

Dynamic Topographic Events of the Gulf of Mexico

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Abstract

Dynamic topography from mantle convection below moving plates is recognized as transient vertical motions in the rock record. Dynamic topography affected the Gulf of Mexico in the Triassic/Jurassic as it split in two, in the Cretaceous in Texas-Louisiana, and in the Cenozoic as North America overran the Farallon subduction system. We correlate Cenozoic thin-skinned sliding to dynamic topography. Perdido, Atwater, Mexican Ridges, and Catemaco fold belts formed partly due to margin tilting from dynamic topography and thermal subsidence. The Cenozoic topographic slope (“regional” from onshore to deep water) was controlled initially by uplift from Farallon–North America plate convergence, and later (post-Oligocene) by mantle upwelling. Mantle drawdown in the deep Gulf of Mexico occurred during both phases. Sediment progradation helped slides flourish. Paleogene uplift (involving basement inversions) developed over shallow/flat Farallon subduction and isostatic uplift (double plate thickness). The second phase of gravity sliding correlates to Neogene-Quaternary mantle upwelling, and uplift/extension of the Basin and Range). Basin and Range extension was superimposed on Laramide structures as the Farallon-Pacific triple junction migrated southward along North America. The driving mechanism was uplift over the subducted spreading ridge (spreading cell reached base of the North America lithosphere). Water-loaded oceanic residual depths reveal drawdown of oceanic floor of 2 km. Drawdown occurs above the downgoing Farallon slab as mapped with mantle tomography. An onshore angular-unconformity is cutting basinward-tilted Cretaceous–Cenozoic strata. Simple estimates of denudation indicate <2 km of missing section; inversion of river profiles indicates uplift of 2.5 km (0–30 Ma). Tomography and volcanism reveal upwelling mantle beneath the Basin and Range in the gap west of the Farallon slab. Neogene uplift in onshore Mexico above the flattening Cocos Plate helped Catemaco gravity sliding. The Eastern Atwater fold belt was not driven by dynamic topography. Appalachian uplift and sliding in the East is from isostatic rebound after Miocene delamination of Appalachian lithosphere.