

Effects of Laramide Foreland Basin Tectonics on Structure, Subsidence, and Hydrocarbons of the Mexican Sector of the Gulf of Mexico

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The Gulf of Mexico (GOM) is traditionally interpreted as a basin formed in a Mesozoic rift and passive margin setting that was subsequently modified by gravity-driven salt tectonics during Cenozoic time. Feng et al. (1994) proposed that anomalously rapid tectonic subsidence of 2.5 to 3.5 km calculated in deep wells along the western edge of the basin reflect the onset of foreland basin tectonics as a result of eastward directed Laramide-age thrusting along the Sierra Madre Oriental fold-thrust belt (SMOFTB). Since the time of their 1994 study, the stratigraphy of both the US and Mexican sectors of the GOM have undergone a major stratigraphic revision based on the recognition that the ubiquitous "mid-Cretaceous unconformity" is now recognized from biostratigraphy in deep exploration wells to be a much younger surface of Late Cretaceous age (e.g., Cantú-Chapa and Landeros-Flores, 2001). Using this important new stratigraphic constraint, we have compiled seismic and well information on this surface over a petroliferous region of approximately 560,000 km² that includes giant fields at the Golden Lane and Cantarell. This top Cretaceous carbonate surface dips uniformly seaward into the GOM at angles of 2° to 5°, is complexly deformed by thrust faults near the modern Mexican coastline, and acts as an extensional detachment surface for 3-6 km of overlying Paleogene to Recent clastic sediments. Our backstripping of four wells in the offshore area east of the Golden Lane and synthetic wells derived from age-dated horizons on regional seismic lines show a major pulse of subsidence at ~66 to ~40 Ma that we infer as the onset of Laramide-related thrusting in the western GOM that is consistent with other areas of Laramide deformation in North America and Mexico dated in the interval from Late Cretaceous to Paleocene (80 to 55 Ma). Reservoirs of giant oil fields in the Chicontepec, Veracruz, and Macuspana basins are located in the overlying and extensionally-detached Cenozoic clastic section although most workers agree that key source rocks are within the Late Cretaceous carbonate section. Previous work shows that thrust-related traps deform the late Cretaceous carbonate section in the area between the SMOFTB and the modern coastline: areas seaward of the modern coastline show that the upper Cretaceous limestone dips uniformly seaward with no compressional deformation.