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Pre-salt rift morphology controls salt tectonics in the Campos Basin, offshore SE Brazil

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Salt-bearing passive margin basins offshore SE Brazil have been and remain attractive for hydrocarbon exploration and production. In the Campos Basin, major reservoir types include post-salt turbidites, which are located in structural traps related to thin-skinned faulting above salt anticlines and rollers. Classic models of gravity-driven salt tectonics commonly depict kinematically linked zones of deformation, characterised by updip extension and downdip contraction, separated by a weakly deformed zone associated with downdip translation above a relatively smooth base-salt surface. We use 2D and 3D seismic reflection and borehole data from the south-central Campos Basin to show that this does not adequately capture the styles of salt-detached gravity-driven deformation above relict, rift-related relief. The base-salt surface is composed of elongated, broadly seaward-dipping ramps with structural relief reaching c. 2 km. These ramps define the boundary between the External High and the External Low, basement structures related to the rift tectonics. Local deformation associated with the base-salt ramps can overprint and/or influence regional, margin-scale patterns of deformation producing kinematically-variable and multiphase salt deformation. We define three domains of thin-skinned deformation: an updip extensional domain, subdivided into subdomains E1 and E2, an intermediate multiphase domain and a downdip contractional domain. The multiphase domain is composed of three types of salt structures with a hybrid extensional-contractional origin and evolution. These are: (i) contractional anticlines that were subjected to later extension and normal faulting; (ii) diapirs with passive and active growth later subjected to regional extension, developing landward-dipping normal faults on the landward flank; and, lastly, (iii) an extensional diapir that was subsequently squeezed. We argue that this multiphase style of deformation occurs as a consequence of base-salt geometry and relief creating local variations of salt flow that localize extension at the top and along the ramps, and contraction at the base. Translation and extension of salt and its overburden across major base-salt ramps resulted in three ramp syncline basins northeast of the study area, partially bounded by salt-detached listric faults. The temporal and spatial distribution and evolution of these and other key salt and overburden structures, and their relationship to base-salt relief, suggest 30 to 60 km of horizontal gravity-driven translation of salt and overburden.