In the Anacacho Mountains of Kinney County, the Anacacho is primarily composed of tan-orange recrystallized, molluscan, sorted biosparite. In addition, there are two interbedded chalky micrites which are distinguished from massive calcrete crusts on the biosparites. At the top of the northeast end of the Anacacho Mountains, some patches of molluscan, bryozoan, biosparrudites occur. In the Whites Mine area of Uvalde County, the biosparite also occurs; however, three mines penetrate an asphaltic, molluscan, unsorted biosparrudite.

The diagenetic sequence of the Anacacho Formation began with early diagenetic events such as micritization, authigenic growth of glauconite in foraminiferal tests, and authigenic growth of framboidal pyrite nodules. Postdepositional diagenesis included the development of microspar, syntaxial overgrowths of spar, recrystallization of allochems, and calcite spar fill. Further burial caused severe compaction, evidenced by fracturing and pressure solution features. The sediments of the Anacacho Formation were then uplifted and subjected to ground-water circulation in the freshwater phreatic zone. This resulted in dissolution of spar and microspar followed by precipitation of "dog tooth" sparry cement. This secondary porosity development primarily occurred in the Whites Mine area biosparrudites; however, paleokarstic development which may have occurred during this stage of diagenesis is found throughout the Anacacho in this area. Following the transgression of Upper Cretaceous and lower Tertiary marine shales, the unconformable surface of the Anacacho was sealed and ultimately trapped migrating hydrocarbons. As the hydrocarbons penetrated secondary freshwater porosity, "dog tooth" spar crystals were dislodged and incorporated into the hydrocarbon matrix by mechanical and/or chemical mechanisms. The hydrocarbons were devolitalized to asphalt following exposure of the Anacacho and, possibly, by thermal activity from local mafic intrusions.

The biosparrudites in the Whites Mine area represent biostromal bank buildups on bathymetric highs that produced abundant skeletal debris. This debris migrated to the southwest, primarily as prograding sand waves, and resulted in deposition of biosparite in the Anacacho Mountains. The skeletal debris built up sufficient bathymetric relief into the photic zone that biostromal growth became active. Therefore, through time, the bank migrated to the southwest over skeletal debris.

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Hydrocarbon Potential of Dead Sea Rift Valley

The Dead Sea Rift is one of the world's unique geologic and topographic features, whose petroleum potential has not yet been evaluated. The sector of the Dead Sea is an asymmetric graben 20 km (12 mi) from rim to rim and over 120 km (75 mi) long. The total throw from the west rim, where the Upper Cretaceous crops out to the deeper portion of the grabens, is more than 8 km (26,200 ft). Throw on the eastern side is considerably greater as the valley wall is largely Precambrian. The level of the Dead Sea is −400 m (−1,300 ft)—the lowest place on earth.

Asphalt blocks floating from the Dead Sea, along with asphalt and heavy oil seeps in the valley, have been known since biblical times. These are suggestive of leaks from deeper accumulations.

Although some exploration drilling has been done, no test has yet reached objectives in the deeper sunken block where the Miocene is figured to be at a depth of at least 7 km (23,000 ft).

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Evolution and Seismic Expression of Mesozoic and Cenozoic Shelf Margins, Gulf of Mexico and Vicinity

Mapping and classification of modern and ancient shelf margins provide a basis for a concise post-rifting history of the Gulf of Mexico basin. Many hydrocarbon occurrences in the basin can be related to styles of shelf margins and their associated slope with implications for frontier exploration in deep-water facies. Seven basic types of shelf margins have been recognized.

1. Reef-dominated carbonate margins surrounded the deep basin during the Early and middle Cretaceous. This category can be subdivided into: (a) low-relief, short-lived (ca. 10 m.y.) margins in Louisiana and Texas (Stuart City and Sligo), and (b) high-relief (1 to 3 km; 3,280 to 9,843 ft), long-lived (ca. 40 m.y.) margins elsewhere (Florida, Campeche, and Blake escarpment, Golden Lane, El Abra), which are typically associated with fore-reef talus.
2. Sigmoidal progradational carbonate margins developed landward of drowned mid-Cretaceous margins of the Florida and Yucatan platforms during the Cenozoic. Large-scale gravity slides with rollover structures have occurred along the Yucatan slope contemporaneously with deposition of sigmoidal carbonate margins.
3. Carbonate ramps with little or no seismic expression characterized the Late Jurassic, when a deep marine basin was first established, an the Late Cretaceous, following drowning of mid-Cretaceous carbonate platforms.
4. Stable progradational clastic margins with well-developed, undeformed, large-scale clinoform stratification are relatively rare in the Gulf basin. Modern examples are limited to offshore Alabama and Veracruz.
5. Unstable progradational clastic margins result from gravity sliding of the continental slope, commonly associated with salt and shale diapirism, which obscures large-scale clinoform stratification. Growth faults with major expansion and rollover characterize the shelf margin; folds and/or thrust faults characterize the lower slope. This type of shelf margin has dominated the northwestern Gulf during the Cenozoic, and now extends from offshore Mississippi to offshore Veracruz. Numerous episodes of deltaic progradation to the shelf margin have been identified in Texas and Louisiana; these clastic influxes have prograded the shelf edge as much as 350 km (215 mi).
6. Tectonically active progradational clastic margins are present in Tabasco and eastern Veracruz. There the shelf margin has prograded up to 200 km (125 mi) since the early Miocene in an area of active compression and sinistral wrench faulting. Interaction of basement tectonics with diapirs and probably gravity sliding has created great structural complexity in thick Neogene deltaic sequences.
7. Tectonically active sediment-bypassing margins characterize the early Tertiary. The continental margins of Veracruz and Cuba underwent major compressional deformation and did not develop broad constructional shelves; instead, most sediment was probably bypassed to the deep basin. At the same time, a deep-water foreland basin, probably with a similar type of margin, extended into Chiapas and central Guatemala.

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Facies and Diagenetic Controls on Reservoir Rock Properties of Hosston Sandstones, Washington Parish, Louisiana

Cored intervals from the Lower Cretaceous Hosston sandstone show sedimentary structures typical of fluvial and deltaic environments. The present depth of burial of the sandstone is 4,300 to 5,500 m (14,100 to 18,050 ft).

Selected samples of the sandstones were analyzed by petrographic, X-ray diffraction, scanning electron microscopy, and other methods to determine the composition and texture of the detrital and authigenic phases, diagenetic sequence, and the relation of facies, diagenesis, and reservoir rock properties.

The sandstones are fine grained, well sorted, and composed on the average of 68% quartz, 17% lithic fragments, 2% feldspars, 7% matrix, and 6% other minerals. Cements include silica and carbonate, which respectively constitute 8% and 9% of the bulk sample in general. Silica cement dominates in the fluvial facies, carbonate cement in the deltaic sandstones.

Alteration of rock fragments and feldspars results in clay authigenesis which accounts for practically all of the < 0.01 mm size fraction in the sandstones. Coarsely crystalline kaolinite makes up 51% of the clays, illite 42%, and chlorite 6%. Kaolinite alters to illite as a function of temperature increase. While kaolinite is pore-filling, illite and chlorite are pore-lining.

The sandstones have an overall average porosity of 4.2%; the fluvial facies generally has porosities below average, the deltaic facies above. Intergranular pores and oversized pores are the dominant porosity types; both have developed by dissolution of cement or detrital grains. The deltaic facies exhibits inverse relation between porosity and total cement content. Because of the persistent presence of authigenic clays in the pores, microporosity forms a significant portion of total porosity, especially in the fluvial facies.

Permeability of the Hosston sandstones ranges from less than 0.01 md to slightly more than 5 md, the average being between 0.1 and 0.2 md. Thin sandstones of fluvial origin, which have microporosity, show lowest permeability, whereas sandstones of deltaic origin in nearby areas have high permeabilities primarily because of dissolution of grains and carbonate cement. Future exploration in the Hosston should, therefore, be directed to the deltaic sandstone.

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Tectonic Trends, Timing, and Mechanics of the Egyptian Edge of the Red Sea and Gulf of Suez

Two major areas of onshore preservation of both pre- and syn-Red Sea sediments occur at Gebel Zeit, near the mouth of the Gulf of Suez, and at Quseir, 200 km (125 mi) to the south. At Quseir, a belt of 600 m.y. greenstone basement has at least three stages of coaxial N30°W deformation curving northwestward into N60°W grain of the regional Hamrawein Synclinorium. In Late Eocene (?) to Early Miocene time, this northwest-trending structure was further downwarped by block faulting with associated local gravity fold tectonics. The Cenozoic synclinorium dies out southeastward into a synchronous or slightly older system of north-south trending fault blocks, many of which show early stage right-lateral strike-slip slickenslides.

In the Mid-Miocene, the Red Sea coast suffered major downwarping along N25°W trends, whereas the interior synclinorium was further broken into generally northwest-trending, northeast-tilted irregular fault blocks reactivating many older fault trends.

By contrast, the Gebel Zeit block appears rigidly parallel with the N25°W Red Sea–Gulf of Suez trend and shows systematic long-term tilting away from the Gulf of Suez with at least five stages of Eocene through Miocene uplift, erosion of its eastern basement edge, and concomitant sinking and deposition on its western edge.

The evidence points to early stage fault patterns "inherited" from the local structural grain of the Precambrian basement that pre-dated the principal Red Sea–Gulf of Suez evolution into its dominant N25°W tectonic trend during the Miocene.

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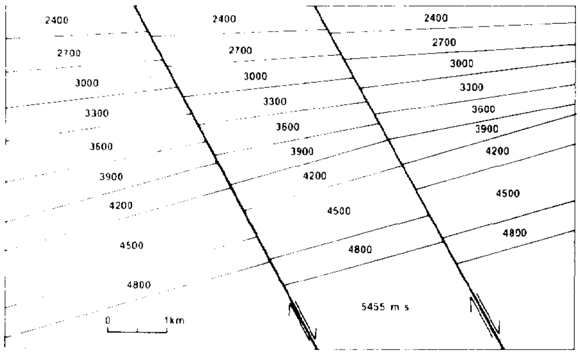
Seismic Reflection Models of Rift-Related Structures

Published field data from several rifted basins indicate that normal faults and associated secondary structures (i.e., minor normal faults, folds produced by drag on fault surfaces, forced folds above faults) are common in rifts. The dip and curvature of the fault surfaces, the fault displacements, the dip of the strata within the fault blocks, and the position and size of the folds vary considerably. Our two-dimensional, seismic-reflection models systematically show how each of these variables, as well as rock velocity, influence the seismic expression of rift-related structures. These seismic models reveal several "pitfalls" of seismic interpretation common to rifts, many of which we have recognized on actual seismic data.

The observed dip and curvature of any fault surface on our unmigrated seismic models depend, not only on the dip and curvature of the actual fault surface, but also on the dip and velocity of the adjacent beds. The observed dip of a fault decreases as the angle between the actual fault surface and strata decreases. For example, normal faults dipping in the opposite direction as the strata appear to have greater dips than identical normal faults dipping in the same direction as the strata. Also, normal faults active during deposition (with beds on the downthrown side having increasing dip toward the faults with depth) appear to steepen

BASIC GEOLOGIC MODEL-FAULTS ACTIVE DURING DEPOSITION



BASIC SEISMIC MODEL-FAULTS ACTIVE DURING DEPOSITION