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Crustal structure and along-strike variations in the Gulf of Mexico conjugate margins: From early rifting to oceanic spreading

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The Gulf of Mexico opened as a Late Triassic-Mid Jurassic continental rift that was first largely covered by the Mid-Jurassic Louann Salt and later split apart by a triangular-shaped oceanic crust. Salt in the Gulf of Mexico largely hampers the imaging and interpretation of underlying pre-salt and crustal geometries, which are fundamental for assessing the early kinematic evolution of the margin. To better define these deep geometries and their lateral variations, we built three seismic-based crustal-scale cross-sections across the Florida-Yucatan conjugate margins, in the areas where the Mid-Jurassic salt unit is thinner.

Seismic-based cross-sections image the architecture of rifting and the geometries of the continental and oceanic crusts and the transition between them (ocean-continent transition, OCT). They show a meaningful along-strike variation: the South Florida-East Yucatan area is characterized by a narrower rifted continental crust that evolves sharply to oceanic crust whereas in the North Florida and central-western Yucatan areas, the rifted continental crust is wider and the transition to the oceanic crust corresponds to a narrow magmatic or exhumed mantle domain. In the rifted continental crust, seismic profiles image doubly-verging basement faults organized into decoupled and coupled rift domains. The geometrical and cross-cutting relationships between these basement faults, the Louann Salt and the underlying pre-salt sequence indicates a progressive migration of rifting from proximal to distal domains and from the central and north-eastern to the south-eastern Gulf of Mexico.

Bulk continental crust extension was determined using the area balancing method. Estimated horizontal extension values vary from a minimum of □120 km in the South Florida-East Yucatan conjugate to a minimum of □240 km in the North Florida-Central Yucatan conjugate, being systematically larger in the northern margin. Crustal domains identified in the cross-sections were laterally correlated and westwards extended considering gravity and magnetic anomalies data to build a regional-scale, crustal domains map of the Gulf of Mexico. This map, together with the crustal extension estimates, has been used as the reference to carry out a plate-scale reconstruction of the Gulf of Mexico from the early rifting stages to the end of oceanic spreading.

Based on our observations and considering previous models, we propose that the study area

evolved from an early rift involving magmatism, to a magma-poor margin, with continental break-up (OCT formation) being characterized by mantle exhumation and associated magmatism along the North Florida and central-western Yucatan areas.