensional and compressional events as well as the influence of thermal anomalies. Initial results show the importance of characterizing the rifting events that have lead to basin development. The results demonstrate that an instantaneous rift event is too simplistic and cannot be applied to the Rockall Trough. Instead multiple rift events or prolonged rifting events provide a better solution to the evolution of the Rockall Trough.

The roles of the thermal anomalies that have influenced the evolution of the northern part of the Rockall Trough are explored within this study. The thermal anomalies are associated with the Icelandic Hotspot and it has been hypothesized that its proximity to the northern part of the Rockall Trough, compared to the southern part of the basin may account for some of the variations observed between the two parts of the basin. Results from the modeling show that it likely that the thermal anomalies introduced by the Icelandic Hotspot do influence the evolution of the northern basin but do not fully explain the transient nature of the basins subsidence pattern. Future work aims to further develop the modeling of thermal anomalies to explore the role of dynamic support provided by the underlying mantle and its affect on the evolution of the basin by extending this two-dimensional study using basin cross-sections into a three-dimensional basin wide study.