Tectono-stratigraphic evolution of the Aptian Pre-Salt of the onshore Espírito Santo Basin, SE Brazil, an example of proximal passive margin sag basin

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The Espírito Santo Basin is part of the Brazilian rift system basins, formed by the break-up of the Supercontinent Gondwana and subsequent opening of the South Atlantic Ocean. The Aptian sedimentary succession of the basin is named Mucuri Member, lower unit of Mariricu Formation, and is contemporary to the pre-salt main carbonate reservoirs. Proximal deposition consists mostly of clastic sediments, interpreted as fluvial and coastal systems in the margins of a wide lake, which synchronously accumulated carbonates to the distal portions. The economic interest for oil is centered on the distal carbonates, thus the proximal sections lack detailed studies. The main objective of this study is the tectono-stratigraphic analysis of the marginal Mucuri Member. Leading methodology is seismic stratigraphy based on 220 2D lines and 1 3D volume, coupled with petrophysical and lithological analysis of 103 well log data and 5 cored wells. The combined analysis of seismic and lithological parameters resulted in the individualization of four seismic facies, which correspond to the predominance of one or two amongst five facies associations interpreted in cored wells. Seismic facies (SF) 1 is predominantly composed of offshore and lower shoreface successions; SF 2 is characterized by a dominance of poorly confined fluvial channels facies association; SF 3 records the interaction between fluvial and coastal successions composing mound-like structures, and is interpreted as wave-dominated deltaic facies association; SF 4 corresponds to sandspits structures and is restricted to regions where the coastal waves interact with basement highs. Four seismic stratigraphic units were identified (named, from the base upwards: MUC1, MUC2, MUC3 and MUC4), delimited by three subparallel horizons. Unit-bounding reflectors coincide with gamma ray maxima or minima representing shales or anhydrites, respectively, deposited in deep water environments. The Mucuri Member records an enlargement in depositional area from the base upwards witnessing an overall lacustrine base level rise during deposition. The geometry of the depositional area during MUC1 and MUC2 was conditioned by the paleorelief of the preceding rift basins. MUC3 and MUC4 seismic units record a decrease in thickness as remnant topography was gradually filled; both units transcended and draped the half-grabens. The Early Cretaceous Mucuri Member composes the beginning of the post-rift sequence of Espírito Santo Basin, marked by the onset of thermal subsidence and cessation of mechanical
subsidence.