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Assessing the rotation and segmentation of the Porcupine Bank, Irish Atlantic margin, during oblique rifting using deformable plate reconstruction

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With an increasing number of global and regional plate reconstruction models established in recent years, the motion of the Porcupine Bank, Irish Atlantic continental margin, underlain by orogeny-related pre-rift crustal basement terranes, have been investigated and restored as well. However, these reconstructed models of the Porcupine Bank margin mainly depend on potential field data analysis and lack seismic constraints, failing to reveal the role of inherited crustal sutures during rifting and associated crustal deformation over geological time. In this study, five deformable models with distinct structural inheritance trends are established in GPlates by adjusting a previously published regional restoration model for the North Atlantic realm. For each model, driving factors (e.g., such as whether the Orphan Knoll is included, the altered rotational poles of the Flemish Cap, and the motion of the eastern border of the Porcupine Basin) are also taken into consideration. Crustal thicknesses from gravity inversion and seismic refraction data modelling are compared against those from these deformable plate reconstruction models to identify the most geologically reasonable one. The resulting preferred model has the Porcupine Bank subdivided into four blocks with each experiencing polyphase rotations and shearing prior to final continental breakup, implying strong inheritance and segmentation of the Porcupine Bank and the Porcupine Basin. The derived reconstructed paleo-positions over time of the Flemish Cap and the Porcupine Bank within the deforming topological network reveal new and evolving conjugate relationships during rifting, which are assessed using regional seismic transects from both margins. Finally, extensional obliquity between both margins is quantitatively restored, showing time-variant orientations due to the rotation and shearing of associated continental blocks, which contributes to unraveling the spatial and temporal evolution of southern North Atlantic rifting during the Mesozoic, prior to the initiation of seafloor spreading.