Assessing Plate Reconstruction Models using Continental Extension Predicted by Gravity Inversion for the NE Atlantic and Labrador Sea Rifted Margins

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Plate reconstructions in the Arctic are dependent on the plate tectonic history of the NE Atlantic and Labrador Sea. Therefore, our understanding of Mesozoic and Cenozoic plate reconstructions can benefit from calibration and refinements of plate reconstructions for the NE Atlantic and Labrador Sea. Whilst the Tertiary plate reconstruction models for the North Atlantic (based on identification of sea-floor magnetic anomalies, continent-ocean-boundaries (COBs) and fracture-zone geometries) are relatively clear-cut, the amount of pre-breakup plate margin deformation is still ambiguous. Pre-breakup lithosphere thinning should manifest itself as COB overlap in plate reconstruction models but previous attempts at creating pre-Tertiary plate reconstructions suffer from either severe continental overlap and COB gaps that require compressional events hitherto not recognized in the geological record.

2D seismic refraction and reflection lines (that image the Moho) across the NE Atlantic and Labrador Sea rifted margins are used to estimate pre-breakup continental lithosphere extension. However, regionally, seismic refraction lines are sparse; therefore, we test whether free-air gravity data (which is available globally) can be used to predict continental lithosphere extension. Gravity inversion incorporating a lithosphere thermal gravity anomaly correction has been used to predict Moho depth, continental lithosphere thinning factors and determine pre-breakup lithosphere extension for the 2D seismic refraction profiles. The gravity inversion method is carried out in the 3D spectral domain and predicts Moho depth, crustal basement thickness and continental lithosphere thinning factor. Sediment thickness has been included in the gravity inversion and a correction for the addition of volcanic material is made. This approach provides a prediction for COB location independent from the magnetic anomaly data. Continental lithosphere extension calculated from gravity anomaly inversion agrees with seismic refraction estimates.

Estimates of pre-breakup extension derived from two different plate reconstruction models are compared to the estimates of continental lithosphere extension from seismic refraction and gravity inversion. The results show that the gravity inversion method can be used to both refine plate reconstruction models and locate the COB.