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Understanding the tectonic evolution of the East Orphan Basin, offshore Canada, and the conjugate Porcupine Basin, offshore Ireland, using a seismic megatransect

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During the last fifty years of seismic data acquisition and interpretation on the Newfoundland and Irish Atlantic rifted margins, a variety of theories about the origin, evolution, and timing of basin formation on these conjugate magma-poor margins have been proposed. These varying theories reflect the complex evolutionary history of these conjugate margins. Using seismic reflection data on both the Newfoundland and Irish margins, we reconnect the once-linked conjugate margin basins to better understand in what ways their subsequent evolution diverged.

Using plate-reconstruction maps of the margins prior to the opening of the modern North Atlantic Ocean, seismic lines from both margins have been interpreted and 2D kinematic restoration performed, using a variable extension factor for the lithosphere (β), to track variations in the sedimentary basin structure and the syn- and post-rift evolution. This work focuses on the link between the East Orphan Basin and the entrance to the Porcupine Basin, which lay conjugate at the initiation of seafloor spreading.

The two basins appear to have experienced differing degrees of extension, with more localised extension observed for the Porcupine Basin and more distributed deformation for the East Orphan Basin. Moreover, the structural trends also differ in both basins. For the East Orphan Basin, the structural trend varies from W-E at its south-west limit, producing half-grabens defined by normal faults with a N-S strike, to NW-SE at its north-east limit, leading to the formation of normal faults with a SW-NE strike. In contrast, the Porcupine Basin exhibits a main structural trend ranging from W-E to NW-SE that led to the formation of half-grabens parallel to the basin boundaries. The observed structural trends may indicate that both basins have undergone different extension directions. At least one compressional episode is identified for the Porcupine Basin and is supported by a localised inverted structure at the southern limit of the basin. This compression was likely generated, based on the interpreted horizons, during the Late Cretaceous to Paleogene. This research will ultimately result in an updated basin evolution model of these Atlantic conjugate basins and will contribute to the promotion of hydrocarbon exploration efforts in these complex and highly prospective basins.