davisi zone and above the Abbeville facies of the Anahuac Formation. The *Planulina* interval is present in the subsurface along a narrow band extending from Lake Verret in Assumption Parish westward through Cameron, Louisiana, into coastal Texas.

The first discovery of gas in *Planulina* sandstones was made in 1945 by Magnolia Petroleum Company in Mud Lake field, Cameron Parish, Louisiana. By 1963, after 18 years of exploratory effort, there were only 4 significant *Planulina* fields. Operations were hampered by elusive structures, erratic sands, extreme correlation problems, high pressures, high drilling costs, inadequate seismic resolution, and a general lack of understanding of the geologic setting. During the past 8 years a sharp increase in success has changed a "bad" trend into one with promise of substantial new gas reserves. Modern drilling technology and CDP seismic techniques were responsible for this success, and the additional control has resulted in a better understanding of the geology.

Planulina sands are believed to have been deposited along the outer edge of a narrow continental shelf. Marine transgression in "late *Planulina* time" shifted the axis of deposition northward. Consequently, the next younger cycle of deposition and associated growth faulting lies north of, and updip from the *Planulina* trend. Because of this shift in the axis of sedimentary loading, growth of many *Planulina* structures ceased in "late *Planulina* time" and were buried by transgressive shale.

Typical *Planulina* structures are anticlines and northward-plunging, faulted noses buried beneath south dipping sediments. Where younger beds are also productive their structural crest generally is well removed from the apex of the *Planulina* structure. *Planulina* structural crests are commonly, though not exclusively, north of the shallow structure or in the upthrown fault block. Some salt domes and high relief uplifts have *Planulina* sandstone pinchouts on the north flanks.

Within the *Planulina* trend stratigraphy plays a vital role in hydrocarbon entrapment and modified stratigraphic traps are common.

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CONTRIBUTION OF JOIDES TO OUR GEOLOGIC KNOWLEDGE OF GULF OF MEXICO

The coring of deep-water sediments in the Gulf of Mexico during Legs I and X of the JOIDES program has contributed significantly to our knowledge of the Gulf's geologic history. The nature of Sigsbee scarp is still not known with certainty, but the results of drilling holes 1 and 92 suggest that both "contemporaneous normal faulting" (perhaps overbuilding and downslope movement) and salt tectonics may be involved.

Drilling results from holes 3, 85, 87, 90, and 91, indicate that formation of the present Sigsbee plain includes late Neogene subsidence and, prior to the Pliocene, a more westerly source for coarse terrigenous clastic debris than the Mississippi River. The discontinuous record of deep-water sedimentation since the end of Early Cretaceous time, found in holes 86, 94, 95, 96, and 97, suggests a complex structural history of block tilting and faulting for the banks and scarps. This may include a Late Cretaceous seaway, and its reemphasis as the present Yucatán Channel–Florida Strait as late as Pleistocene. Correlatibility of the discontinuities bounded above and below by deep-water sediments may require some more comprehensive explanation than slumping and submarine current removal of sediments.

Perhaps worthy of note, is the possibility that the overly publicized recovery of hydrocarbons from Challenger Knoll in the Campeche embayment salt-tectonic province (hole 2) affected the extenders of the JOIDES program, thus helping to make Leg X cruise possible. Drilling during this cruise, in turn, under the influence of changing political winds, contributed to the pollution-scare, thwarting the original Leg X goals. Many of our basic questions have not been answered adequately by JOIDES work, but we are, at least, aware of many more questions.

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ENVIRONMENTAL CONTROLS OF BENTHIC MACROFAUNAL PATTERNS IN GULF OF MEXICO ADJACENT TO MISSISSIPPI DELTA

Two communities of shelled benthic macrofauna are recognized south of the Mississippi delta by means of cluster analysis. The faunal pattern is correlated closely with water depth, pelecypod feeding type, and substrate texture. Correlation of faunal, lithologic, and environmental characteristics reflects joint sedimentation and biotic production in response to the present hydrologic regime.

East of the Mississippi delta, 8 communities of benthic shelled macrofauna are recognized by means of cluster analysis. Distribution patterns of these communities (biofacies) appear to reflect the primary environmental factors controlling the nature of the water mass: distance from the delta front; water depth on the shelf away from the influence of the delta; and subdivision of the shelf by the Chandeleur-Breton islands. Faunal and substrate patterns are poorly correlated; histograms of sediment texture for each of the biofacies are not significantly different from the histogram of sediment texture for the whole area. The poor correlation of fauna with substrate texture is the result of the formation of the substrate distribution pattern during deposition of the St. Bernard delta. Faunal distribution patterns are determined primarily by the environmental factors controlling present water-mass characteristics and only secondarily by the relict substrate texture pattern. If preserved in the geologic record, the co-occurring fauna and sediments would represent 2 different periods of deposition.

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ORIGIN OF CABO ROJO BEACH-RIDGE PLAIN, VERACRUZ, MEXICO

The Cabo Rojo beach-ridge plain was formed in a low-energy shadow behind the Blanquilla-Lobos coral-reef tract. The source of the sand comprising Cabo Rojo was offshore material of Wisconsin (?) age, most probably deposited by the Río Panuco during a lower sea-level stand. Islands within the Laguna de Tamiahua define a sandstone body similar in shape and orientation to that of Cabo Rojo, strongly suggesting either a 2-stage Holocene constructional history, or the remains of a pre-Wisconsin barrier.

The beach-ridge plain consists of low, hummocky ridges (relief less than 1 m, spacing of 100 m) oriented parallel with the present coast. This coast is undergoing erosion, and beach ridges are *not* forming. Cliffed, back-beach dune ridges are found on the northern and

southern parts of Cabo Rojo, the northern ridges being best developed. Longshore drift compartmentalization has been effected along this coast by the Blanquilla-Lobos offshore reef tract.

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THEORETICAL APPROACH TO HISTORY OF SOUTHERN UNITED STATES

The hierarchical plate hypothesis of geologic history includes the concept that the North American continental block has been circling the Pacific Basin plate in a counterclockwise sense and rotating in the same sense, with an approximate period of 10^9 years. Implications inherent in the hypothesis, for comparison with the actual history of North America during its latest 10^9 years of development, include the following.

1. *Climate.*—Continental glaciation about 10^9 years ago; warming during late Precambrian. Tropical during Paleozoic; much carbonate deposition; widespread coal in late Paleozoic. Cooling during Mesozoic and Cenozoic, climaxing in new glaciation.
2. *Appalachian Mountains.*—Left lateral movement plus compression during Paleozoic. Right lateral movement plus tension during Mesozoic and Cenozoic.
3. *Carribbean.*—Developed initially about end of Paleozoic—beginning of Mesozoic. Strike-slip margins on north and south.
4. *Gulf of Mexico.*—Tensional feature; developed initially about end of Paleozoic-beginning of Mesozoic.
5. *Sedimentation.*—Major drainage toward south (ambient coordinates), producing very large sediment volumes in Gulf of Mexico.
6. *Depocenter.*—Shifting location toward north and east, from Texas into Louisiana, due to continental rotation during post-Paleozoic.
7. *Stream patterns.*—Reorientation, due to continental rotation, through Mesozoic and Cenozoic in clockwise sense for first-order drainage, counter-clockwise for second-order drainage in mid-continent area; much piracy.
8. *Eastern and western margins.*—Lateral shrinking subsidence, and formation of north-south grabens, during post-Paleozoic.
9. *Diapirism.*—Dikes, plugs, volcanoes, and salt domes (where salt was available) along western, southern, and eastern margins, during Mesozoic and Cenozoic.
10. *Probable geosyncline.*—Short-lived, late Paleozoic age; near southern edge of continent; orientation now northeast-southwest.

These predictions compare favorably with the actual history of the continent.

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TABASCO BEACH-RIDGE PLAIN: AN ERODING COAST

The beach-ridge plain in the state of Tabasco, Mexico, is undergoing erosion today. It has not been growing for at least 50 years, and perhaps for as long as several centuries. Ten lines of evidence, including some severe limiting dates, substantiate this analysis. The numerous beach ridges, however, indicate that, prior to the present epoch, there was a long interval of growth. The area has gone through a late Holocene history having 2 main parts: (1) a littoral economy of abundance of sand, during which the beach-ridge plain was built; and (2) a littoral economy of scarcity of sand, during which the edge of the plain has been attacked by erosion.

This history coincides with that of other beach-ridge plains in North and South America. We conclude that the equilibrium beaches of the world have undergone a shift in the last few centuries, or are now undergoing a shift, from dominant deposition to dominant erosion. The problem of essentially worldwide coastal erosion is, therefore, increasing.

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OSTRACODA OF COASTAL GROUP OF FORMATIONS OF JAMAICA

Traditionally the group of formations that crops out along the northeast, east, and southeast coasts of Jamaica, has been divided into an upper and lower part. The upper, of Pleistocene age, includes the Manchioneal Formation with the Navy Island Member, and the beds in the upper part of the Bowden section. The lower part, at least partly of Pliocene age, includes the Bowden Formation, the San San clay, the Buff Bay Formation and overlying beds in the Buff Bay section, and the August Town Formation.

Correlation of 8 different sections by means of ostracods shows some discrepancies with Blow's correlation, based on planktonic forams. Distribution of ostracods in the August Town Formation suggests that its age is older than that of the Bowden shell bed. The overlying Harbour View beds are brackish-water deposits. A new species of *Cyprideis*, with reversal of overlap and hinge, has been found.

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GEOLOGY OF FREEPORT ROCKS, OFFSHORE TEXAS

The Freeport Rocks, a linear trend of isolated, submerged rock pinnacles about 6 mi offshore from Freeport, Texas, were studied by SCUBA diving, petrographic techniques, and carbon-14 dating. They have been interpreted previously as a relict beach which developed about 30,000 years B.P.

The present study indicates the environment of deposition was an offshore bar or barrier island composed predominantly of reworked material from the underlying Beaumont Formation. Diagenetic features include cementation by low-Mg calcite (in the form of druse and blocky cement) and inversion of aragonite shells to low-Mg calcite. The diagenetic features suggest that the deposit subsequently was exposed subaerially and cemented by low-Mg calcite. Because much of the original shell material was neomorphosed during diagenesis, carbon-14 age determinations may not give the age of the deposit. Thus carbon-14 dates were interpreted in light of the neomorphism and suggest that deposition of the Freeport Rocks was less than $15{,}857 \pm 268$ years B.P. This information, combined with data from various eustatic sea level curves, strongly suggests that the Freeport Rocks were deposited during the stillstand of the transgressing Holocene sea between 7,500 and 8,200 years B.P.

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REGIONAL STRUCTURE, STRATIGRAPHY, AND OIL POSSIBILITIES OF SOUTH FLORIDA BASIN

The South Florida basin is part of the larger Florida-Bahama platform province, a slowly subsiding area.