Since the initial discovery of hydrocarbons in Jurassic strata in the 1930s, rocks of this age have produced prolific amounts of oil and gas. Most of the exploration, and all of the production to date, have been in Upper Jurassic strata above the Louann Salt. This "post-salt" section appears to provide significant future Jurassic hydrocarbon potential. Available well control fails to provide favorable clues to reservoir potential at reachable depths in "pre-salt" Jurassic rocks.

The Smackover, Haynesville, and Schuler Formations have provided most of the Upper Jurassic production predominantly from relatively simple structural traps (anticlinal and fault closures). Exploration for these traps will continue along the entire length of the Jurassic trend with the emphasis of the search being intensified in sparsely drilled areas such as South Texas and the trend from Mississippi eastward to Florida. More complicated structural traps (*e.g.*, the flanks of salt piercements), combination structural-stratigraphic traps, and wholly stratigraphic traps offer increasing potential in the well-developed area of East Texas, southern Arkansas, and North Louisiana. Stratigraphic traps are important in the Schuler Formation.

Other formations such as the Denkman Sandstone, Cotton Valley Limestone, and Knowles Limestone are prospective at least within local areas. These units have not been heavily explored to date, but may provide important reserves in the future.

Reservoir variability, differing gas quality, and area of deep drilling depth add to the cost and risk of finding profitable hydrocarbons in much of the Jurassic province; however, it is anticipated that significant reserves will be discovered in the sparsely developed areas to justify the exploration. The essentials for entrapment that have resulted in important accumulations in the well-developed areas also are present in the sparsely drilled areas.

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CAUSES OF DOMINANTLY ARENACEOUS FORAMINIFERAL ASSEMBLAGES IN DOWNDIP WILCOX OF LOUISIANA

Studies of cores and cuttings from 9 wells reveal a predominantly *Haplophragmoides-Trochammina-Ammomarginulina* assemblage. *Spiroplectammina, Bigenerina,* and *Bathysiphon* are less common. These forms are best represented in the more shaly and deeper water intervals of a marginal, shallow, marine section deposited under the influence of intermittently active deltaic conditions. Foraminifera, lithology, minerals, sedimentary structures, and electric-log character reflect persistently shallow and turbid water with low-oxygen and high-organic content resulting in a reducing paleoenvironment. The water chemistry inhibited $CaCO_3$ formation and the presence in quantity of calcareous Foraminifera. An abundant supply of clastic material and the lack of competition from calcareous types caused arenaceous Foraminifera to prevail in Wilcox microfossil populations.

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UPPER CRETACEOUS-CENOZOIC PALEOBATHYMETRIC CYCLES, EASTERN PANAMÁ AND NORTHERN COLOMBIA

Analysis of planktonic microfossils and benthic Foraminifera indicates 1 deep-water depositional cycle in the Late Cretaceous of northern Colombia and 2 major deep-water sequences in the Cenozoic of both northern Colombia and eastern Panamá. Only slight evidence of a Late Cretaceous deep-water cycle was found in eastern Panamá. The Upper Cretaceous deep-water cycle in the radiolarian-rich Campanian sequence of northern Colombia is characterized by a *Dictyomitra multicostata* radiolarian assemblage. Deep-water or abyssal depths of the next younger cycle (upper Paleocene-lower Eocene) are suggested by a *Pleurostomella-Nuttallides* fauna in combination with a rich radiolarian assemblage. A third abyssal sequence or cycle, in middle Oligocene to lower Miocene strata, is indicated by a *Melonis pompilioides* fauna together with a rich radiolarian assemblage.

The shallowest water facies, separating the deep-water cycles, represent mostly neritic or upper bathyal depths. These are characteristics of the basal Paleocene, the upper Eocene-lower Oligocene, and the upper Miocene through Quaternary sequences of eastern Panamá and northern Colombia. Locally, unconformities and/or nonmarine beds may represent these geologic ages.

In contrast to the deep-water cycles of eastern Panamá, the sections of the Gatún Lake area west of the Río Limón fault show relatively shallow-water marine facies (neritic to upper bathyal depths at the most). These shallow-marine facies are present in the Eocene, upper Oligocene, and upper Miocene-Pliocene sections. They are separated by either paralic beds or unconformities. Faults, such as the Río Limón fault, separate tectonic blocks that have contrasting stratigraphic and depositional records throughout most of the Cenozoic.

In eastern Panamá and northern Colombia, the shallowest water zone of each paleobathymetric cycle may represent times conductive to the migration of land faunas. These times are latest Cretaceous-earliest Paleocene, late Eocene-early Oligocene, and Pliocene and Quaternary.

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CRITERIA FOR IDENTIFICATION OF SEDIMENTARY ENVIRONMENTS IN RESERVOIR SANDSTONES

The interpretation of depositional environments for reservoir sandstones requires a knowledge of primary rock properties: composition, texture, sedimentary structure, and morphology. Each property has special significance in interpretation. Compositional and textural changes in vertical sequence are the most important criteria, but because these properties are interdependent, composition alone may be a key indicator of environment. The use of compositional criteria is illustrated by the Lower Cretaceous Muddy Sandstone in the Powder River basin, Wyoming and Montana, where fluvio-deltaic and marine-bar sandstones are clearly separated by compositional differences. Sedimentary structures are also significant. Largely on the basis of bedding, Muddy barrier island strata can be divided into 4 distinct subenvironments even though the unit is only 25 ft thick. These facies represent lower shoreface, middle shoreface, beach-upper shoreface, and dune environments. Morphology of sandstone bodies, commonly suggests environment of deposition, but this criterion is the least reliable unless it is applied with a knowledge of other rock properties.

The interpretation of morphology is commonly the principal exploration problem in stratigraphic traps. Where details of rock character are absent, the secondary properties of porosity and permeability may reflect compositional and textural changes because these

properties are largely dependent on the primary properties.

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COMPOSITION OF SOME MIOCENE AND HOLOCENE PLANKTONIC FORAMINIFERAL ASSEMBLAGES

The composition of planktonic foraminiferal assemblages varies with depth in the upper few hundred feet of the present oceans. Empirical data show similar composition variations for early Miocene planktonic foraminiferal assemblages in the south Louisiana subsurface. Two variables most closely related to these changes appear to be (1) water temperature as a function of latitude and (2) water temperature as a function of bathymetry. Thus, planktonic foraminiferal assemblage compositions can be used to interpret paleobathymetry of marine strata at least as old as early Miocene.

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EPI-PALEOZOIC HYPERSALINITY AND MARINE BIOTIC EXTINCTIONS

From consideration of the volumes of halite and associated salts deposited since the Permian, one must infer that either seawater at the close of the Paleozoic was hypersaline compared with seas of today (35‰ salinity); or, although 6 million cu km or more of salt has been precipitated from the world ocean in highly varying amounts at irregular intervals since the Permian, an equal volume of salt has gone into solution. Data from analysis of sedimentary sulfur-isotope ratios strongly support the former inference. Concordant, but more speculative, support also is available from aridity indices.

A condition of hypersalinity in the oceans during the Permian Period would explain the known patterns of Permian extinctions. Evidence suggests that those marine taxa (*e.g.*, echinoderms, fusulines, coelenterates) with the lowest tolerance for salinity variability were the group within the entire Permian biota that suffered the greatest proportion of extinctions at the close of the Paleozoic. Such an explanation is more consistent with a uniformitarian earth than causes sought in cosmic radiation variability or pulses, which should have affected terrestrial organisms more strongly than marine taxa.

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GRAND ISLE—BARRIER ISLAND IN GULF OF MEXICO

Grand Isle is part of a barrier-island chain along the coast of southeastern Louisiana. It separates the estuarine environment of Barataria Bay from the marine environment of the Gulf of Mexico. The island is 7½ mi long and about ½ mi wide.

Mechanical analyses of 102 surface samples indicate that the island is composed of fine-grained terrigenous sand, silt, and clay, with a minor percentage of shell material. Median grain diameters range from 0.166 mm for beach sands to 0.005 mm for isolated clay pockets of the back-island area. Grain-size isopleth maps demonstrate a parallelism of grain-size characteristics with sedimentary features and environments such as the beach, dunes, ridges, and interridges. They also demonstrate an increase in the size of beach sand on the southwest. Beach and dune sands are well sorted. Ridge and interridge sediments contain a higher percentage of silt and clay and exhibit poorer sorting. Organic content of representative sediment samples ranges from 0.20 to 9.08%.

The high oxidation environments of the beach and dunes generally have the lowest organic content. Carbonate content in the form of shell material ranges up to 4.2% with the smaller grain-size sediments generally having a higher carbonate content.

The subsurface stratigraphy was studied using 127 soil-boring logs. All strata found by the borings (to a maximum depth of 320 ft) were Holocene sand and clay. The oxidized Pleistocene contact is interpreted to be at a depth of 400 ft as determined by deeper borings on nearby islands. Four Holocene sands are recognized in this subsurface section. The deepest sand, interpreted to be a Holocene transgressive unit, is 120–170 ft thick. The maximum thickness of 3 shallower sands is 43 ft, and the average thickness is 10–20 ft. The three upper sands are fine to very fine grained. The deepest sand is fine to coarse grained. Typical silty prodelta clays and highly plastic offshore clays are found between the sand beds.

The Grand Isle beach has an average seaward slope of 2½°. A low dune ridge runs almost continuously behind the beach. Approximately 25 sets of relict beach and dune ridges can be identified behind the active dunes. These sets trend nearly parallel with each other and with the present beach. The ridges are 35–100 ft wide and are 3 ft or less high.

The sediments to a depth of 100 ft are interpreted to be related to deltaic progradation of the ancestral Mississippi River. This deltaic progradation began about 5,600 years ago when sea level reached a stillstand. The Lafourche delta formed west of Grand Isle about 2,000 years ago. As wave action attacked the delta front, sediment was carried northeastward by littoral currents. A barrier spit was constructed in the mouth of Barataria Bay. The barrier spit was eventually breached by a narrow tidal channel. From this original nucleus island, Grand Isle has grown by beach and dune-ridge accretions.

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PALEOECOLOGY AS EXPLORATION TOOL

Paleoecology, properly interpreted and applied, can serve as a valuable tool in any exploration program. To be interpreted properly, it is of prime importance that standard criteria for paleoecologic data be used without attempting to alter the data obtained to fit preconceived ideas.

In order that the data developed may be presented uniformly and be consistent with other available information, Paleo-Data, Inc., uses the general criteria and depth zonation suggested by the Gulf Coast SEPM Committees on Paleoecology.

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DEPOSITIONAL SYSTEMS IN JACKSON GROUP OF TEXAS GULF COAST BASIN

Regional outcrop and subsurface investigation of the Jackson Group in Texas indicates development of 5 main depositional systems. Dominant element in the central and east Texas Gulf basin (bounded by Guadalupe River on the south and Neches River on the