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Reconstructing deformable continental blocks and crustal thicknesses back through time within the North Atlantic Ocean

Michael King¹ and J. Kim Welford²

¹Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Canada (mtk282@mun.ca)

²Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Canada (kwelford@mun.ca)

The tectonic evolution of the North Atlantic Ocean has been extensively studied using a variety of geological, geophysical, and plate reconstruction techniques. Recently, deformable plate tectonic reconstructions, built using the GPlates software, have become an increasingly used method for studying the plate kinematics, deformation, and subsequent crustal thickness evolution of tectonic regimes. For the North Atlantic Ocean in particular, deformable plate models have proven to be useful for studying the kinematic evolution of continental blocks (e.g. Flemish Cap and Galicia Bank) and the partitioning of strain within sedimentary basins (e.g. Orphan Basin). However, despite these advancements, previously published deformable plate models have included limitations that can be geologically unsatisfying. Some notable examples include, but are not limited to, uniform crustal thickness assumptions at model start times, and the rigid nature of continental blocks and model boundaries that define the limits of where deformation takes place.

Using the interplay of GPlates and its python programming module, pyGPlates, we present a new deformable plate modelling strategy and application within the North Atlantic Ocean. In contrast to previous studies, this approach considers deformation within continental blocks and the reconstruction of present day crustal thickness estimates calculated via gravity inversion. In addition, we also demonstrate the minimized impact of rigid landward model boundaries using this approach and the resultant ability to reconstruct rift domain boundaries a priori. The results of this study provide insight into the pre-rift (200 Ma) crustal thickness template of the North Atlantic and the evolution of relevant continental blocks during rift-related deformation. Furthermore, this work also highlights the potential impact of Appalachian and Caledonian terrane boundaries on the distribution and extent of rifting experienced along the Newfoundland, Ireland, and West Iberian offshore rifted margins.