The Pre-Break-Up Position of the Falkland Plateau Within Gondwana — Insights from Deformable Plate Modelling

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Abstract

Early stages of transform margin formation are frequently associated with crustal fragmentation and the formation of microcontinental blocks, some of which undergo vertical-axis rotations. The limited outcrop extent of these crustal fragments can hinder our attempts at reconstructing transform margins and understanding their evolution. This can result in erroneous crustal type distribution models and underestimations of the structural and stratigraphical complexities of the sedimentary basins formed along these margins. The aim of this study is to constrain the palaeoposition of one of these microcontinents, the Falkland Islands (Islas Malvinas) microplate (FIM), in order to investigate how transform margins evolve. To accomplish this, we integrated seismic and gravity data and redefined the crustal architecture and structural framework of the Falkland Plateau (FP). The results represented the main input for a deformable plate model. This allowed us to test different scenarios for the position of the FIM. Crustal thickness maps for the entire FP were generated and used for validation and the identification of the best fit model. The structural framework mapped across the FIM indicates a change in the extension direction throughout the Jurassic and Early Cretaceous. When compared to the regional stress in south-western Gondwana, this variation can be explained through a rotation of the FIM of approximately 80°. Evidence of sinistral wrenching in the form of en-échelon faults can be seen east of the islands and is consistent with intraplate deformation generated by a clockwise rotation. The crustal thickness models obtained from the deformable plate modelling also

show that a rotation of the FIM would generate a crustal architecture similar to the one observed today along the FP. These findings support a rotated reconstruction of the FIM within Gondwana in which the sedimentary basins east and north of the islands represent a continuation of the offshore South African basins, having a common history until the Late Jurassic. The use of deformable plate modelling proved to be a crucial instrument in investigating the validity of transform margins reconstructions. By integrating seismic and potential fields data interpretation with these models we have been able to provide more insights into how the architecture of the crust along a transform margin is affected by the isolated vertical-axis rotations of its constituent continental fragments. Furthermore, the methodology alone can lead towards more robust crustal models for tectonically complex areas as it can be used to assess the reliability of pre-existent interpretations.