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LATE QUATERNARY SEA LEVELS IN GULF OF MEXICO

Definitive data for late Quaternary sea levels in the Gulf of Mexico largely were gathered more than 15 years ago, and primarily were based on the presence of submerged shoreline depositional features. During the last 3 years new evidence has been gathered from wave-cut terraces and erosional unconformities present on submerged banks near the edge of the northern Gulf continental shelf. At least 9 distinct levels can be recognized between 20 and 200 m, and there are many additional minor ones.

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PALEOTEMPERATURES IN GULF COAST USING ESR-KEROGEN METHOD

Concentrations of liquid hydrocarbons in modern sediments are only a few parts per million, but hydrocarbons in subsurface shales reach several thousand parts per million. The increase in hydrocarbons is the result of the alteration of insoluble organics called kerogens. The primary energy for this reaction is heat associated with burial. Significant hydrocarbon generation begins at 150°F, but liquid hydrocarbon destruction dominates at temperatures greater than 300°F. Thus, there is a liquid window between 150 and 300°F which encompasses the zone of oil occurrence.

Present geothermal gradients can be used only to predict organic maturity in young downwarping basins. Paleotemperatures can be estimated from kerogen. Electron spin resonance (ESR) of kerogen has been used to estimate paleotemperatures in the Mesozoic-Tertiary trends of the Gulf Coast. The data indicate that some rocks have been 50–100° F hotter than their present temperatures and that some present geothermally cool areas were "hot spots" in the past.

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GEOLOGY OF WEST FLOWER GARDENS BANK

The West Flower Gardens Bank has been the subject of study by the Department of Oceanography at Texas A&M University during the past several years. These studies, conducted from surface oceanographic vessels, have included bathymetric surveys, high-resolution subbottom profiling, analyses of sediment producing organisms, and delineation of sediment facies surrounding the prominence.

Geologic data obtained during EFORC Mission 72-0605-X, using the Nekton Gamma submersible, include: (1) verification of the accuracy of sediment distribution patterns as delineated by surface sampling; (2) the occurrence of dead barrier reefs at depths of 180–190, 290–315, and 420–430 ft; and (3) the occurrence of dead patch reefs on terraces behind the barrier reefs.

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NANNOPLANKTON BIOSTRATIGRAPHY OF UPPER BLUFFPORT MARL–LOWER PRAIRIE BLUFF CHALK INTERVAL (UPPER CRETACEOUS) IN MISSISSIPPI

Upper Cretaceous strata of Mississippi contain diverse nannofossil floras. Samples taken from the upper Bluffport Marl, Ripley Formation, and lower Prairie Bluff Chalk of Kemper and Oktibbeha Counties, Mississippi, were examined to determine nannoplankton abundances and occurrences.

In the strata examined, 117 nannofossil species were recognized and 9 biostratigraphic zones were delimited of which 6 are new. The intervals of 3 previously described zones, the *Tetralithus aculeus, Chiastozygous initialis,* and *Lithraphidites quadratus* zones have been modified.

In these sections, the Bluffport-Ripley contact could not be delineated using nannofossils but the unconformable nature of the Ripley-Prairie Bluff contact could be recognized by significant nannoplankton changes.

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GEOLOGIC CONTROLS ON HYDROCARBON SOURCE POTENTIAL OF YOUNG SEDIMENTS

This study was carried out as part of a broad study of the continental-slope environment in the northern Gulf of Mexico. The primary objectives of this geochemical study of young sediment sequences was to obtain fundamental knowledge of the composition of the organic matter and of the processes involved in the origin and accumulation of petroleum, and to relate these to their geologic controls.

Organic matter incorporated in these slope sediments differs from the organic matter in nearshore sediments in several respects which suggest that the organic matter had been reworked by marine bacteria before it was incorporated in the slope sediments. The presence of slope basins is important in the accumulation and preservation of this organic matter.

The geochemical-source characterization of the slope sediments was based primarily on the amounts of organic matter, total heavy (C_{15}^+) extractables (bitumen), and total heavy (C_{15}^+) hydrocarbons and gasoline-range (C_4-C_7) hydrocarbons. These organic-richness parameters are similar on the slope throughout the Gulf. There is a single gross organic facies. A few Pleistocene sequences presently contain enough C_{15}^+ hydrocarbons and organic matter to be considered source sediments by the criteria currently being applied to older sediments. Many more of these young sediment sequences contain significant amounts of heavy (C_{15}^+) bitumens which could generate petroleum if sufficiently matured, that is, if exposed to greater depths and temperatures. These sequences are considered to have "source potential."

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LATE PLIOCENE–EARLY PLEISTOCENE NANNOFOSSIL STRATIGRAPHY IN NORTH-CENTRAL GULF COAST

The early Pleistocene deposits of southeastern Louisiana consist of basal regressive sandstones overlain by a thick marine transgressive shale unit to which various informal names have been applied. This early Pleistocene shale has an areal extent of more than 20,000 sq mi and ranges in thickness from 100 ft in updip areas to several thousand feet in the continental shelf. This study was based on sidewall cores from 4 wells drilled more than 60 mi offshore from the coastline in the southern part of the Ship Shoal area, Terrebonne Parish, Louisiana. Samples also were examined from piston cores taken in the Atlantic and Pacific Oceans and the distribution of pertinent calcareous nannofossils in these samples was compared with distributions in the Louisiana sections.

Thirty-two species of calcareous nannofossils from 20 genera have been identified from the late Pliocene and early Pleistocene strata of the Louisiana continental shelf. Of these 32 species, 2 are restricted sufficiently to be useful as stratigraphic criteria. The significant occurrences are, the extinction of *Discoaster brouweri* Tan Sin Hok and the first appearance of *Gephyrocapsa caribbeanica* Boudreaux and Hay and these 2 species may be used to define the base of the early Pleistocene marine shale in the north-central Gulf Coast. Other results include: (1) delineation of a phylogenetic series extending from *Coccolithus doronicoides* Black and Barnes in the middle Pliocene section to *Emiliania huxleyi* (Lohmann) in the Holocene, (2) recognition of the co-occurrence of *Ceratolithus cristatus* (Kamptner) and *Ceratolithus rugosus* Bukry and Bramlette in the earliest Pleistocene sediments, (3) extension of the geologic range of *Gephyrocapsa protohuxleyi* McIntyre and *Cricolithus jonesi* Cohen back to the early Pleistocene, and (4) the first reported fossil record of *Homozygosphaera wettsteini* (Kamptner) and *Calyptrosphaera oblonga* Lohmann.

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DEPOSITION OF COCCOLITHS IN COMPENSATION ZONE OF ATLANTIC OCEAN

Recent coccoliths deposited in the Atlantic Ocean undergo selective dissolution in the calcium carbonate compensation realm, resulting in an increase in the relative proportion of solution-resistant placoliths in the assemblage. Solution of the coccoliths proceeds through gradual selective removal of ultrastructural elements in a sequence characteristic for each taxonomic group.

Selective dissolution of coccoliths allows recognition of 3 zones: (1) a basal dissolution zone termed here the "Mesolytic zone," about 500 m thick, directly overlying the calcium carbonate compensation depth. Sediments in this zone lack planktonic Foraminifera, have a low $CaCO_3$ content, and contain a coccolith assemblage of low diversity and composed of solution-resistant species, chiefly placoliths. In the southern and equatorial Atlantic these sediments are bathed by Antarctic bottom waters. (2) The middle Oligolytic zone is in the region from 500 to 1,500 m above the calcium carbonate compensation depth. Sediments contain corroded and fragmental tests of planktonic foraminifers and a coccolith assemblage with abundant resistant species and some corroded, less resistant forms. (3) The upper Eolytic zone extends from about 1,500 m above the calcium carbonate-compensation depth to the calcium carbonate-saturation depth. Sediments contain normal planktonic foraminiferal assemblages and diverse, well- to moderately well-preserved coccoliths, with only a few species showing obvious signs of corrosion.

Selective dissolution with depth removes "tropical" species, so that assemblages deposited at greater depths resemble living assemblages from higher latitudes.

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MODERN WELLSITE EVALUATION OF EOCENE WILCOX IN TEXAS

Present exploration efforts in the Eocene Wilcox of Texas are being conducted in areas with varied depositional environments and associated significant changes in sedimentary facies. The facies changes that most affect quantitative log interpretation are sediment size, sorting, and composition. Variable lithologic fabric and the wide range of connate waters present in the various intervals can cause difficult and unreliable interpretation when applying conventional methods for Sw and productivity analysis.

Supplemental methods are used to (1) locate zones of interest, (2) gain an idea of whether hydrocarbon production can be expected, and (3) provide porosity and saturation information.

Zones of interest are detected by the $Rxo/_{Rt}$ Quick-Look curve as compared to the S.P. curve. Changes in connate water and/or shaliness do not affect this method. Zones so located are then analyzed by using the dual-induction data to verify productivity.

Finally, an Ro curve is obtained by positioning a density-derived formation-factor curve in water-bearing sands, aided by information gained by the $Rxo/_{Rt}$ Quick-Look curve. This permits verifying the constants needed for water-saturation evaluation. In the pay zones, both porosity and water saturation can be scaled off this overlay.

This simultaneous display for visual analysis, available on the basic resistivity log, provides a convenient way to compare the quality of the zones of interest. The interpretational aids are mutually supplemental and lead to significant improvements in formation evaluation.

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GULF COAST EARLY CRETACEOUS NANNOPLANKTON BIOSTRATIGRAPHY—REVIEW

Formal zones have now been proposed for virtually the entire stratigraphic range of nannoplankton. Those for the Late Cretaceous and Cenozoic, though in various states of standardization, are generally applicable. However, the study of Early Cretaceous nannofossils is just emerging from the descriptive state, taxa are becoming stabilized, and attention is being directed to their stratigraphic and geographic distribution patterns. Recently published zonations, based primarily on coccoliths and related forms, are reviewed and evaluated in terms of their practical utility in the subsurface of the Gulf Coast. A state of flux is indicated by the general lack of agreement among these zonal schemes, either in terms of species ranges or in the choice of species by which zones should be defined. These conflicts suggest, in part, that provincialism and perhaps homotaxis are involved. Most of these zonations have been established outside of the Gulf Coast. The practice of defining zonal boundaries by evolutionary appearances renders them difficult to apply to most subsurface samples. Consequently, none of these zonations are entirely satisfactory.

Nannoconids are an important, and someplaces the only, constituent in Gulf Coast Early Cretaceous nannofossils suites. This group represents a remarkable evolutionary lineage consisting of approximately 12 usable species. They are geographically widespread and their occurrence in varied lithofacies suggests that they were less environmentally restricted than many nannoplankton. They apparently are less susceptible to diagenetic destruction than other calcareous microfossils and consistently are recovered from the deepest wells of the region. Although nannoconids themselves do not provide the desired degree of resolution, they are indispensable as a means of establishing a basic biostratigraphic framework which can be augmented by less common occurrences of coccoliths and related nannofossils, as well as other microfossil groups. Despite