hydropressured, sandy, updip facies of the Tuscaloosa. Thus, reverse osmotic effects are probably unimportant. The head peak above the Lower Cretaceous shelf edge, although characterized by relatively low hydraulic gradients, could be a locus of membrane filtration at the top of Tuscaloosa sandstone if bypassing of reverse osmosis by fluid escape along faults has been minimal. The role of permeable Tuscaloosa sandstone as a sink for fluids near the top of geopressure may have localized gas along the producing trend.

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Foraminifers of Lower Ojinaga Formation (Cretaceous), Southern Quitman Mountains, Hudspeth County, Texas

Three partial sections of the lower Ojinaga Formation were measured in the southernmost Quitman Mountains, near the Rio Grande. The lower Ojinaga is composed largely of medium-gray to black, variably calcitic shale, except for dark, flaggy, calcarenitic limestone and shale in the basal 20 m and for a few thin limestones and a dolomite above. Thirty-two residues and 75 thin sections were studied.

The foraminiferal populations are overwhelmingly planktonic; plankton-benthos ratios exceed 99:1 without exception. The fauna consists primarily of *Hedbergella amabilis* Loeblich and Tappan, *H. brittonensis* Loeblich and Tappan, *H. delrioensis* (Carsey), *H. planispira* (Tappan), *H. simplex* (Morrow), *Rotalipora cushmani* (Morrow), *R. montsalvensis* Mornod, *R. brotzeni* (Sigal), and *R. greenhornensis* (Morrow), although *Heterohelix* occur sporadically and poor preservation obscures possible *Praeglobotruncana* and *Whiteinella*. In addition to foraminifers, calcispheres and radiolarians equal or exceed the foraminifers in many samples. In varying proportions, the three taxa form minute laminae, commonly microscopically cross-bedded and disconformable in the calcarenitic biogenic limestones. Juvenile ammonites and protoconchs are common at the top of the section. Inoceramid prisms, oyster fragments, and fish debris occur in the coarser and thicker laminae.

The sequence sampled is generally correlative with the middle and upper Cenomanian and the lower Turonian. A more precise correlation suggests middle Cenomanian and lower Turonian with an intervening unconformity, although the taxonomic foundation is questionable.

The microfauna is markedly pelagic and typical of midbathyal or deeper depositional environments. The dark color and general lack of bioturbation suggest the possibility of bottom anoxia and consequent absence of benthic forms, but tests for organic carbon show only a modest elevation of total organic carbon, with a maximum of 2.7%.

The microscopic sedimentary structures of the biogenic flaggy limestones testify to gentle but definitely tractional current action at bathyal depths.

MITCHELL-TAPPING, HUGH J., Sun Expl. & Prod. Co., Dallas, TX

Petrology of Sunniland, Forty Mile Bend, and Bear Island Fields of South Florida

The Sunniland and Forty Mile Bend fields were the first two oil producing fields of south Florida. The Sunniland field was discovered in 1943, and the Forty Mile Bend field was discovered 10 years later. These two fields are oil productive from the Cretaceous Sunniland formation, and their pay zones are biostratigraphically and lithologically similar. A similar lithology is also found in the pay zone of the Bear Island field, discovered in 1972. The relatively great time span between field discoveries is indicative of the slow pace of exploration in south Florida at that time. In the early 1970s, increased drilling (from 2 to more than 15 wells/year) resulted in the discovery of eight more fields. Since exploration started 73 years ago, only a little over 200 wells, both wildcat and development, have been drilled in this basin. Although exploration methods initially relied on gravity and magnetics, subsequent geophysical methods have proved disappointing. Effective exploration in this area applies to petrology, sedimentology, and electric-log response. Because the biostratigraphy of the Sunniland formation pay zone is not the same in all fields, three fields having similar biostratigraphic pay zones were investigated.

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Magnetotelluric Soundings in Ouachita Thrust Belt of Central Texas

A 25-station, 84-line-mi, remote referenced magnetotelluric (MT) traverse across a portion of central Texas has been recorded and analyzed. Among the geologic and geophysical elements crossed are the Ouachita foreland, the frontal and interior zones, and the rimming gravity maximum.

MT signatures of the allochthonous Ouachita facies have been established with the aid of well control and are correlated along the traverse. Both conductive foreland facies and the underlying resistive Precambrian can be traced beneath the resistive frontal thrust zone, but become indeterminate along the central part of the traverse, owing to abrupt thinning of the Precambrian resistor. Well control suggests that this resistive basement is correlative with the Grenville-age granitic basement of the nearby Llano uplift. A thick conductive interval of metasedimentary(?) basement material underlies Paleozoic rocks along the central portion of the traverse. This conductive basement appears to dip steeply beneath the Llano-type resistive basement and subcrops on the foreland flank of a basement antiform coincident with the rimming gravity maximum.

Still another resistive basement interval appears deep within the basement near the central portion of the traverse, and shallows abruptly to the southeast to form the core of the basement antiform coincident with the rimming gravity maximum. Stratigraphic relationships within the Precambrian basement suggest that the resistive basement, which cores the basement antiform, may be older than the conductive metasedimentary(?) and resistive Llano-type basement, and that the basement beneath the Ouachita trend is of North American affinity at least as far south and east as the rimming gravity maximum.

The MT signature of the subthrust foreland facies is truncated on the crest of the basement antiform coincident with the rimming gravity maximum. The geometry of the truncation suggests that the frontal thrust zone may have detached from the age-equivalent foreland facies near the present crest of the basement uplift, and that the distance between the foreland facies truncation and the foreland facies–frontal thrust zone boundary may serve as a crude minimum estimate of frontal thrust zone translation (about 60 mi).

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Correlation of Beds Within Ferry Lake Anhydrite of Gulf Coastal Plain

The Lower Cretaceous Ferry Lake Anhydrite is one of the most distinctive, widespread sedimentary units within the Gulf coastal plain. The formation extends from east Texas across southern Arkansas, northern Louisiana, central Mississippi, and southern Alabama, all the way to south Florida where it has been correlated with anhydrite beds of the Punta Gorda formation. The formation consists of alternating carbonates, claystones, and sulfate beds (altered from original gypsum to anhydrite during burial) deposited in a predominantly subaqueous environment within a broad lagoon located shoreward of an extensive reef fringing the shelf edge.

Highly resistive anhydrite beds within the Ferry Lake Anhydrite, and within formations above and below, may be correlated across east Texas, Arkansas, Louisiana, and Mississippi, using a network of closely spaced electrical logs. The geographic distribution of these anhydrite beds is variable. Some anhydrite beds may be traced across the entire area, whereas other beds are less widespread. The difference in geographic distribution of these beds reflects the variation in size and configuration of the extensive lagoonal sea in which they were deposited. Water depth, positive conditions around stable areas, subsidence, duration of each evaporitive pulse, and areal salinity variation are among the factors that controlled the thickness of individual beds accumulating within the lagoon.

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Modern Foraminiferal Species Diversity Patterns vs. Tidal Response: Louisiana-Mississippi Salt Marshes

Twenty-eight modern bottom samples from marshes in Hancock County, Mississippi, and Pearl River, Louisiana, yielded variable foraminiferal populations (total = live plus dead) during May and June 1981. Fourteen stations were sampled twice—at "peak" high and low tides.

We identified 22 benthic species of foraminifera in the samples (counts of approximately 300 specimens/sample); no planktonic species occurred. Diversity patterns [S = number of species, H(S) = Shannon-

Weiner information function, E = species equability] among the 14 doubly sampled stations indicate that the following ranges and averages (X) exist at high tide: S = 2 to 13, X = 7.5; H(S) = 0.311 to 2.046, X = 1.25; E = 0.306 to 0.720, X = 0.522. Low-tide samples have these ranges and averages: S = 2 to 12, X = 7.0; H(S) = 1.721 to 3.750, X = 1.08; E = 0.326 to 0.727, X = 0.488. In comparison to low-tide samples, high-tide samples have a higher species diversity, slightly lower dominance, and are more equable.

Three microbiotopes occur among the 14 stations: (1) beach at 3 stations, (2) lacustrine at 3 stations, and (3) bayou-fluvial at 8 stations. Among the microbiotopes, the beach marshes have the highest diversity (S = 10), the least dominance [H(S) = 1.36], and are least equable (E = 0.400). Lacustrine environments exhibit the greatest dominance [H(S) = 0.969] and equability (E = 0.635), although the diversity is midrange (S = 6.5). The bayou-fluvial marshes show a lower diversity (S = 6.12) and have midrange values for dominance and equability (S = 1.17; E = 0.510).

In the beach and bayou-fluvial marshes, arenaceous foraminifera dominate; however, a calcareous form, *Discorbis* sp., dominates the lacustrine marshes. Numerical abundance (number of individuals) and the diversity of the less common species appear to cause the greatest differences between microbiotopes.

POSEY, HARRY H., Bur. Econ. Geology, Austin, TX, AUDREY L. WORKMAN and JEFFREY L. HANOR, Louisiana State Univ., Baton Rouge, LA, and STEPHEN D. HURST, Univ. California, Davis, CA

Isotopic Characteristics of Brines from Three Oil and Gas Fields, Southern Louisiana

Isotopic analyses of 20 brine samples from two diapir-related oil fields and one growth-fault-related gas field in southern Louisiana lend support to a model proposed by A. L. Workman and J. S. Hanor that brines from the geopressure zone are mixing with hydropressured formation waters along the flanks of the Iberia salt dome and, within the limits of the sampling, suggest that this hydrodynamic process may be characteristic of the region. The $\delta^{18}O$, δD and $^{87}Sr/^{86}Sr$ determinations suggest that formation fluids above 2,000 m depth have partly equilibrated with terrigenous clastic rocks. Fluids below 2,000 m appear to be mixed Oligocene and Miocene seawater and clay-mineral water or evolved hydrocarbon-bearing water. These fluid compositions vary with depth due to mixing and possibly to temperature variations. Some samples may contain constituents derived from salt dissolution.

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Subsurface Lignite Occurrence in Wilcox Group, Northeast Louisiana and Northwest Mississippi

An investigation of lignite occurrence in the Wilcox Group of northeast Louisiana and northwest Mississippi revealed high lignite concentrations associated with a highly constructive elongated delta in the lowermost Wilcox Group. Bar-finger sandstone and distributary channel sandstone facies of an elongated delta lobe were recognized trending north-south through the central portion of the study area by sandstone percent maps, net sandstone isopach maps, and characteristic SP curves on electric well logs. Lignite isopleth maps identified principal areas of lignite occurrence adjacent to the elongate delta. Fewer, but thicker seams were found in the northern regions, where a maximum of four seams ≥ 5 ft thick were identified. To the south, a greater concentration of thinner seams occur. The distribution is attributed to a change in the position on the deltaic plain. Numerous, thin lignite beds in the southern region are indicative of lower delta-plain environments, where bifurcating distributaries, crevasse splays, and marine inundation inhibited thicker peat development. The presence of thicker, but fewer lignites to the north supports a transitional to upper delta-plain environment.

Mapping of individual sandstone beds revealed dip-oriented, bifurcating, fanlike geometries indicative of a lower to transitional delta plain. Capping lignite seams are blanket type, having areal extents of up to several hundred square miles and thicknesses ranging from 2 to 20 ft. Thicker seam development occurs along the delta-lobe margins, extending landward into adjacent interdistributary basins. The large extent of the blanket seams is in part attributed to (1) lignite beds capping channel-fill deposits, and (2) distributary channel and point-bar sandstones directly overlying lignite beds, with no truncation evident. Cross sections illustrate subsidence of the lignite beneath the overlying channel deposits.

High-quality lignite originates in transitional to upper delta-plain environments. Optimal areas for high-quality lignites in the Wilcox Group should be the extreme northeastern and northwestern portions of the study area, and farther north into central Tensas and Franklin Parishes, where thicker, transitional to upper delta-plain paleoenvironments should exist. Minimum subsurface depth to the highly lignitic, lowermost Wilcox Group ranges from approximately 5,000 ft (1,510 m) in the northwestern region to 7,000 ft (2,114 m) along the extreme southern boundary.

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Correlation of Cenozoic Sediments on Gulf of Mexico Outer Continental Shelf: Galveston Area Offshore Texas to Vermilion Area Offshore Louisiana (Part 1)

Detailed stratigraphic correlations of the Texas and Louisiana outer continental shelf (OCS) of the Gulf of Mexico have been conducted for the past several years as part of the geological and geophysical effort included in the resource evaluation program.

Part 1 of this study includes the area from Galveston, offshore Texas, to Vermilion, offshore Louisiana. Part 2 will extend down the Texas coast to Port Isabel. Part 3 will extend eastward beyond the Main Pass area. Other parts in the series are contemplated for the eastern gulf and the deep-water areas.

The study area for part 1, Galveston through Vermilion, was selected because it is centrally located and includes portions of most of the productive trends on the federal OCS, and it includes a stratigraphically complex region characterized by the transition from the deltaic sedimentary sequences of the central Gulf of Mexico OCS to the offshore bar facies of the western Gulf of Mexico.

The primary objective of this investigation is to establish a regional stratigraphic correlation grid including all major productive intervals based on electric-log, seismic, and paleontological data. Twenty-five stratigraphic horizons have been identified and regionally correlated.

The correlations of regional markers are presented on both electric-log (geologic) cross sections and on seismic sections that closely parallel the geologic cross sections. The regional markers correlated on the E-logs were projected onto nearby seismic sections and correlated from well to well to verify the accuracy of the electric-log correlations. Time-depth values were calculated from borehole velocity surveys and integrated sonic logs. Approximately 30 electric log and 40 seismic sections have been constructed. Work on part 1 included the detailed analyses of more than 1,500 wells, three-quarters of which had paleontological data, and the interpretation of 12,000 line-mi of seismic data.

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Local Carbonate Production on a Terrigenous Shelf

During the past 10 years, the Department of Oceanography at Texas A&M University has been involved in investigating reefs and banks on the Texas-Louisiana outer continental shelf. Studies were conducted on the geologic structure, sediment distribution, biology, and water and sediment dynamics at over 30 reefs and banks. Because of the influence of the Mississippi River and other streams, the dominant sediments in this part of the Gulf of Mexico are terrigenous sands and muds. Uplift of the sea floor caused by salt diapirism exposes bed rock that serves as a substrate for colonization by calcareous organisms.

Sediment facies and biologic zones at the Flower Garden Banks are closely related. The presence of a bathymetric high influences the direction and velocity of bottom currents. Factors that control sediment facies are biologic components and depth of the nepheloid layer (turbid water). Factors that control biologic zonation are the nature of the substrate, the water depth, and the depth of the nepheloid layer.

No land-derived sediment (silt and clay) are present above a depth of 75 m. Studies of the physical characteristics of the water column indicate