includes eight hydrocarbon fields, a geothermal prospect, and two viable prospects. The areas of migration are most likely to occur at areas of structural expansion, i.e., at grabens, crests of diapirs, or at the intersections of faults. The latter appears to be especially important as eight of the twelve areas of migrations are near fault intersections.

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Effects of Hurricane Frederic on Morphology of Dauphin Island, Alabama

Hurricane Frederic made landfall at Dauphin Island, Alabama, on September 12, 1979. With property damage estimates as high as $2 billion, Frederic represents the costliest natural disaster in United States history.

Most of the destruction caused by Frederic was due to winds up to 65 m/s (126 knots), storm-surge (3.1 m above mean sea-level) flooding, beach erosion, and overwash. The latter of these three factors was the most significant in terms of property damage.

Photographic overflights, ground surveys, and inspection of structures after the hurricane all led to the conclusion that damage was controlled by the following features: (1) nearshore bathymetry, (2) relative elevation of different parts of the island, (3) location and orientation of pre-storm canals and driveways, and (4) placement of house-support pilings.

The ebb-tidal delta of Mobile Pass dominates the nearshore bathymetry of eastern Dauphin Island. Extending several kilometers offshore, this delta platform produced shoaling and breaking of storm waves offshore, and thus spared the eastern part of the island from more intense wave attack. However, immediately west of the delta, wave refraction and focusing produced the highest beach retreat (40 m) of any place on the island.

Dauphin Island exhibits two distinct physiographic divisions. The eastern fifth of the island is composed of a Pleistocene core topped by high dunes, with elevations over 10 m. This area escaped much of the destruction of the storm, receiving only relatively minor wind damage. The western four-fifths of Dauphin Island consists of a low-lying Holocene spit, which was completely inundated by the passage of Frederic. The overwash of this part of the island resulted in damage to virtually every building and complete destruction of many.

Streets and canals which ran perpendicular to the beach on the Holocene spit served as initial passageways for storm-driven water. These areas developed into the major overwash channels and were responsible for the most intense property damage.

Numerous small overwash channels were found to have developed in the lee of house-support pilings. Presumably scour was enhanced by the turbulence of water flowing around such pilings. In areas of high building concentration, this effect was most pronounced and caused significant damage.

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Biostratigraphic Significance of Fossil Molluscan Larvae

Most marine mollusks have some form of pelagic larval stage which produces a distinctive protoconch. Scanning electron microscope studies reveal that larval shells are routinely preserved in sediments as old as the Upper Cretaceous, and that protoconchs are characteristic enough to identify to species on the basis of the unmetamorphosed larval shell. This has paleoecologic and biostratigraphic potential in cores where only a few identifiable adult mollusks are normally found. In addition, larval shells are carried by water currents to areas not inhabited by the adults, extending the species geographic range and partly eliminating facies dependence. Fossil mulluscan larvae are, therefore, a potentially valuable new micropaleontologic group.

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Louisiana Tuscaloosa Versus Southeast Texas Woodbine

The deep Tuscaloosa play extending across south-central Louisiana has resulted in the recent discovery of large gas reserves. This same downdip lower Upper Cretaceous interval, known as the Woodbine in southeast Texas, extends into Texas across Newton, Jasper, Polk, and Tyler Counties. Although well control is sparse through this interval in southeast Texas, available data suggest a different depositional and structural setting for the lower Upper Cretaceous interval. No thick units of sands are within the interval, and most of the production has been found in stratigraphic traps exhibiting thin sands, as in the Seven Oaks field.

Subsurface studies of the lower Upper Cretaceous interval across south-central Louisiana and into southeast Texas indicate it is unlikely the Louisiana Tuscaloosa play will extend into the southeast Texas area. However, there is sparse downdip control in Texas south of the Lower Cretaceous shelf edge and it is, therefore, possible that some sands have been deposited subparallel to the shelf. The best area to explore for this possibility would be south of the 1,000-ft Tuscaloosa or Woodbine isopachous contour which extends across southeast Texas.

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Pressure, Temperature, Salinity, Lithology, and Structure in Hydrocarbon Accumulation in Constance Bayou, Deep Lake, and Southeast Little Pecan Lake Fields, Cameron Parish, Louisiana

Pressure, temperature, salinity, lithology, and structural studies indicate that hydrocarbons in Deep Lake, Constance Bayou, and Little Pecan Lake fields were generated in the shale beds of the hard geopressured zone and migrated upward along major growth faults. The hydrocarbons were originally dissolved in hot fresh pore water and came out of solution in the overlying low temperature and pressure zones, accumulating in the sand beds of the first structural traps encountered. By examining regional cross sections and anomaly maps, fluid escape routes taken by the hot pore water containing dissolved hydrocarbons can be identified. Areas below which a vertical flush of hot fresh pore

water from the hard geopressured zone has occurred have three identifying characteristics: low fluid pressures, high formation-water salinity values, and residual high pressure areas. These areas are considered to be highly prospective places to search for hydrocarbon accumulations. In the study locality there are five areas below which a vertical flush has occurred from the hard geopressured zone and each area contains commercial accumulations of hydrocarbons.

Pressure, temperature, and salinity studies, when coupled with lithology and structure, add a new dimension to hydrocarbon exploration and should definitely be used in the search for new reserves of oil and gas.

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Ostracode Biostratigraphy of Lower Oligocene (Vicksburgian), Mississippi and Alabama

Ostracodes are abundant and diverse in most samples collected from clastic and carbonate facies of the Vicksburg Group (Mint Spring, Marianna, Glendon, Byram, and Bucatunna Formations) and the underlying Red Bluff and Bumpnose Formations. About 92 species have been identified from 125 samples collected from measured sections and cores from Mississippi and western Alabama. Graphic correlation, no-space graph, and principal coordinate analyses of the data have resulted in a zonation that allows more precise correlation of the lithostratigraphic units than heretofore existed in the literature.

The sequence is divided into three successive first-appearance interval zones, defined, oldest to youngest, on *Actinocythereis dacyi, Aurila kniffeni,* and *Actinocythereis rosefieldensis.* The top of the *A. rosefieldensis* Zone is defined by the first appearance of *Leguminocythereis quadricostata.* In Mississippi, the Red Bluff is placed in the *Actinocythereis dacyi* Zone; the base of the *Aurila kniffeni* Zone is approximately coincident with the base of the Mint Spring; and *Actinocythereis rosefieldensis* first appears in the upper part of the Glendon. The Byram and the Bucatunna, where it is fossiliferous, are included in the *Actinocythereis rosefieldensis* Zone. In western Alabama, the basal carbonate rocks of the Oligocene, commonly referred to the Red Bluff by other workers, are here considered to represent the westernmost extent of the Bumpnose; the overlying dark clays, usually referred to the nonmarine to brackish or nearshore marine Forest Hill, are here placed in the Red Bluff. Both the Bumpnose and Red Bluff represent the *Actinocythereis dacyi* Zone. The ostracode data suggest that the Mint Spring and the lower part of the overlying Marianna of western Alabama are older than the Mint Spring of Mississippi and therefore correlate with the Forest Hill. This correlation is confirmed by analysis of occurrence data for the *Pecten perplanus* lineage. The upper part of the Marianna in western Mississippi is included in the *Aurila kniffeni* Zone. No ostracodes were recovered from the Glendon in western Alabama; *Actinocythereis rosefieldensis* is first found in the Byram.

Published and unpublished planktonic foraminifer data indicate that the *Actinocythereis dacyi* and *Aurila kniffeni* Zones are approximately correlative with the *Cassigerinella chipolensis–Pseudohastigerina micra* Zone (= P18 and P19). The *Actinocythereis rosefieldensis* Zone approximates the *Globigerina ampliapertura* Zone (= P20). Published calcareous nannofossil data indicate that the *Actinocythereis dacyi* Zone closely approximates the *Ericsonia subdisticha* Zone NP21). The *Aurila kniffeni* and lower *Actinocythereis rosefieldensis* Zone correlate with the *Sphenolithus predistentus* and *Helicopontosphaera reticulata* Zones (NP22 and NP23, undifferentiated). Ostracode and calcareous nannofossil data from South Carolina indicate that the base of the upper Oligocene *Leguminocythereis quadricostata* Zone, and, therefore, the top of the *Actinocythereis rosefieldensis* Zone, is within the calcareous nannofossil *Sphenolithus distentus* Zone (NP24). The upper part of the *Actinocythereis rosefieldensis* Zone and the lower part of the *Leguminocythereis quadricostata* Zone are apparently represented in Mississippi and western Alabama by the unconformity between the Bucatunna and the overlying Chickasawhay Formation. The latter formation is of late NP24 and late *Leguminocythereis quadricostata* Zone age.

A study of the distribution of ostracode genera thought to be cogent environmental indicators and a species of *Trachyleberidea* that has trefoil surface ornamentation indicates that the entire sequence below the Byram in western Alabama was deposited in relatively deep waters, that is, probably at outer sublittoral depths. This sequence includes the Red Bluff clays previously thought to represent an eastward tongue of the deltaic Forest Hill Formation. In western Mississippi, deeper water indicators are present in the upper part of the Mint Spring through Glendon interval, but they are not dominant. The lower part of the Mint Spring and Byram are dominated by inner sublittoral forms. In eastern Mississippi, the Red Bluff, Mint Spring, Marianna, and Glendon represent open-marine, probably middle sublittoral, sedimentation. No ostracodes were obtained from rocks that could unequivocably be said to represent the Forest Hill Formation. The Byram in eastern Mississippi and western Alabama was deposited at inner sublittoral depths, as was the marine part of the Bucatunna. The presence of *Jugosocythereis* in all the shallow-water facies strongly suggests that tropical to perhaps subtropical conditions prevailed during deposition of these Vicksburgian sediments.

Seven new species are proposed: *Ghardaglaia obovata* Mumma, *Hermanites moorei* Hazel, *Leguminocythereis quadricostata* Mumma and Hazel, *L. alata* Hazel, *L. edwardsae* Hazel, *Patellacythere comptonae* Hazel, and *Loxoconcha pseudoinflata* Huff and Hazel.

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Paleoenvironments and Trace Fossils of Large Aggrading Delta Margin Embayment—Upper Woodbine Formation of Northeast Texas

The broad Lewisville embayment of northeast Texas covers an area of 30,000 sq km and developed during the latter half of Cretaceous (Cenomanian) Woodbine deposition as a result of reduced clastic influx and bypassing of sediment toward the south, where deltaic sys-