

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

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Continental crust extension is the pre-cursor to South Atlantic passive margin formation. Variations of simple shear stretching models purport to explain differential extension of the lithosphere along the 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. In contrast along-strike to the north, the distribution of attenuated continental crust appears more symmetric about the COB. Furthermore the spatial relationship of characteristic syn-rift "sag" to Aptian salt sequences is thought to reflect poly-phase rift-kinematics and complex syn-rift subsidence patterns. Consequently it is tempting to conclude that during Neocomian rifting, extensional processes were partitioned spatially by inherited lithospheric-scale discontinuities. It is both logical and compelling to 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 a consistent model that accounts for cool -brittle versus warmer-ductile extension relationships prior to oceanisation. We differentiate at least two phases of diachronous rift evolution that describes the response of the plate margin to changing stress regimes in the lithosphere. 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 a unique consequence of the rifting history. The restored-margin model provides an interesting frame of reference that may determine the extent and variability of hydrocarbon potential in pre-salt basins of the South Atlantic.