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The Port Isabel Fold Belt: Salt enhanced Neogene Gravitational Spreading in the East Breaks, Western Gulf of Mexico

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The Port Isabel fold belt is situated at the northwestern corner of the deep water Gulf of Mexico where the regional E-W trending Texas-Louisiana shelf bends into the NNE-SSW trend of the East Mexico Shelf. The fold belt forms an allochthonous wedge that ramps up from West to East with its front occupied by shallow salt complexes (local canopies). It is assumed that the belt predominantly comprises Oligocene siliciclastic sequences which reveal eastward facing folds and thrusts with a NE-SW regional trend. The structural architecture of the fold belt is very well imaged on recently processed 3D seismic volumes. Crystal III is a wide-azimuth survey acquired in 2011 and reprocessed in 2016 leveraging newly developed state-of-the-art technology. 3D deghosting, directional designature and multi-model 3D SRME resulted in broader frequency spectrum. The new image benefits from unique implementation of FWI, combined with classic tomographic updates.

Seismically transparent zones indicating over-pressured shales are limited to the core of anticlines or to the footwall of internal thrust. Mobile shales associated with diapirs are absent in the study area. In contrast, salt is mobile and apparently forms the major decollement of the PIFB as indicated by remnant salt preferentially located in triangles along the major thrusts and fault intersections or at the core of anticlines. Shallow salt diapirs seam to root in the fold belt, while lacking evidence for salt feeders being connected to the deep salt underlying the Mesozoic to Paleogene substratum of the fold belt.

Towards the WNW the fold belt is transient into a extensional regime, characterized by roll-over structures associated with deep reaching normal faults which form ultra-deep mini basins filled with Neogene deposits. Kinematic restorations confirm the simultaneous evolution of the deep mini basins and the outboard fold belt. This resembles a gravitational spreading system with the extensional tectonics of the deep Neogene mini basin balanced by the outboard compressional domains of the displaced Paleogene sediment sequence. In this context the role of salt is enigmatic, as the system's concave, deep reaching major detachment conflicts with the interpretation of a destabilized former salt canopy. It rather indicates syn-kinematic salt extrusion from a deeper source along the major frontal thrust ramp. A syn-kinematic (Poiseuille) salt flow along the major decollement (channel flow) is required to feed the salt accumulations at the frontal section of the fold belt and the shallow salt diapirs.