The Nacatoch Sand, the middle formation of the Navarro Group, consists of marine sandstones and mudstones derived largely from a source area to the north and northeast of the east Texas embayment. Terrigenous clastics were supplied to the Nacatoch basin by two major dispersal systems: (1) a bifurcating northwestern and northern system in southern Hunt and southern Delta Counties, and (2) a northeastern system originating in southwestern Arkansas.

Five facies are recognized in surface exposures of southwestern Arkansas: tidal flat, tidal channel, tidal inlet association, shoreface, and shelf facies. In northeast Texas, a deltaic sequence is recognized in south-central Hunt County, and shelf sandstones and mudstones are present in Navarro and Kaufman Counties.

Nacatoch sandstones in the East Texas basin are significant shallow oil and gas reservoirs. Production of hydrocarbons from the Nacatoch is restricted to the shelf-sand facies. Hydrocarbon occurrence is perhaps more a function of structural closure than depositional facies. Hydrocarbon production is associated with the Van salt dome in Van Zandt County and coincident with the Mexia fault system trend along the western margin of the basin.

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Diagenesis of Deltaic Sandstone: Olmos, San Miguel, and Upson Formations (Upper Cretaceous), Northern Rio Escondido Basin, Coahuila, Mexico

During the Late Cretaceous, the Rio Escondido basin was filled with deposits of lobate deltas that prograded eastward. Three distinct depositional environments can be recognized in the subsurface: delta plain (Olmos Formation), delta front (San Miguel Formation), and prodelta (Upson Formation).

The sandstone of the Rio Escondido basin is predominantly feldspathic litharenite. Major framework grains are quartz (23%), plagioclase feldspar (35%), and volcanic and sedimentary rock fragments (42%). Most of the matrix was formed by compaction of sedimentary and volcanic rock fragments during early burial. Porosity was reduced to 19% by compaction before cementation. Chlorite, the earliest cement, formed thin rims around framework grains and replaced feldspar rock fragments, and matrix. Minor thin quartz overgrowths precipitated next. Extensive calcite cement occluded most remaining porosity by filling intergranular pores and replacing framework grains (chiefly feldspar). Subsequently, widespread dissolution of calcite created 5 to 10% secondary porosity. Kaolinite precipitated next as a pore-filling cement and today is the chief occluder of secondary porosity. Ferroan dolomite replaced most remaining calcite; only remnant calcite is present in the sandstone today. Late-stage cements include local authigenic siderite and pyrite. A final dissolution event locally removed remaining calcite cement or framework grains (feldspar).

Essentially all porosity present in the sandstone today is of secondary and not primary origin. Macroporosity in the sandstone is 5.0% and permeability is 2.6 md. Kaolinite cement, volcanic rock fragments, and matrix contain an estimated 6.5% microporosity. Porosity distribution is patchy and cannot be correlated with depositional facies. Porosity and permeability values do not indicate good reservoir quality in the northern Rio Escondido basin sandstone.

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Future Petroleum Provinces of Gulf of Mexico Region

The Gulf of Mexico area is the fifth largest potential petroleum-producing region in the world, exceeded only by the Arabian (Persian) Gulf basin, the West Siberian basin, the Eastern Venezuela (Maturín) basin, and the Western Canada basin. The last two are larger than the Gulf of Mexico basin because of their enormous tar-sand deposits.

Within the United States, large areas of the west Florida shelf remain unexplored, specifically, the Paleocene and parts of the Mesozoic. In the upper Gulf Coast, the post-Ouachita Pennsylvanian and Permian rocks are promising. Jurassic objectives, particularly the Smackover, require intensive exploration in Texas. Additional Gulf Coast plays of the United States include: westward extension of the Tuscaloosa trend; development of the Austin Chalk play; the drilling of numerous structures still undrilled, in central Louisiana; development of Wilcox marine sandstone plays; and extensive drilling of the salt ridges and domes of the continental slope where large reserves of oil and gas can be expected. There are other plays, but those listed are the largest.

In Mexico, the Upper Jurassic-Lower Cretaceous gas reserves of the Sabinas basin are just being developed. Several score structures remain to be drilled and tested. In the Parras basin, gas should be found in formations ranging in age from Late Jurassic through the Late Cretaceous, possibly extending into the earliest Tertiary. Farther south, Upper Jurassic-middle Cretaceous plays are almost untested in the San José de las Rusias homocline, and the Arenque Jurassic reef play north of the Golden Lane still is undeveloped. A subthrust play extends from north of the Sabinas basin to the mountain front south of the Isthmus of Tehuantepec. Large subthrust fields should be expected, particularly between Monterey and the southwestern part of the Veracruz basin. The full extent of the Reforma-Campeche shelf play, onshore and offshore, still has not been determined. Southeast of the Reforma trend, the Upper Jurassic and Lower to middle Cretaceous of the Chapayal basin remain unexplored. Beneath the Reforma trend and the Chapayal basin is an extremely attractive section of Pennsylvanian and Permian with probable reef development, similar to that of west Texas. Some major Paleozoic structures have been found at depths of less than 3,000 m. Offshore, west of the Campeche shelf, a salt-dome province extends from the Isthmus of Tehuantepec northward to the Sigsbee Knolls, all of which may be prospective. Tertiary turbidites also may be objectives in the deep gulf. Certainly the Mexican Ridge province east of eastern Mexico offers attractive possibilities for future exploration.

Cuba is far less attractive because of its complex alpino-type geology. However, several large structures in Upper Jurassic and Lower Cretaceous carbonate rocks still remain to be drilled in northern and northwestern Pinar del Río province.

Although the entire Gulf of Mexico region can be regarded as having reached the mature stage of exploration, many areas have not even been explored. As a consequence, it is possible that only half of the potential reserves of the entire Gulf of Mexico region have been found.

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Petrographic, Stratigraphic, and Structural Study of Smackover Gray Sand (Jurassic), North Louisiana

The Smackover Gray Sand is the target of intense exploration activity in the north Louisiana area. The gas-producing Gray Sand, a dark gray to black, very fine-grained sand, occurs as three sand tongues in the lower member of the Smackover Formation in the subsurface of Bossier, Webster, Claiborne, and Lincoln Parishes, Louisiana. The majority of Gray Sand wells have been drilled in Bossier and Webster Parishes; however, the most active exploration presently is to the east in Claiborne and Lincoln Parishes.

Samples of the Gray Sand are classified as subchertarenites because of their high percentage of quartz and the dominance of chert fragments over plagioclase. Additional mineral constituents include muscovite and biotite; oolites are also present. A flaser-bedded silty shale facies indicates deposition on a mid-tidal flat environment.

Smackover deposition during the Jurassic in the study area was located on the gently dipping slope between a broad coastal shelf on the north and a basin on the south. The Gray Sand was deposited over the Norphlet Formation and Louann Salt before flowage and swelling of the Louann Salt began. Uplift and swelling of the Louann Salt later in the Jurassic created growing anticlines; sediment slumped off the structural highs of the growing salt anticlines into basinal muds and silts. By superimposing the isopachous map of the Gray Sand interval over the structure map of the Gray Sand, it can be seen that the thickest Gray Sand intervals lie on the flanks of the anticlinal structures in South Sarepta, Ivan, and Cotton Valley fields. Absence of the Gray Sand between Ivan and Cotton Valley fields indicates a facies pinch-out due to localized deposition of sand tongues on the structural highs.

The Gray Sand, because of its low porosity (7 to 10%) and permeability (0.5 md), must be stimulated through hydraulic fracturing to be productive. Extreme bottomhole pressures and temperatures require the use of tailor-made high viscosity gels and high-strength proppants.

In Lincoln Parish fields, favorable structures for Gray Sand production are located by seismic exploration. The Smackover Gray Sand however continues to challenge exploration geologists because of the lateral pinch-out of its sand tongues.

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Nearshore Bars Along United States Gulf Coast

The microtidal, low-wave energy, United States coast of the Gulf of Mexico is characterized by an abundance of shoreface bars. Four distinct component bars can be identified, though interference patterns exist. Vertical air photos since 1945 and numerous overflights and field measurements during the last two years have shown that the equilibrium bar configuration at any given site is time-invariant. During storms, however, the bars go through cycles of change in a manner similar to those identified by Short.

Based on plan geometry the following four bar types are identified.

Multiple (10 or more) longshore bars—Multiple longshore bars, without interference from other bar types, occur on the low-tide platform in front of a steep beach face, along shoreline segments of convex plan form and low wave energy. The bars have a sinusoidal cross-profile, constant height, and constant spacing suggesting that they form in response to a standing wave pattern established through interference between incident wind waves and waves reflected from the steep beach face.

Transverse bars—Bars oriented at steep angles relative to the shoreline dominate in low energy environments (Mississippi Sound and other sheltered embayments) along the central Gulf coast. Intersecting transverse bars, forming an overall rhombic pattern, dominate the lagoonal platform behind the Mississippi-Alabama barrier chain. The mainland shoreface of Mississippi Sound, however, is dominated by intersecting transverse and multiple longshore bars.

Generally, transverse bar spacing appears to be proportional to bar amplitude. The transverse bar morphology reflects a complex interaction between incident, high-frequency waves and the resultant longshore currents.

Crescentic bars—The Gulf beaches of barriers and spits of the Florida panhandle, Alabama, and Mississippi are characterized by crescentic bars or single longshore bars. The crescentic form is best developed adjacent to, or between, shore-normal structures which might be jetties, groins, or natural headlands. This suggests that the crescentic bar morphology forms in response to a wave motion transverse to that of the incident waves, i.e., edge waves which are expectedly best developed trapped between reflecting shore-normal structures.

Longshore bars—These bars characterize the entire Texas coast and many Louisiana barriers. This coastline has the highest wave energy in the study area. The constant crest-to-trough water depth ratio, the asymmetric cross-profile, and the landward decrease in size and spacing suggest that these are breakpoint bars.

These four component bars, all resulting from different mechanisms of generation, occur either individually or in different patterns of superposition creating six commonly observable bar morphologies along the Gulf Coast barriers and mainland shores. Specific coastal subenvironments are characterized by time-invariant equilibrium bar configurations.

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Late Paleocene Planktonic Foraminiferal Biostratigraphy of Tuscahoma Marls, Southwest Alabama

Using vertical distribution of planktonic foraminifers