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# Lateral Boundaries in Deepwater, Salt-Detached Fold-and-Thrust Belts

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Lateral boundaries, with strike-slip and/or oblique slip deformation, are common in deepwater fold-and-thrust belts. An entire margin does not move basinward as a solid mass; instead, different blocks move different amounts, at different rates or different times, and in different directions. Fold and thrust development is a response to gravitational failure of the margin, and various parameters impact the deformation. First, the rift-basin architecture is critical: it determines whether the margin is straight, concave toward the basin, or convex toward the basin; and it controls the areal and original thickness distribution of the salt, or décollement, layer. Second, the salt evolution is important: the effectiveness of the detachment decreases as the salt thins and ultimately welds; and the establishment of diapirs and minibasins creates strength anisotropy in the deforming wedge. Third, the tilting history of the margin, whether driven by differential thermal subsidence or uplift of the craton, may vary spatially and temporally. Fourth, shifts in proximal depositional loading may similarly vary. Finally, development of extensive salt canopies provides additional detachment layers.

These various factors interact in complex ways to dictate whether or not failure occurs in any given part of the margin at any given time, the direction and amount of that failure, and how that failure is accommodated. The resulting contractional strain in deepwater fold-and-thrust belts is partitioned along strike, with adjacent compartments moving relative to each other, forming lateral boundaries with strike-slip or oblique-slip deformation. Here, we examine four examples from the northern Gulf of Mexico (GoM) and offshore Angola:

1. In the Atwater foldbelt of the GoM, there is a NNW-SSE trending zone some 25 km wide that is characterized by folds, thrusts, and squeezed diapirs with a similar orientation, roughly orthogonal to the regional strike direction. In addition, the depositional pinchout of the Louann salt jogs by about 30 km in the same zone, as does the front of the Mesozoic salt nappe. The lateral boundary zone is attributed to an underlying accommodation zone in basement and the consequent thickness variations in the Louann salt.

2. In southeastern Mississippi Canyon (GoM), a series of minibasins and diapirs was established prior to Miocene shortening. Strong minibasins moved mostly rigidly and independently during gravitational failure, with deformation taking place in the weak diapirs and over connecting ridges of deep salt that separates the minibasins. The result is a polygonal array of structures, some with strike-slip or oblique-slip movement. Additionally, one minibasin probably rotated clockwise about a vertical axis during translation.

3. In the deepwater of offshore Angola, contractional folds and thrusts are generally oriented NNW-SSE. In addition, there are basinward-vergent thrust sheets that have carried Cretaceous and Paleogene strata up to 15 km over their subthrust equivalents. These thrusts merge along strike with the basal detachment at low-dip lateral ramps or end abruptly at steep tear faults.

4. At a completely different scale, total shortening amounts vary significantly along strike in the deepwater fold-and-thrust belt of offshore central and eastern Louisiana (GoM). Shortening in most of Atwater Valley is ~10-12 km, decreases to 6-8 km in western Atwater Valley and Green Canyon, and then decreases abruptly to only about 1 km in Walker Ridge. This order-of-magnitude change occurs across a discrete zone of strike-slip deformation that extends to the NNW through central Green Canyon. It cannot be attributed to a westward decrease in proximal loading and failure, because there was actually greater Miocene loading and consequent extension to the west. Some have speculated that the necessary Miocene shortening must be accommodated updip of Walker Ridge, in western Green Canyon and Garden Banks, but this is not supported by seismic data. Instead, the lateral boundaries in the foldbelt line up nicely with the eastern edges of extensive canopies on the inner shelf and onshore of Louisiana. Most Miocene failure to the west occurred above the canopies, with only little deformation at the Louann level. To the east, there were only isolated canopies and thus no good shallow detachment, such that most of the failure detached at the Louann level. Thus, the southwestern lateral boundary of the Atwater foldbelt is a consequence of canopy distribution in more proximal areas.