level changes effected migration of depositional environments. Such migrations were evidently cyclic in nature, i.e., they comprise a repetitive series of transgressive-inundative-regressive sequences.

Retreat of Mesozoic shorelines, and inception of active erosion of former depositional areas, was commonly anticipated by the gulfward migration of lithotopes. An example of this is seen in the upward increase in grain size and clastic ratio in strata below the sub-Gulfian unconformity. Thus, in some areas of east Texas, the Buda Limestone is succeeded upward by the "Maness Shale," which is then succeeded by sands of the upper member of the "South Tyler Formation." The sub-Gulfian unconformity constitutes regionally the most useful means for determining the Gulf and Comanche Series boundary. Accordingly, strata deposited immediately before culmination of the South Tyler regression are assigned to the Washita Group. Strata deposited immediately after the beginning of Woodbine-Tuscaloosa transgression are assigned to the Woodbine Stage. Consequently, some lower sands along the lower Tuscaloosa fairway could be latest Comanche regressive deposits.

Fluviatile deposits have been described in the lower Tuscaloosa Formation near the inland edge of the Toledo Bend flexure. The presence of continental facies, within such a short distance of the Mesozoic shelf break, indicates that the shoreline previously had migrated almost completely across the Mesozoic shelf by the end of Washita deposition. The fluviatile deposits grade upward into finer grained strata of the middle Tuscaloosa Formation, thereby suggesting increasing distance of transport and deepening of waters. The upward change from the fine-grained middle Tuscaloosa to the coarse-grained strata of the upper Tuscaloosa suggests the gulfward spread of shallow-water conditions. Accordingly, the lower, middle, and upper Tuscaloosa divisions are interpreted to represent, respectively, the transgressive, inundative, and regressive phases of the Woodbine-Tuscaloosa depositional cycle.

An interesting phenomenon of inland areas was the opening of the Mississippi embayment. During this event, Gulf-related deposition spread inland across a series of basin-concentric, Paleozoic elements inland from the Ouachita deformed belt. These elements included a linear trend of fore-basins and a trend of large foreland uplifts. The embayment first extended northward across the Black Warrior basin, then across a saddlelike feature between the Nashville dome and the Pascola arch (i.e., the buried southeastern extension of the Ozark uplift). Coarse clastics were supplied to the Tuscaloosa by Paleozoic formations, such as the Fort Payne Chert, which cropped out on nearby structures. The embayment axis has since migrated progressively westward to its present position near the course of the Mississippi River.

Indicated reserves along the lower Tuscaloosa fairway seem impressive. Furthermore, the fairway opens up whole new types of Mesozoic reservoirs, those deposited along the Mesozoic slope. Since this trend defines the gulfward edge of the Mesozoic shelf, it permits the study of a complete suite of shelf facies and the definition of a new frame of reference for stratigraphic and environmental studies.

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Preliminary Observations of Modern Point Bar Facies, Amite River, Louisiana

The modern Amite River, an incised, flashy discharge stream, represents a coarse sand and gravel bed-load system typical of the Florida Parishes of southeastern Louisiana. Preliminary investigation provides general descriptions of channel morphology and sedimentology which permit the recognition of distinct point bar facies.

Bed-form and stratification types are used to differentiate lower bar, upper bar, and chute bar facies. The lower bar facies contain transverse bars, scour pits, dunes, and ripples. A vertical sequence reveals poorly defined tabular and trough cross-stratifications and horizontal stratifications. The upper bar facies appear similar to a longitudinal bar with superimposed ripples. A vertical sequence shows small scale ($<$ 5 cm thick) or medium scale (5 to 15 cm thick) trough and tabular cross-stratifications, horizontal laminations, ripple-drift cross-laminations, and clay drapes. The chute bar facies is characterized by coalescing lobate bars with superimposed ripples. A vertical sequence displays large scale ($>$ 15 cm thick) tabular cross-stratifications, small or medium-scale trough cross-stratifications, ripple-drift cross-laminations, and clay drapes.

Evaluation of observed facies characteristics indicates that the distribution of bar facies and the development of vertical sedimentary profiles appear to be related to the degree of meander curvature. Further research is being initiated to construct a semiquantitative geomorphic and sedimentologic facies model useful to investigators of both modern and ancient fluvial systems.

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Morphology of Turbidite-Channel Reservoirs, Lower Hackberry (Oligocene), Southeast Texas

Gas is produced from Hackberry sandstones at depths from 9,500 to 11,500 ft (2,900 to 3,500 m) in the western part of the Hackberry embayment. Adjacent shales contain a microfauna generally believed to represent bathyal depths. The Hackberry sandstones are turbidites in the form of dip-trending, channel-like bodies. Recent cores from fields in southeast Texas provide more details concerning reservoir character and morphology.

Hackberry reservoirs are found in narrow channels only 3,000 to 4,000 ft (914 to 1,219 m) in width. Channel sandstones thicken abruptly to 200 to 300 ft (61 to 91 m). Middle-channel locations are characterized by stacked, massive sandstones which represent the A division of the turbidite sequence. Stacked channel beds are about 10 ft (3.5 m) thick, but no intervening shales separate bed sets. The channel-margin sections consist of interbedded sandstone and shale. The beds are 3 to 5 ft (1 to 1.5 m) thick and consist of massive and laminated sandstones that form turbidite sequences of the A and

AB type. The adjacent overbank sections are composed dominantly of shale but contain thin sandstones and siltstones that are massive to laminated and rippled, and form more complete turbidites of the ABC type. All sandstones have graded texture and are volcanic-chert arenites of moderate quartz content.

The channels appear to be of constructional origin, and log correlations above and below the channel facies suggest that they are inserted in the sedimentary section rather than filling eroded channels. The several facies illustrated by cores have characteristic responses on borehole logs which permit recognition of channels and overbank sections by logs alone. These distinctive log characteristics may permit the prediction of channels in exploratory and development drilling.

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Calpionellids and Nannoconids of Taraises Formation (Early Cretaceous), Santa Rosa Canyon, Sierra de Santa Rosa, Nuevo León, Mexico

Santa Rosa Canyon dissects the Sierra de Santa Rosa at the western end of an arcuate range in south-central Nuevo León, Mexico, about 40 km west of Linares. About 2,000 m of Late Jurassic (Tithonian) to Late Cretaceous (Maestrichtian) rocks are exposed. The Taraises Formation is composed mainly of dark gray to black, well-indurated lime wackestones and mudstones 132 m thick. The upper part of the formation includes 31 m of dark calcareous shale which contains a few thin beds of moderately indurated lime wackestone which bear ammonites of Valanginian age. Other megafossils are rare throughout the formation. Microfossils are common to abundant in about one third of the samples collected at 2-m intervals. Induration and recrystallization allowed micropaleontologic study by thin section only. The microfauna includes radiolarians, ostracods, echinoderm debris, and unidentified biogenic grains as well as calpionellids and nannoconids, but only the last two are persistently common.

Calpionellid taxa include *Amphorellina subacuta* Colom, *Calpionella alpina* Lorenz, *Calpionella elliptica* Cadisch, *Calpionellites darderi* (Colom), *Calpionellopsis oblonga* (Cadisch), *Calpionellopsis simplex* (Colom), *Remaniella cadischiana* Catalano, *Salpingellina levantina* Colom, *Stenosemellopsis hispanica* (Colom), *Tintinnopsella carpathica* Colom, and *Tintinopsella longa* (Colom). The distribution of these taxa indicates that the Taraises ranges in age from middle Berriasian to the Hauterivian-Valanginian boundary. No calpionellids were found in the overlying Tamaulipas (= La Pena and Cupido of many workers).

Although abundant in some thin sections, nannoconids were less useful than calpionellids. *Nannoconus steinmanni* Kamptner appears intermittently throughout the Taraises Formation. It has been reported to range throughout the Berriasian and Valanginian. Other species of nannoconids were tentatively identified but they are comparable in form and range and their occurrence was plotted with *N. steinmanni*.

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Preliminary Report on Microplankton and Microbenthon Responses to 1979 Gulf of Mexico Oil Spills (Ixtoc I and Burmah Agate), with Comments on Avenues of Oil to Sediments and Fate of Oil in Column and on Bottom

During 1979 the Gulf of Mexico was the scene of the world's largest oil spill (Ixtoc I in the Bay of Campeche) and a major oil tanker spill near a metropolitan area and an estuarine system (Burmah Agate spill off Galveston). Pre-spill sampling provided base-line data on the microplankton and microbenthon. Post-spill sampling (after the oil came ashore in each area, the south Texas and Galveston beaches) illustrated immediate responses to oil in the water column (death of meroplanktonic and holoplanktonic forms, but an apparent congregation of copepods feeding on the oil) and perhaps rapid (increase in nematode standing stock) and longer term (increase in nematodes and benthonic foraminiferans) responses to the oil as it reached the bottom. Four pelagic avenues of oil to the bottom were recognized (tar balls and perhaps on the bodies of dead plankton near the Burmah Agate, flocculation or adhering of clay-sized particles to sheen or mousse, fecal pellet transport, and aerosol transport to the turbid nearshore zone with the adhering of silt-sized particles). Impact was noticeable near the Burmah Agate, in nearshore regions, and under open ocean areas covered by extensive mousse and tar balls; however, most of the open ocean continental shelf appeared to be unaffected.

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Depositional Systems and Lignite Prospecting Models—Wilcox Group and Meridian Sandstone (Eocene), Northern Mississippi

The first year of a three-year Mississippi Mineral Resources Institute project to map the surface and subsurface terrigenous clastic depositional systems and lignite units of Mississippi has been completed. Data from 620 oil- and water-well electric logs, 65 sample logs, and 35 surface exposures have been used to determine the distribution of the principal sandstone bodies in the northern third of the state. Evidence from eight regional cross sections indicates that the Wilcox-Meridian vertical stratigraphic interval can be subdivided into a minimum of four distinct units: (1) a basal Wilcox progradational interval, (2) a lower Wilcox fluvial-deltaic unit; (3) an upper Wilcox fine-grained fluvial unit; and (4) a Meridian coarse-grained fluvial unit. In extreme northwestern Mississippi the highest 200 ft (61 m) of the Wilcox is composed of massive sandstone and is genetically related to the overlying Meridian Sandstone (Claiborne Group). This is the Meridian—upper Wilcox aquifer system (basal part of the Memphis aquifer) of hydrologists. Hence, a fourth Wilcox subdivision, a massive upper Wilcox coarse-grained fluvial unit, can be delineated for the northernmost counties of the study area.

Sandstone-body geometry and lignite distribution in the Wilcox-Meridian systems are indicated by net sandstone isolith, net sandstone percent, thickness of most