

“Basement Controls on Subsurface Geologic Patterns and Coastal Geomorphology across the Northern Gulf of Mexico: Implications for Subsidence Studies and Coastal Restoration”

by Bryan P. Stephens given to the New Orleans Geological Society, June 14, 2010

Several causes of subsidence in the Gulf Coast in general, and Southeast Louisiana in particular, have been identified. These include sediment loading, compaction of Holocene sediments, subsurface faulting, salt withdrawal and fluid extraction. Recent geodetic leveling studies suggest much of the subsidence is tectonic in nature and related to movement along Tertiary fault systems. This paper suggests that an ordered basement structure has also exercised a profound level of control on all subsequent geological processes including recent coastal environments and ongoing subsidence.

The arrangement of structural elements across the northern Gulf of Mexico suggests the continental margin is segmented by northwest-southeast trending transfer fault zones related to Mesozoic rifting. Major transfer faults segment the continental margin into structural corridors approximately 25 to 40 miles in width, characterized by varying degrees of extension, crustal attenuation and tectonic subsidence. The corridors are more finely segmented by minor transfer fault trends which also exhibit regular and predictable lateral and vertical offsets that are reflected in overlying Tertiary cover.

Mesozoic and Tertiary faults, salt systems and shelf margins are segmented along the same transfer-fault delimited corridors. Variations in sediment thickness suggest that the transfer faults have influenced deposition throughout the history of the basin. Modern seismicity demonstrates ongoing activity along these deep crustal boundaries.

Gulf Coast topographic and bathymetric trends appear to be sympathetic to the basement structure as reflected by stream courses, incised valleys and offshore sediment fairways. The shape of the coastline and distribution of coastal barriers and spits also conform to lateral and vertical offsets along underlying transfer fault zones.

Recognition of the ordered arrangement of basement structures, faulting and salt systems can help coastal scientists better understand the emerging body of detailed subsidence measurements and guide future lines of inquiry. Identification of areas of relative geologic stability may influence coastal restoration efforts.