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A framework for modelling continental margin deformation within global plate tectonic reconstructions

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Regional and global scale reconstructions provide a quantitative description of surface plate kinematics. Periods of continental extension or compression can be represented most simply as overlaps or gaps between adjacent continental blocks - for example, full-fit reconstructions of major ocean basins result in large overlaps between the conjugate continental plates on the basis that the continental margins are highly extended compared to their pre-rift state. Hence, these rigid plate polygons do not provide an adequate description of the kinematics within areas of continental deformation. A fundamental challenge in generating more robust global-scale plate reconstructions is the incorporation of a more quantitative description of the kinematics within extended passive margins, based on observations.

We present a workflow for incorporating extension at continental margins into existing global plate reconstructions. Analysis of geophysical data over passive margins allows us to define the extent of different crustal types and estimate the variation of crustal thickness within the extended crust. Models integrating plate kinematics, plate geometries and present-day crustal thickness allows us to represent continental rifting in a way that eliminates gaps and overlaps. The models describe along-strike variations in the age of breakup for pairs of conjugate margins, and provide first-order quantitative estimates of the kinematics and evolution of crustal thickness during phases of continental deformation. The results have implications for a variety of applications - for example, providing more realistic boundary conditions as constraints for geodynamic modelling, and providing a framework for more detailed estimates of subsidence, paleobathymetry and associated impact on sea-level change for continental margin settings.