

Geologically Constrained Deformable Plate Reconstruction Methods Provide New Insights into the Development of the Irish and Newfoundland Conjugate Margins

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The application of new deformable plate reconstruction methods gives us an enhanced understanding of the major controls and mechanisms for basin formation and evolution in offshore Atlantic Ireland and Eastern Canada, which has implications for basin analysis and petroleum exploration in those areas. The new method takes into account the wide range of geological processes responsible for basin development by incorporating seismic, magnetic and geological interpretation with analytical techniques that include 2D or 3D gravity inversion, flexural backstripping and forward modelling.

The plate kinematics of the North Atlantic Ocean has been well documented and there is general agreement that extensional deformation started in Triassic times and lasted until the Tertiary, with final separation between the Flemish Cap and Galicia Bank occurring in the Early Cretaceous and between Greenland and the Hatton Bank in the Tertiary. The ability to apply the results of deformable plate modelling to restore pre-breakup geometry represents a major advance over the rigid plate models. Restored structure maps, palaeogeography maps, sediment source area maps, source rock and reservoir facies maps may be reconstructed to their palaeo-position to be used to evaluate source rock and reservoir potential.

A regional seismic grid has been interpreted on each conjugate margin using a combination of high quality deep long-offset industry data, and reflection and refraction seismic profiles from government and academia. Key regional seismic profiles were selected on the conjugate margins for 2D flexural backstripping to establish the timing and amount of pre-breakup extension that has occurred. Selected seismic lines include deep long-offset seismic data on the Irish margin (courtesy of ION-GX Technology) and the Orphan Basin (courtesy of TGS-NOPEC). Major tectonostratigraphic sequences defined from seismic interpretations around the margin are mapped to produce isopachs that are used to provide an estimate of the 3D tectonic subsidence for each time interval. The results of gravity inversion studies, flexural backstripping along selected regional profiles and tectonic subsidence calculations are used to determine crustal extension for each time interval for the deformable model. The new deformable plate reconstruction method benefits from advances in the fields of kinematic and geodynamic modelling, while making use of all available onshore and offshore geological constraints.

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