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Depositional Systems of Lower Tuscaloosa Formation (Cretaceous), North-Central Gulf Coast Basin

The lower Tuscaloosa Formation in east-central Louisiana and southwestern Mississippi consists of a southward-thickening wedge of coarse to fine-grained sandstones and shales. The Lower Cretaceous carbonate-shelf margin is a natural boundary separating the updip fluvial depositional system from the downdip deltaic depositional system. The lower Tuscaloosa Formation thickens from a minimum thickness of 120 ft (37 m) updip to a penetrated thickness of 2,800 ft (850 m) downdip. The tectonic setting is one of regional uplift to the north, local uplifts within the alluvial valley, and growth faulting south of the Lower Cretaceous shelf margin.

Based on analyses of core, lithologic logs, and a series of sandstone isolith maps constructed from electric logs, the lower Tuscaloosa is interpreted to have been deposited in 3 major depositional systems: (1) a fluvial system, (2) a deltaic system, and (3) a barrier-island system. Seven subenvironments of these depositional systems include: (1) fluvial channels, (2) floodplains, (3) deltaic distributary channels, (4) distributary natural levees, (5) crevasse splays, (6) shallow-marine bays, and (7) accretion ridges.

The deltaic depositional system is composed of several fluvial-dominated, wave-influenced deltas. The distribution of deltaic depositional subenvironments was influenced by the tectonics of the basin and by the near-shore wave energy. This type of delta persisted throughout most of the lower Tuscaloosa deposition.

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Exploration Potential and Variations in Shelf Plume Sandstones, Navarro Group (Maestrichtian), East-Central Texas

Fine-grained marine sandstones within the Kemp Clay of the Navarro Group (Maestrichtian) of east-central Texas were deposited on a muddy, shallow shelf by migrating sandbars. These sands were transported in traction from deltaic headlands by seaward-deflected coastal/shelf currents. The sand formed thin (3-20 ft; 1-6 m) arcuate belts (shelf sand plumes) which were 17-20 mi (27-32 km) wide and extended 27-30 mi (43-48 km) downdrift and 21-40 mi (34-64 km) onto the shelf. Orientation of the long axes of ridges, formed by the stacking of individual bars within the shelf sand plume, changes (from dip to strike-oriented downdrift) corresponding to the flow directions of the shelf currents.

Southwestward, fair-weather reworking of these delta-supplied sands by shelf currents resulted in the down-current stratigraphic climbing of the migrating shelf-bar complexes. Onshore stratigraphic climbing in the landward parts of the plume complexes was related to storm activity. Current patterns and the resulting distribution of sand were influenced by the configuration of the shelf and the topographic relief inherited from previously deposited deltaic/shelf depositional platforms.

Three variations of the basic shelf sandstone-plume model were recognized in the study area: (1) a rapidly deposited, immature plume, (2) an abandoned, current-reworked plume, and (3) a storm-modified, onshore-reworked plume. Each of these variants displays unique characteristics which influence their potential as hydrocarbon reservoirs.

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Sand Shoal Development on Muddy Mississippi River Delta Shelf

Trinity and Ship Shoals are transgressive sand bodies on the Louisiana inner continental shelf, and they represent the reworked sands of the abandoned Holocene Teche and Maringouin deltas. The development of these shoals is initiated by an episode of delta abandonment followed by subsidence-enhanced sea level rise. Through the process of shoreface retreat, the abandoned delta lobe evolves from an erosional headland with flanking barrier islands to a barrier-island arc and finally into a submerged inner-shelf shoal system. Trinity and Ship Shoals represent the final stage in the Mississippi River delta barrier shoreline cycle and provide a possible modern analogue for some Cretaceous shelf sandstones of the Western Interior. More than 1,000 km (620 mi) of high-resolution seismic profiles correlated with cores provide the data base for interpretation of the depositional history of sand-body development on the muddy Louisiana shelf.

Ship Shoal is the oldest inner-shelf shoal associated with the abandonment and subsequent reworking of the Maringouin delta 6,150 y.B.P. Located 25 km (16 mi) south of the Isles Dernieres, the Ship Shoal transgressive sands lie disconformably over the Maringouin deltaic muds. The Ship Shoal sand body is shore parallel, 32 km (20 mi) long and 2-4 km (1-2 mi) wide. The inner-shelf relief ranges (east to west) from 2-6 m (7-20 ft) with a corresponding decrease (east to west) in the water depth over the shoal crest from -6 to -3 m (-20 to -10 ft). The shoal profile is asymmetric landward. The Ship Shoal sand body is composed of an upward-coarsening sequence of well-sorted fine-grained sand with a median size of 125μ.

Trinity Shoal is associated with the Teche delta, abandoned 3,500 y.B.P., and it is located 20 km (12 mi) south of Marsh Island. The base of Trinity shoal lies unconformably over the Teche deltaic sediments. Trinity shoal is a shore-parallel lunate sand body, 36 km (22 mi) long and 5-10 km (3-6 mi) wide. The inner-shelf relief ranges (east to west) 2-3 m (7-10 ft), with a corresponding decrease (east to west) in the water depth over the shoal crest 5-2 m (16-7 ft). The Trinity Shoal sand body is 5-7 m (16-23 ft) thick.

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Cross Structures and Cover Response in Gulf of Suez Tilt Blocks

Two studies along the west bank of the Gulf of Suez show that: (1) complex cross structures control the subcrop pattern and synorogenic facies; (2) brittle faulting in the preorogenic rocks gives way to more plastic behavior in overlying units; and (3) secondary normal faults sole within the cover but reflect underlying fault patterns.

Gebel Zeit is the eroded crest of a major horst block, exposing Precambrian through Recent rocks. Internal structures include gulf-parallel faults, normal cross faults, and complex keystone grabens. Internal faulting, in conjunction with erosion, controls the reservoir subcrop pattern and synorogenic facies, including location of porous reefs.

The Ras Issaran horst system exposes Miocene to Recent deformed sediments. Continuing movements on cross faults control synorogenic clastic facies and reef locations. Reversal of movement direction on cross faults is common. Even through thick cover, the internal breakup of the horst is discernable.

The role of secondary cover faulting has been neglected in the Gulf of Suez. At Gebel Zeit, brittle faulting in the rigid preorogenic rocks dampens out as less pronounced faulting and folding in the plastic Miocene cover. At Ras Issaran, faults in the brittle Plio-Pleistocene clastics apparently sole in underlying evaporites. While these faults are decoupled from the underlying primary structures, they mimic the concealed fault pattern and provide clues to later movements of these faults. More detailed investigation of the internal breakup of horsts and the role of secondary faulting in the Gulf is needed.

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Presentation of New Tectonic Map (and Accompanying Sections) of Trinidad and Tobago

The Geologic Map of Trinidad, compiled by H. G. Kugler and published in 1961, is currently out of print. While it is the most widely available geologic map, it is confined to onshore Trinidad. This map remains an important reference source, but there have been significant increases in our knowledge of Trinidad and Tobago geology since its publication. In particular, there has been: (1) considerable geophysical work, on land and offshore, including 20,000 km (12,400 mi) of seismic lines; (2) approximately 1,000 exploration and development wells drilled, including wells in the previously unexplored north and east coasts of Trinidad; and (3) significant advances in our understanding of the tectonic evolution of the area, which has resulted largely from the development of the plate tectonic theory.

The following items, which take into account many of these new data

and concepts, have been compiled. (1) A geologic tectonic map of the entire territory of Trinidad and Tobago, at a scale of 1:200,000. Apart from the surface geology of the land areas, this map shows the major faults and their displacements and locations, total depths and status of exploration wells, and the positions of major petroleum fields. (2) Five accompanying geologic sections at the same scale. (3) A new stratigraphic correlation chart.

These new compilations attempt to fill the gap in the published literature on the petroleum geology of Trinidad and Tobago.

PHILLIPS, F. JAY, Denver-Alaska Oil Co., Golden, CO

A Computerized Paleontological Work Station

A microcomputer efficiently replaces the pencil and notepad by the microscope. The same reports produced by hand are produced in less time at lower cost by computer. System components are the Checklist II program, a microcomputer, two disk drives, and a dot-matrix printer. Advantages over manual methods include multiple data use without reentry, automated drafting, more complex capabilities, and no transcription errors. Advantages over mainframe implementation include ease of use, same-day reports, work station mobility, and cost savings.

A computer system should be as easy to use as the manual system it replaces. This ease is achieved by using menus rather than memorized commands, and by duplicating manual procedures already in use. Data are stored by project; each file contains abundances for species in a related group of samples. This speeds program use by keeping all species information in active memory. Completed data files can be fed into a mainframe data base if desired. Various abundance formats are accepted, including specimen counts, relative abundance, presence/absence, and free form. Interpretive information can be entered as comments.

Data can be displayed as a variety of range of charts. Sample can be sorted. Species can be ordered alphabetically, by highest or lowest appearance, or manually. Abundances can be an entered, or converted to percent, presence/absence, total range, relative abundance, or graphic characters. Other analyses such as diversity calculations, cluster analysis, histograms, and graphic correlation can use the same data set.

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New Ulm Field: An Example of Cretaceous Shelf-Slope Instability in East Texas

The New Ulm field in Austin County, Texas, is an example of the structural and stratigraphic complexity above the Cretaceous Edwards shelf margin of east Texas. Deep wells and improved seismic data provide documentation of structural patterns and deepwater facies not previously considered in Gulf Coast reservoir play modeling.

Study of the data implies the Late Cretaceous to Eocene section was deposited along a shelf-slope break. Late Cretaceous, pre-Midway sedimentation was affected by structurally induced slope instability, and consequent gravity faulting and slumping resulted in an irregular sea-floor surface. Paleocene Midway sands were carried onto this surface by storm-generated density currents where the uneven topography caused deposition in constructional channels. Continued deposition of the fluvio-deltaic Wilcox on this surface caused faulting and folding by differential compaction. The folds are minor and the faults small and steep, not like the typical large growth faults of the Gulf Coast. Upper Wilcox sediments were progressively less disturbed as the region stabilized.

New Ulm field production includes gas from the Midway Formation and oil and gas from the Wilcox Group. Midway reservoirs are stratigraphic, consisting of turbidite channel sandstones; Wilcox reservoirs are structural, consisting of fluvio-deltaic sandstones within faulted anticlines.

This study adds evidence to data describing shelf-slope geology along the Edwards margin. The setting can be a new type of hydrocarbon play in the Gulf Coast.

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Barium Partitioning in Carbonates: Theory and Applications

The partition coefficient for Ba^{2+} into calcite has been established as 0.06 ± 0.01 at 25°C (77°F). The partition coefficient proved independent of rate of precipitation in a series of 19 runs of varying duration. This value is substantially lower than that reported by Kitano in 1971, reflecting our seeding technique, which focused the experiment on crystal growth rather than on spontaneous nucleation and growth. The 0.06 value is compatible with the values reported for Sr^{2+} (0.05 to 0.14), a cation of identical charge, but closer to Ca^{2+} in ionic radius.

The natural partitioning of Ba^{2+} was examined in fresh (aragonite) and altered (calcite) corals from the Pleistocene reef terraces exposed on Barbados, West Indies. The Ba^{2+} concentrations ranged from 8 to 15 ppm in the aragonites and decreased to typical values of 1 to 3 ppm in the calcites. The partitioning of Ba^{2+} in these samples was quantitatively similar to the attendant partitioning of Sr^{2+}. The partitioning of Ba^{2+} during the carbonate cycle offers new areas of investigation. The low concentrations of Ba^{2+} in sedimentary biograins (3 orders of magnitude less than Sr^{2+}) make Ba^{2+} a sensitive monitor of externally derived, barium-bearing solutions involved in diagenetic reactions. Likewise, the low concentrations ensure ideal partitioning behavior in diagenetic solutions of low ionic strength.

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Depositional Environments and Invasion Profiling in Heavy Oil Sands, Eastern Venezuela: A Case Study

A comprehensive study of a single well for INTEVEP and Meneven in the Faja Petrolifera del Orinoco—an extensive (570 × 140 km, 350 × 90 mi) east-west trending heavying oil belt located immediately north of the Orinoco River, eastern Venezuela—resulted in an interpretation of an invasion profile dependent on depositional environments. The data base was derived from: (1) 400 ft (121 m) of whole core (67% recovery) and 124 sidewall cores taken from the 1,500-1,900 ft (457-579 m) interval of the upper Tertiary Oficina Formation, which, in this area, overlies the Precambrian metamorphosed igneous basement. (2) A logging suite of 22 conventional, experimental, and prototype wireline logs.

In this area, the Oficina Formation is a complex series of stacked, heavy oil-saturated, sand-dominant, fluvially-transported, unconsolidated sediments overlain by lignite- and mud-dominant backswamp and estuarine sediments. Bedding, mineralogy, lithology, and paleontology define fluvial-channel fills, channel-lag deposits, crevasse splays, overbank levees, swamps, estuarine lagoons, and estuarine-channel fills in a delta-plain environment.

Reservoir geometry and facies analyses suggest that several short, wide, deep-channeled, meandering rivers flowed generally northward across a tropical-subtropical plain of low relief carrying the bulk of the sediment in bedload traction (channel fills) and a smaller fraction in density suspension (crevasse splays).

A unique logging suite permitted the measurement of invasion in this heavy-oil environment. The invasion of the mud filtrate was measured at varying depths of investigation using, from shallowest to deepest depths: (1) gamma ray spectrometry log, (2) microspherically focused log, (3) nuclear magnetism free fluid index, and (4) deep Laterolog.

In addition, water trapped in the fine-grained sands was characterized by comparing the porosity from the electromagnetic propagation log to the free fluid index from the nuclear magnetism log. Identification of the depositional facies coupled with these log responses produced an innovative interpretation of the invasion profile. From an oil-bearing gross interval of 262 ft (80 m) 9 sand units were defined according to their primary and secondary (steam processing) production capability.

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Platform-Margin and Marginal Slope Relationships and Sedimentation in Devonian Reef Complexes of Canning Basin, Western Australia

Devonian limestone platforms in the Canning basin were generally rimmed by reef-margin and reef-flat deposits, constructed by stromatoporoids, algae, and corals in the Givetian and Frasnian, and by algae in the Famennian. However, some platforms were low-relief banks with little or no reef development.