Geophysical Research Abstracts
Vol. 21, EGU2019-7579, 2019
EGU General Assembly 2019

A combined modelling approach to plate vector rotation in rift-transform intersections.

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Transform margins are first-order structural features that represent a total of 16% of the cumulative length of continental margins accommodating plate motion. Yet, their evolution, genetic relation to oceanic spreading, and general structural character still present a challenging research field. In this work, we investigate the evolution of rift-transform intersections using a combined analogue and numerical modelling approach.

Through a series of analogue experiments, we investigate the effect of an imposed rotation in the rift extension direction, a component in rift-transform interaction that has not been studied previously. In the model, we use a two layer ductile-brittle configuration to simulate the crustal rheology. We initiate rifting in an orthogonal direction and then proceed to gradually rotate the plate vector to a 7o angle. This angle is comparable to the amount of rotation seen in natural examples. Rifting then continues with the new plate motion vector. The experimental configuration we use allows the study of transpressional and transtensional rotation of the moving plate simultaneously. Results show that: a) a transtensional shift in the plate direction produces en-echelon oblique slip faults (alongside a principal displacement zone) which accommodate the horizontal displacement until the new plate motion vector is stabilized and b) a transpressional shift produces buckle folding near the rift-transform intersection and widespread transpression further away from the rift. Using the open source geodynamics code ASPECT, we present a suite of 3D numerical models of lithospheric rifting in the presence of plate vector rotation. We test both the timing and the angle of the vector rotation to investigate the effect these have on deformation patterns along a rift-transform intersection. Our numerical simulations complement the analogue models while exploring the rheological and mechanical parameter space that guides our preliminary results.

Finally, we then compare our observations from the combined modelling approach with seismic reflection images from a range of margins around the world, including the Gulf of California partitioned oblique margin and the Tanzania Coastal Basin.