Kinematic and paleobathymetric evolution of the South Atlantic

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The opening of the South Atlantic Ocean is one of the most extensively researched problems in plate kinematics. In recent years focus has shifted to the early stages of continental separation. General agreement exists about ocean opening being the result of the diachronous separation of two major plates, having involved a certain degree of intracontinental deformation. However, in order to achieve their best fits, most modern models assign most of this intracontinental deformation to narrow mobile belts between large, independently moving plate-like continental blocks, even though timings and motions along their boundaries are not well known. Aiming to step away from the very large uncertainty introduced by this approach, here we present a model of oceanic growth based on seafloor spreading data (fracture zone traces and magnetic anomaly identifications) as a context within which to interpret intracontinental tectonic motions.

Our model results are illustrated by an animated tectonic reconstruction. Spreading started at 138 Ma, with movement along intracontinental accommodation zones leading to the assembly of South America by 123 Ma and Africa by 106 Ma. Our model also provides an explanation for the inception and evolution of the Malvinas plate and its connection with the formation of a LIP south of the Falkland-Agulhas Fracture Zone. Finally, we challenge the view of narrow deformation belts as the sole sites of stress accommodation and discuss the implications of our model in terms of the distribution of intracontinental strain.

However, paleobathymetry (depth variations through time) also needs to be considered for a fuller understanding of the ocean's evolution and development of its petroleum systems. At first order, this is controlled by plate tectonics, which determines changes in the geographical location of the lithosphere, along with thermal subsidence, which controls changes in its vertical level. Thermal subsidence is modelled by applying plate-cooling theory to a high-resolution seafloor age grid derived from the plate kinematic model. Then, this thermal surface is refined to account for other factors that affect bathymetry at smaller scales or amplitudes, both within the ocean and the continent-ocean transition zones. The results are a series of paleobathymetric reconstructions of the South Atlantic, which provide a fuller picture of its evolution from Cretaceous times to present.