UPPER JURASSIC CARBONATE ROCKS IN NORTHEASTERN TEXAS AND ADJOINING PARTS OF ARKANSAS AND LOUISIANA[1]

Carbonate rocks make up only a small part of the total Upper Jurassic sequence, but they are widespread and are sensitive indicators of their environments of deposition. Consequently, carbonate studies have yielded data vital for stratigraphic correlation and interpretation of environment. Rocks of Upper Jurassic age include, in ascending order, the Smackover and Buckner Formations and the Bossier and Schuler Formations of the Cotton Valley Group. These rocks are in the subsurface at depths ranging from 3,000 to 12,000 ft.

The Smackover Formation contains three informal members. The lower member, one of the most widespread and easily recognized units of Late Jurassic age, consists of dark-gray, commonly laminated, silty to argillaceous limestone, that was deposited throughout a deep, possibly stagnant, basin. The middle member, generally restricted to basin margins, consists of medium-brown pelletoid or structureless limestone deposited in the shallower parts of a basin that supported a relatively abundant fauna. The upper member, also limited to basin margins, consists mostly of light-brown to black oölitic to pisolitic limestone that represents deposition in a shallow-water high-energy environment. This member includes the petroleum-producing Reynold's oölite.

The Buckner Formation contains two members. The lowest member consists mostly of laminated micrograined anhydrite and anhydritic mudstone, but in restricted areas consists of fine-grained dolomite. It represents deposition in an evaporitic basin and associated mudflats. The upper member consists mostly of nodular anhydritic mudstone that represents deposition in evaporitic mudflat. It contains a bed of limestone, known locally as the A zone, that represents a temporary advancement of the sea across the mudflat.

The Bossier Formation represents the offshore equivalent of the Buckner and parts of the Smackover and Schuler Formations. It consists mostly of dark-gray splintery calcareous shale, but contains shell material in various amounts. A limestone at the base of the Q tongue consists mostly of silty micrite containing a fossil assortment that is characterized by algal-encrusted grains but also includes foraminifers, gastropods, ostracods, and echinoid fragments.

The Schuler Formation, which includes a marine and a nonmarine facies, consists mostly of mudstone, shale, and sandstone but contains some limestone in the marine facies. Algal micrite is present in the upper part, and some argillaceous coquina and phosphatic clastic limestone that apparently represent beach environments are present near the base.

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LIST, BIBLIOGRAPHY, AND INDEX OF FOSSIL VERTEBRATES OF LOUISIANA AND MISSISSIPPI

Species of fossil vertebrates reported from Louisiana and Mississippi are listed. The bibliography consists of 167 titles and contains detailed annotations on vertebrates from those states. Both systematic and chronologic-geographic indexes are provided.

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LATE NEOGENE PALYNOMORPH DIAGRAMS, NORTHERN GULF OF MEXICO

The cyclic nature of late Neogene climate is reflected in the relative frequency diagrams of palynomorphs deposited in the northern Gulf of Mexico. A general cooling through the late Neogene and at least five glacial cycles for the Quaternary are indicated. An additional prominent cold cycle in latest Miocene time is interpreted from the frequency diagram of *Picea*, spruce. The Pliocene-Pleistocene boundary is marked by an abundance of *Ambrosia* and *Helianthus* types of Compositae pollen below and increased frequency of *Alnus* and *Exesisporites* above. A new species of fungal spore occurs abundantly in the lower part of the Pleistocene and also lower in the Neogene.

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PROFILE ANALYSIS—A GEOLOGICALLY ORIENTED GRAVITY INTERPRETATION

A byproduct of the examination of three different analytic methods of reducing gravity data to a form useful to the geologists is the presentation of the local gravitational field of one complete quadrangle in the Jurassic trend of Mississippi. The major salt dome minima are qualitatively confirmed by all three methods, although the quantitative effects vary. The more subtle effects of the Jurassic features are more susceptible to distortion by the process of removing the influence of regional density changes. The least distorting method of regional removal is shown to be the interlocking profile network. This technique obtains the most definitive resolution of the local gravitational effects of deep, low-volume structures.

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DEPOSITIONAL EPISODES: THEIR RELATION TO QUATERNARY SEA-LEVEL FLUCTUATIONS IN GULF COAST REGION

The stratigraphic record yields evidence that each episode of clastic deposition has been of limited duration and that each has been preceded and followed by a significant hiatus. Evidence for alternations of deposition and nondeposition is readily apparent in the landward part of Pleistocene sequences along the Gulf Coast because of the glacioeustatic changes in sea level. Evidence of alternations, although elusive, exists also in the basinward part of the sequences. The concept of depositional episodes explains the significance and relation of these alternating conditions throughout the basin for clastic Pleistocene sequences.

A depositional episode is the duration of time required for the sedimentation of a depositional sequence. The depositional sequence attributed to each depositional episode is composed of several discrete facies sequences. A facies sequence consists of either a single delta lobe within a deltaic complex or one of the several repetitive facies sequences deposited in an interdeltaic environment.

Each depositional sequence indicates three phases of development. Deposits of the initial phase record a stillstand of the sea during which each of the rivers entering the basin prograded a succession of delta lobes and interdeltaic facies sequences. The second phase of development is recorded by the intercalation

of clastic and organic floodplain deposits which accumulated on the newly formed coastal plain. The terminal phase is documented by sediments deposited during a period of instability when a marine transgression either continuously or intermittently forced estuarine conditions on the rivers entering the basin. Throughout the terminal transgression the finite zone of active deposition adjacent to the shoreline was shifted landward. Basinward of this active zone of deposition, hiatal conditions existed, and at the instant of maximum transgression, when the depositional episode was terminated, all points on the hiatal surface were synchronous.

The bounding surfaces of depositional sequences represent natural stratigraphic breaks and are related to hiatal conditions imposed by marine transgressions. Within the Quaternary section, the repetitive alternation of depositional episodes and significant hiatuses is due to the glacioeustatic fluctuations of sea level. As a result, worldwide correlations of the Pleistocene sequences and hiatuses can be made.

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BAY MARCHAND—TIMBALIER BAY—CAILLOU ISLAND SALT COMPLEX, LOUISIANA

This salt complex, more than 28 mi long and up to 12 mi wide, may be part of a much longer salt feature that extends both east and west. The mother salt bed, of probable Late Triassic-Early Jurassic age, is buried at depths of 40,000–50,000 ft, whereas the tops of the individual domes along the trend rise to within 2,000–3,000 ft of the surface.

Production to date on the three-field complex has been more than 0.7 billion bbl of oil. Oil reserves are estimated to range from 0.75 billion to 1.0 billion bbl. Significant gas reserves also are present.

Hydrocarbon accumulation occurs in sands of Pleistocene through late Miocene ages and ranges in depth from 1,000 to below 20,000. A wide variety of traps is found, including supradomal arching, shale and salt truncations, stratigraphic traps, and those resulting from faults.

Production was established on this complex in 1933. The total hydrocarbon production for 1968 was approximately 99 million bbl.

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PROFILE OF BIOGENIC SEDIMENTARY STRUCTURES IN HOLOCENE BARRIER ISLAND—SALT MARSH COMPLEX, GEORGIA

Biogenic sedimentary structures, many of which are characteristic of particular depositional environments, are abundant among Holocene barrier island–salt marsh habitats of coastal Georgia. The major environments represented are (1) beaches, including the shoreface, lower and upper foreshore, backshore, dunes, and washover fans; (2) salt marshes, consisting of the low marsh, high marsh, and salt pans; and (3) estuaries and tidal streams, including channel deposits, point bars, stream banks, and natural levees. Biogenic sedimentary structures in these environments consist of bioturbate textures and tracks, trails, burrows, and dwelling tubes, and are produced chiefly by polychaetes, gastropods, pelecypods, decapods, amphipods, and insects. Such structures, either singly or as assemblages of lebensspuren, are ordinarily sufficient to delimit major habitats. Further, most of these structures are capable of preservation, and many of them have been documented in the Pleistocene of Georgia and Florida.

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CORRELATION OF NEOGENE PLANKTONIC FORAMINIFER AND CALCAREOUS NANNOFOSSIL ZONES

From the uppermost Miocene (Messinian) to the Holocene six planktonic foraminifer zones have been recognized in tropical and subtropical latitudes. Using overlapping segments from deep-sea cores previously dated by use of planktonic foraminifers, the calcareous nannofossils for this same interval were analyzed in order to relate nannofossil ranges to established foraminiferal zones.

With the light microscope nine calcareous nannofossil zones are readily distinguishable for this interval, one for the uppermost Miocene (Messinian), four for the Pliocene, and four for the post-Pliocene. The planktonic foraminifer zones N-18 through N-20 have roughly corresponding nannoplankton zones, although zone N-20 appears to represent a shorter stratigraphic interval than the corresponding nannoplankton zone. Zone N-21 is divisible into two nannofossil zones of about equal duration. The top of zone N-21, which is marked by the first evolutionary occurrence of *Globorotalia truncatulinoides*, corresponds rather closely to the extinction of discoasters in deep-sea sediments. Above this horizon for additional nannofossil zones can be recognized, based on partial ranges or concurrent ranges of three placolith genera that successively dominate the nannofossil assemblages.

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DEPOSITIONAL ENVIRONMENTS DEFINED BY DIPMETER INTERPRETATION

A new method of dipmeter interpretation gives an estimation of water depth during deposition. This method is applied to high-resolution dipmeter surveys in which short-interval correlations are machine computed at closely spaced levels of the well.

The major premise is that these short-interval dip computations reflect the energy of the depositional environment. High-energy marine environments lead to a large scatter of dip magnitudes. Conversely, low-energy environments, such as found in deep water, lead to "layer-cake" deposition, and appear as uniform dip magnitudes on the dipmeter plot. Thus, the scatter of dip magnitude in a formation is the key by which the depositional water depth is interpreted to be shallow (less than 50 ft), medium, or deep (greater than 300 ft).

Comparisons with paleoecologic data indicate the interpretation method to be both valid and useful. Exceptions to the rules for dipmeter interpretation occur when the original bedding planes are distorted or overshadowed, as in fault zones, weathered formations underneath unconformities, marine slides, and heaving shales. Even with these exceptions, and partly because of them, the dipmeter interpretation and paleoecologic data augment each other in defining depositional environments.

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