(1) a Pliocene and Miocene nearshore to continental massive sandstone facies; (2) an early Miocene and Oligocene continental-shelf facies of alternating sandstone and shale; and (3) a thick bathyal shale facies of Oligocene age. Oil and gas production in the area is confined almost entirely to sandstone beds in the continental-shelf facies.

South Bosco-Duson-Ridge fields are on a faulted, elongated north-south anticline that trends normal to the regional stratigraphic strike. All faults are normal and are either down-to-the-basin or up-to-the-basin. The down-to-the-basin faults are regional and are parallel with the regional stratigraphic strike. The up-to-the-basin faults are compensating faults confined to the South Bosco-Duson-Ridge complex. The fault throw generally increases with depth. All the faults "die out" upward in the section in or before reaching early Miocene sedimentary rocks.

Strata thicken into the downthrown sides of the faults and thin toward the crest and over the highest parts of the structure. The amounts of thickening or thinning generally increase with depth. Thus, fault movement and anticlinal folding were contemporaneous with sedimentation, continuously from Oligocene into Miocene time, and were most intense during Oligocene time.

The South Bosco-Duson-Ridge structure probably originated from faulting and anticlinal folding on the continental slope during Oligocene time. Structural growth was greatest where the structure was in the unstable environment of the hinge line (or shelf edge). Structural activity continued during the deposition of the neritic sediments of the Oligocene and early Miocene but at a steadily reduced rate. The structure was buried by a great thickness of nearshore and continental massive sandstone beds during Miocene and Pliocene time.

4. EDWARD D. MINIHAN, E. L. Erickson Co., Jackson, Miss., AND MARVIN L. OXLEY, Lone Star Producing Co., Jackson, Miss.

PRE-CRETACEOUS GEOLOGY OF POOL CREEK FIELD, JONES COUNTY, MISSISSIPPI

Commercial production from the Jurassic Cotton Valley and Smackover and pre-Smackover shows at Pool Creek represent a new era in exploration for the state. Thick multiple pays, high production rates, large reserves per well, and better spacing regulations offer oil hunters new incentives for deeper drilling. Knowledge gained from the study of this field will aid materially in the search for other Jurassic prospects.

Pool Creek is an intermediate-type salt dome overlain by a complexly faulted graben. Prior to the discovery of Jurassic production, the Cretaceous geology was well defined and used to help predict the presence of the older and deeper structure. Upper Cotton Valley sandstone beds rest unconformably on an eroded Smackover surface. At Pool Creek, depositional environment, length of erosional period, and time of salt movement are the controlling factors for accumulation.

5. MAX BORNHAUSER, Dillard-Waltermire, Inc., Houston, Tex.

MARINE UNCONFORMITIES IN NORTHWESTERN GULF COAST

The marine unconformities occurring in the northwestern Gulf Coast region are classified into: (1) non-deposition unconformities (parallel unconformities); (2) truncation unconformities (angular unconformities); and (3) excavation unconformities (scour-and-fill unconformities).

This classification is applied to the unconformities already reported in Gulf Coast literature; additional examples of unconformities are described and illustrated from western Madison and central Orange Counties, Texas.

6. HUBERT C. SKINNER, Tulane University, New Orleans, La.

MODERN PALEOECOLOGICAL TECHNIQUES: AN EVALUATION OF ROLE OF PALEOECOLOGY IN GULF COAST EXPLORATION

In recent years there has been a great increase in interest in ecology and paleoecology and in the use of paleoecological data to define ancient environments. This is true especially in the petroleum industry where success in exploration is dependent upon the accurate correlation of strata. During the last 2–3 decades, several hundred papers dealing with this subject have been published, creating a formidable mass of paleoecological literature.

The historical background of paleoecological study is reviewed. The basic principles, the limitations of paleoecology, and some of the common problems are discussed. Because benthonic and planktonic faunas are distinct and separate in nature, a review of modern literature studies involving benthonic faunas is considered first, followed by studies of planktonic faunas. Planktonic/benthonic ratios, paleotemperature indicators, and the relation of live/total ratios to sedimentation rates are discussed and evaluated.

7. B. J. SCULL, C. J. FELIX, S. B. McCALEB, AND W. G. SHAW, Sun Oil Company Research Laboratory, Richardson, Tex.

INTER-DISCIPLINE APPROACH TO PALEOENVIRONMENTAL INTERPRETATIONS

In subsurface studies, unlike surface studies, specific environments of deposition can not be established reliably on the basis of sediment geometry because a sediment pattern can represent several environments. Clues from various disciplines can be integrated to identify regional and local environments—deltaic plain, open shelf, distal bar, longshore bar, lagoon, swamp, littoral zones, *etc.* The accuracy of interpretations is governed by the types of samples available, types of disciplines applied, spacing of control wells, and the experience and imagination of the interpreters. The confidence level ordinarily ranges from 80 to 95% in Tertiary and younger strata but is in few cases more than 85% in older sediments.

Because paleoenvironments resulted from the interaction of climatic, physical, chemical, and biotic factors, each factor must be evaluated in part and in combination. The physical-chemical system is determined from the mineralogy, textures, sedimentary structures, and trace chemical gradients ascertained with petrologic, X-ray mineralogy, and geochemical methods. These methods are applicable to all environments. Palynology utilizes pollen and spores and other plant and animal micro-entities; their acid-resistant nature and abundance permit statistical applications to paleoecologic and stratigraphic problems. Evaluations principally are botanical with an environmental range of terrestrial to open-marine shelf. Fossil faunal assemblages chiefly are marine and contribute information about water depths, salinity values, and turbidity. For each specific environment, one discipline

dominates the interpretation and other disciplines increase the confidence level.

Interpretive procedures illustrated are: a regressive marine wedge in the Miocene sedimentary rocks of Terrebonne Parish, Louisiana; supralittoral, littoral, and sublittoral sequences in the Oligocene sedimentary rocks of Starr County, Texas; and a channel system in the Cretaceous lower Tuscaloosa sedimentary rocks of Amite County, Mississippi.

8. GULF COAST SECTION S.E.P.M. STUDY GROUP

INTERPRETATION OF DEPOSITIONAL ENVIRONMENT IN GULF COAST PETROLEUM EXPLORATION FROM PALEOECOLOGY AND RELATED STRATIGRAPHY

Paleoecology is the relationship between ancient organisms and their environment. Interpretation of the depositional environments of foraminiferal species in the geologic section is based largely on information calibrated from studies of the habitat of Recent Foraminifera. In Gulf Coast clastic rocks, oil and gas occur most commonly in strandline or nearshore sediments composed of interbedded transgressive shallow-marine and regressive non-marine strata. Large deltas that formed in rapidly subsiding basins are typical of this environment. In carbonate rocks, reefs with back-reef bays and lagoons in brackish- and shallow-marine environments are favorable for oil and gas occurrence.

Accurate paleoecologic interpretation depends on sufficient knowledge and consideration of the associated lithologic types, sedimentation, and tectonics which are related components of stratigraphy. Gulf Coast sedimentation occurred in a mediterranean basin, and structural features, both regional and local, have affected deposition. An estimated 40,000 ft. of Cenozoic clastic sandstone and shale underlying the Texas-Louisiana coast thins eastward to a thickness of approximately 5,500 ft. under Florida where the terrigenous rocks grade into carbonate rocks. Eight major transgressive-regressive cyclic depositional units comprise Gulf Coast Cenozoic sedimentation; the units are Midway-Wilcox, lower Claiborne, upper Claiborne, Jackson, Vicksburg-Frio, Anahuac, Fleming, and Quaternary. Paleoecologic or depositional environment zones are classified as transitional, inner shelf, middle shelf, outer shelf, upper slope, lower slope, and abyssal.

9. ROBERT E. GERNANT AND ROBERT V. KESLING, University of Michigan, Ann Arbor, Mich.

FORAMINIFERAL PALEOECOLOGY AND PALEOENVIRONMENTAL RECONSTRUCTION OF OLIGOCENE MIDDLE FRIO IN CHAMBERS COUNTY, TEXAS

Middle Frio, here defined as material deposited from the time of *Anomalina cocoaensis* until the time of *Nonion struma*, has sedimentary rocks deposited in seven depositional environments in the subsurface of Chambers County, Texas: continental, brackish, saline bay, shallow inner shelf, deep inner shelf, middle shelf, and outer shelf. From the absence or abundance of various foraminiferal species, environments can be delineated by comparison of the Frio assemblages with the preferred distribution of living Foraminifera.

In Chambers County, eight persistent sandstone bodies can be recognized and correlated on the basis of seven foraminiferal chronologic indicators and of distinctive electric-log characteristics. Isopachous contour maps, incorporating thicknesses of sandstone bodies from approximately 400 electric-log sections, suggest depositional environments of the sandstone bodies.

The county is crossed by a system of middle Frio growth faults. Faunal analyses of sedimentary units indicate that topographic relief existed on the upthrown sides of the faults during deposition, and that turbidity currents periodically moved shallow-water sediments and their contained faunas to deep water on the downthrown sides.

Environments indicated on paleobathymetric maps, constructed from faunal analyses of 13 wells, correspond closely to the environments suggested by geometry of the sandstone bodies.

10. J. M. COLEMAN, Coastal Studies Institute, Louisiana State University, Baton Rouge, La.

ECOLOGICAL CHANGES IN MASSIVE FRESH-WATER CLAY SEQUENCE

Cored borings of Recent swamp deposits in the Atchafalaya basin presented a difficult problem in deciphering ecological changes. The fauna was either absent or badly leached; grade-size parameters remained nearly constant from top to bottom; and the 100 ft.-cored section consisted of "massive-appearing" clays. X-ray radiographs of core slabs, however, revealed a varied assemblage of primary, secondary, and post-depositional sedimentary structures and epigenetic and syngenetic inclusions.

Five environmentally controlled facies were recognized in the borings: poorly drained (stagnant) swamp; well-drained swamp; fresh-water-lacustrine; lacustrine delta fill; and channel fill. Overlying a cross-bedded sand and gravel substratum (braided channel-fill deposits) is a 10-ft. layer of swamp clay. Large carbonate and iron concretions, finely disseminated iron cement, and replacement of organic fragments by iron oxides attest to high-oxidizing conditions. Near the top of the layer, there is a gradual change to more reducing conditions and stable water levels. As the rate of sedimentation decreased, 22 ft. of highly organic clays was deposited in a poorly drained swamp environment. High pyrite and vivianite content, siderite concretions, high organic layers, and intensive root burrowing characterize this unit. As sedimentation rates increased, conditions gradually changed to allow better drainage; the accumulated clays are similar to the lowermost clay unit. During accumulation of this 12-ft. sequence, water levels apparently fluctuated considerably, because intensive leaching is apparent. A sharp reduction in sediment supply and compaction of previously deposited clays resulted in the formation of a large lake. Thirteen ft. of "massive" lucustrine clays was then deposited. Radiographs revealed that the lower part is highly burrowed, and few remnants of primary stratification remain. The upper section, however, consists of alternating laminations (0.1-2 mm. thick) of differing X-ray absorption caused from alternating layers of well-oriented clay particles (flocculated settling), as well as local concentrations of colloidal organics and carbonates. Sedimentation rates gradually increased, and normal lacustrine sedimentation was interrupted by an advancing lacustrine delta. Twelve ft. of alternating silt, silty clay, and clay forms this facies. A fresh-water shell layer marks the final fill of the lake. Poorly drained swamp conditions were established again and apparently continued uninterruptedly, until the present. Subsequent diagenic changes include growth of concretions, gradual change in concretion composition with depth, and enrichment of certain layers in carbonate.