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Explaining lateral changes in tectonic subsidence and uplift along the Southeast Brazilian margin

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The South Atlantic segment comprising the Santos, Southern Kwanza and Benguela basins make up an asymmetric 1000 km wide conjugated margin. Refraction seismic experiments in the Santos Basin reveal high seismic velocities below sediments in the proximal margin, compatible with lower crustal rocks. Dynamic models demonstrated that thinning profiles at margin of this type could result from slow extension and distributed deformation of a weak lower crust. In this sense, crustal extension evolved trough a core complex phase with lower crust exhumation in the footwall of normal faults, whereas large distance translation would transport the hangingwall several kilometers away from its original position. The sedimentary infill associated to the rifting of the Santos Basins includes Hauterivian sandstones and shales (∼128 Ma), overlain by thick packages of Barremian lacustrine sediments (128-125 Ma), followed by Aptian shales, marls and carbonate rocks (∼125-113 Ma). All of this is buried beneath a thick layer of salt deposited at the very end of the Aptian (112 Ma). Hauterivian and Barremian infills were formed in proximal minibasins, and are located today more than 100 kilometers away from its original position. In the proximal margin, the Aptian is considered a time of tectonic quiescence, as 1 km thick Aptian lacustrine shales conformably lie over the Hautiverian-Barremian sediments. However, in the distal margin, the occurrence of shallow water, mid to late Aptian shales, marls, and carbonate ramps strongly controlled by faults and rotated blocks; indicate continuity of rifting into the Aptian. Erosive unconformities at the top of the rotated blocks also reveal important vertical movements at the end of the Aptian, probably responsible for the maintenance of shallow water environments necessary for the deposition of the carbonate platforms. Estimates of erosion based on the truncation of the seismic reflectors and the maintenance of thickness through the section indicate approximately 3 km of erosion during the Aptian. Drilled subaerial flood basalts interleaved with the sediments support important Aptian vertical movements at the distal margin of Santos and Campos basins. Such evidences demand the activity of first order tectonic mechanisms that explain large uplifts and depressions during the Aptian evolution of the Southern Brazilian Margin.

The combination of restoration, backstripping and forward kinematic simulation based on seismic observations performed in this work demonstrates that the apparent contrasting uplifting and subsidence histories during the Aptian of the Santos Basin and its conjugate margin may be the product of the combination of rift migration, sequential faulting, and isostatic compensation of rotated fault blocks. In this sense, thermal and tectonic subsidence would be continuous processes throughout the rifted margin with temporal and spatial distribution strongly dependent on the history of thinning and lateral migration of the rift axis. Such mechanisms could also be responsible for the creation of the shallow water conditions necessary not only for deposition of the Brazilian pre-salt but also for the maintenance of these conditions late in the Aptian, when the Salt Basins formed.