Enigmatic aspects of the early history of the southern Gulf of Mexico margin

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Several aspects of the early history of the southern Gulf of Mexico are enigmatic. First, the amount of Upper Jurassic thin-skinned extension is much greater to the northeast. Second, early allochthonous flow of salt over oceanic crust is less extensive to the southwest. Third, although an outer marginal trough is apparent to the northeast, its presence to the southwest is questionable and the level of salt is higher than the oceanic crust. These observations have led to an interpretation in which the Campeche and Yucatan segments of the margin are sub-basins separated by a basement high, with the Campeche salt confined at its distal end by uplifted basement just landward of oceanic crust.

A revised explanation based on the opening history of the Gulf of Mexico nicely explains the observations. Oceanic crust was generated by the counter-clockwise rotation of Yucatan about a pole near western Cuba, with the geometry of the basin requiring a higher proportion of transform margin segments in the west and more ridge segments in the east. Three scenarios are compatible with this: (1) the onset of spreading was coeval everywhere but the amount of spreading decreased to the east; (2) the onset of spreading was diachronous, getting gradually younger eastward; or (3) the onset was diachronous but shifted abruptly across one or more transform faults.

The last option best accounts for the differences between the Campeche and Yucatan segments. First, excess thin-skinned Upper Jurassic extension in the Yucatan sub-basin is balanced by crustal hyperextension and/or mantle exhumation prior to oceanic spreading, whereas coeval extension in the Campeche area was accommodated by spreading. Second, the relatively minor early movement of salt over oceanic crust in the southwest is due to the dominance of transform segments and thus initially small areas of oceanic crust. Finally, outer marginal troughs are not absent in the Campeche sub-basin but are generally small and local, separated by longer transform faults. For two reasons, seismic lines across these faults show the salt higher than oceanic crust as opposed to the outer marginal troughs: first, the juxtaposed oceanic crust is relatively older and thus deeper; and second, continental crust along transform segments is often elevated along marginal ridges.

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