which is critical in identifying and establishing the placement of the sub-lower Hackberry unconformity that records erosion of the early Frio surface.

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Lyles Ranch Field, South Texas: Production from an Astrobleme?

The process of impact cratering results in the instantaneous formation of unique structures characterized by extensive fracturing and brecciation of the target rock. This process can be conducive to economic hydrocarbon accumulations (Red Wing Creek field with 130 million bbl of oil in place and Viewfield containing 100 million bbl in place—both in the Williston basin), provided these impact features can be recognized in the subsurface. Geologists generally are unfamiliar with cratering mechanics and the high-temperature, high-strain-rate, and high-pressure effects that cause quartzofeldspathic rocks to undergo the mineral transformations so often misinterpreted as being "volcanic" in origin.

Reservoirs associated with astroblemes generally are limited to a highly deformed central uplift in larger craters, or to the fractured and brecciated rim facies. The presence of reservoirs and trapping mechanisms largely depends on the preservation state of the crater in the subsurface.

A probable impact crater recently has been identified in south Texas. The poorly preserved, roughly circular crater outline has rim uplifts consisting of well-cemented ferruginous Carrizo sandstone that is overturned in places. Large allochthonous blocks of Carrizo sandstone litter the area outside the impact site, and thrust faults are present in the Indio shale outcrops along the Nueces River adjacent to the impact area. A test well was drilled in the center of the impact area to investigate a strong gravity maximum that had been observed previously. The well, drilled to 1,200 ft, was dry. However, subsequent wells drilled along the crater periphery have been completed as producers from depths as shallow as 200 ft. Lyles Ranch field, which lies in the immediate vicinity of the impact crater site, may represent another hydrocarbon accumulation associated with an astrobleme.

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Early Evolution of Salt Structures in North Louisiana Salt Basin

Several salt diapirs and pillows in southern and central areas of north Louisiana have been studied using approximately 355 mi (570 km) of seismic reflection data and information from 57 deep well holes. Seismic profiles, with deep well-hole data, are the most advantageous method to document regional salt tectonism through time.

Three stages—pillow, diapir, and postdiapir—are required to explain salt-stock growth through time in the North Louisiana salt basin. The pillow stage and its associated primary peripheral sinks exhibit 11-34% thinning over pillow crests and 12-50% overthickening in the primary peripheral sinks in the basin. Thinning values as great as 87% and overthickening values as high as 400% are inferred for prediapiric (juvenile) salt pillows. The diapir stage and its associated secondary peripheral sinks exhibit 50-250% overthickening. This stage is characterized by piercement diapirism and the withdrawal of large volumes of salt from the flanks of the pillow. The postdiapir stage and its associated peripheral sinks exhibit less than 45% overthickening. Moreover, in some instances dome growth is in a steady state with sedimentation. Growth stages are generally confined to the following stratigraphic units: Smackover to Terryville (pillow stage), Calvin (diapir stage), and Winn and younger sediments (postdiapir stage).

These considerations lead to the following observations and conclusions on diapirism in the North Louisiana salt basin: (1) timing of the diapiric event commenced early (Late Jurassic) in the southern and central portion of the basin, and later (Early Cretaceous) in the northern portion; (2) the initial diapiric event is much more rapid and intense in the southern and central diapirs compared to the later diapiric event in the northern diapirs; and (3) regional depocenter shifting, relative sea level fall, local erosion with salt extrusion, and rapid depositional loading of sediments are the major controls on diapirism in the basin.

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Tectonic Transpression in Northeastern Mexico: Its Relation to Sea-Floor Spreading in Gulf of Mexico

The visual analysis of the SIR-A images (Shuttle Imaging Radar) of the folded belt located between Saltillo, Coahuila, and Galeana, in northeastern Mexico, revealed the existence of several geologic features including: (1) a well-developed pattern of en echelon folds, (2) juxtaposition of tectono-stratigraphic domains, (3) fold structures ranging from fan-shaped asymmetric to recumbent doubly plunging anticlines, and (4) anticlinal-synclinal trends displaying marked morphologic variations, associated to regional plunging, twisting, and tilting of the structures. These structures are interpreted as the result of transpressive forces related to a complex, anastomosed wrench-faulting system in the basement, reactivated in the Late Jurassic during active sea-floor spreading in the Gulf of Mexico.

The Saltillo-Galeana orogenic belt is interpreted as the early Tertiary culmination of an ancient Mesozoic (Jurassic and Cretaceous) transpressive deformation generated from an oblique-slip mobile zone in the Gulf of Mexico. This transpressive tectonic model gives the adequate paleogeographic scenario to integrate all previously postulated, apparently incompatible, deformational models for northeastern Mexico, and conciliates the differences in fold vergences observed in the region.

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Bay-Margin Sand Distribution, North Texas Coast: Model for Sediment Distribution in Microtidal Bays and Lagoons

Analyses of sediment from four bays on the north Texas coast reveal that sand distributions in microtidal bays and lagoons can be related to wind regimes and bay geometries (i.e., fetch and water depth). In order to examine this relationship, bottom profiles were constructed and sediment samples were collected along the profiles in Christmas, West, Trinity, and Galveston Bays. Grain-size analyses of these samples showed a point of marked change in the sand-mud ratio along each profile. This marked change from muddy bay-center sediment to sandy bay-margin sediment occurs at increasingly greater depths in the larger, deeper bays and at greater depths along the southeast side of the bays than along the northwest side.

The difference in the depth of the sand-mud break point between the northwest (76 cm) and southeast (92 cm) sides of Christmas Bay, the northwest (132 cm) and southeast (147 cm) sides of West Bay, the northwest (160 cm) and southeast (174 cm) sides of Trinity Bay, and the south side of Galveston Bay (220 cm) can be related foremost to the wind regime of the Texas coast. During 9 to 10 months of the year, moderate southeasterly winds dominate, creating waves that mainly affect the northwest side of the bays. During the winter months, however, strong northerly winds create larger waves, effectively winnowing sediments to a greater depth along the southeast side of the bays.

In addition to the differences between break-point depths on the northwest and southeast bay sides, minor differences in break-point depths occur along the same side within a bay and are related to variations in bottom geometry.

On the basis of these preliminary analyses, it appears that sand distributions in analogous bays can be predicted using wind, fetch, and water-depth data.

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Application of Pleistocene Climate Models to Gulf Coast Hydrocarbon Reservoirs

The Quaternary is characterized by two climatic signatures: that of the last 800,000 years (the upper Pleistocene), and that of the period from 900,000 to 1,800,000 years ago (the middle Pleistocene). Glacial cycles within the upper Pleistocene climatic signature are 100,000 years long and contain interglacial periods of 10,000-12,000 years and a "full" glacial period of 20,000-30,000 years. Cycles of the middle Pleistocene climatic signature range from 20,000 to 40,000 years. Analysis of Miocene cores from the Deep Sea Drilling Project reveals eight widespread hiatuses. These hiatuses correspond to intervals of cooling, as indicated by fauna and flora, ^{18}O anomalies, and low sea levels. The Miocene hiatuses may result from decreased polar temperatures and concomitant increased bottom-water circulation and corrosiveness. Durations represented by