

Complex Poly-phase Extension during South Atlantic Rifting - A New Kinematic Perspective

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Continental crust extension is the pre-cursor to passive margin formation. Variations of simple shear rift models purport to explain differential extension of the lithosphere along the South Atlantic plate margin. Differential extension is manifest in the distribution of modified continental crust which imparts a conspicuous asymmetry to the Santos Basin and its conjugate margin. Somewhat paradoxically along-strike the distribution of attenuated continental crust associated with basins to the north (Campos, Espirito Santo and conjugate African margin basins) appear more symmetric about the continent-ocean boundary. Furthermore the spatial relationship of characteristic syn-rift “sag” to Aptian salt sequences is thought to reflect the complex along-margin rift-kinematics and resultant syn-rift subsidence history. As a consequence it is tempting to conclude that during Neocomian rifting, extensional processes were partitioned along-strike, separated by an inherited lithospheric-scale discontinuity. It is both logical and compelling to then hypothesize that an asymmetric rifting process augmented by non-orthogonal extension, results in an asymmetric rift outcome. Models that incorporate sub-crustal detachments are popularly cited in this respect however, seismic observations in support remain equivocal. Incorporating new regional seismic observations, high resolution gravity and magnetic data we offer new perspectives for the plate margin development in time and space via plate restoration models. The basis of our restored margin view relies on the identification of attenuated continental crust provinces which record the poly-phase response of the lithosphere to evolving far-field stresses, the consequence of spatially evolving rift heat-flow and oceanic ridge propagation. We have been able to reconcile the evolution of the margin and demonstrate consistent model that accounts for cool brittle versus hotter ductile extension relationships prior to oceanisation. We differentiate several phases of diachronous rift evolution that describes the response of the margin to initial E-W extension and then NE-SW extension. An early northern salt basin forms whilst contemporaneous deformation in the Santos Basin is dominated by hyper-extension and volcanic addition to thinned and modified continental crust. Anomalous syn-rift subsidence of the Sao Paulo Plateau is unique consequence of the rifting history which results in the development of extensive aggradational reservoir facies.