structure of strata around the domes, and to ascertain the growth history of the domes as a means to evaluate tectonic stability. Upper Cretaceous to lower Eocene strata bound the upper part of the domes. Three main types of domes have been interpreted from well-log data: (1) at Hainesville dome, Upper Cretaceous strata exhibit notable thickening in a rim syncline, and stratigraphic markers dip toward the dome except near the contact with domal material; (2) at Keechi dome, strata are uplifted and dip away from the dome; strata thin toward the dome; (3) at Oakwood dome, strata are approximately horizontal until near the dome edge, where they are upturned; minor thickening of strata occurs toward the dome. Differences in stratigraphy and structure of Cretaceous-Eocene strata in the vicinity of these domes are attributed to differences in growth history.

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Smackover Reservoir—Interpretation Case Study of Water Saturations Versus Production

Predicting the initial production from wells drilled in certain Smackover reservoirs is often difficult. Production history from the field, core analyses, and log data have not always proved to be helpful.

The Smackover reservoirs for which interpretation is difficult fall into two categories. The first is oolitic limestone characterized by low resistivity, moderate porosity, and reasonable permeability. High water saturation (S_w) calculated from logs does not necessarily preclude hydrocarbon production. The second is oomoldic limestone typically having high resistivity, very high porosity, and low permeability. Although log interpretation indicates low water saturation, no hydrocarbons are produced.

Cores from these reservoirs were studied to evaluate the relations now employed for understanding and predicting production. The investigation included determination of the "m" and "n" exponents (commonly known as the cementation and saturation exponents in Archie's equation), evaluation of the microporosity by scanning-electron microscopy, and laboratory determination of density, porosity, and permeability.

Results of the rock physics investigation support the empirical relations established, provide data for improved interpretation, and can be expanded to include other Smackover reservoirs within the same diagenetic facies.

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Petrography of Some Subsurface Igneous Rocks of Mississippi

Cuttings and cores from test wells in 13 Mississippi counties were examined for igneous material. Samples appearing to be igneous were studied in 41 thin sections. Rocks were classified as intrusive dikes, extrusive volcanics, and basement granite. Alteration of rock types is moderate to severe.

Intrusive dike rocks and extrusive volcanic rocks are present at depths from 3,562 ft (1,085 m) to 10,010 ft (3,043 m). The basement granite observed is present at 11,010 ft (3,347 m) in Lafayette County in north Mississippi and 18,826 ft (5,738 m) in Jackson County in the coastal area.

Basement granite of Precambrian age represents the oldest stratigraphic interval recognized. Volcanic extrusive rocks and plutonic intrusive rocks have been interpreted to be present in sediments of Paleozoic through Cretaceous ages. Available age dates of the volcanic material indicate Jurassic to Late Cretaceous activity.

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Sedimentation on Trailing Plate Margin—Northern Gulf Coast

The breakup of Pangea and the splitting of South America from North America in the early Mesozoic left a rifted and attenuated trailing margin on the latter plate which became the initial depositional surface for a sedimentary sequence of Late Triassic to recent age. The Late Triassic Eagle Mills Formation and its equivalents are interpreted as being the initial deposits confined to rift grabens of the attenuated plate margin. Deposition of Jurassic evaporites resulted from sedimentation by the brine-mixing process in the restricted circulation of a young and narrow seaway similar to the Red Sea. Upper Jurassic and Cretaceous strata represent the transgressive deposits formed as open-marine conditions prevailed as the plates diverged and the North American plate margin subsided. Laramide tectonism in the continental interior provided a rejuvenated hinterland source area that supplied the voluminous sediment for the regressive and prograding Cenozoic clastic wedge.

Studies of this entire sedimentary record reveal the influence of the tensional effects of continental splitting and lower crustal creep that established the initial depositional surface that slowly subsided as proposed by crustal thinning and the thermal-decay curve of cooling oceanic lithosphere. In addition, these studies also reveal the control and influence of (1) inherited structures of the rifted margin, (2) hinterland source areas, (3) the timing and amount of differential subsidence between continental and ocean crust, (4) active syndepositional faults, (5) hinge lines, and (6) postdepositional rejuvenation due to contemporary plate movement.

Not only do these studies add to our understanding of the geologic history of the area, which is most important for development of successful exploration programs, but they provide a guide for the study of sedimentary infills within ancient lithospheric plates, a neglected but important task facing all who are confronted by the complex problem of interpreting the sedimentary record of ancient basins.

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Hydrology and Water Quality of Eocene Wilcox Group in Relation to Lignite Development in East Texas

Lignite development will place major demands on groundwater supplies. The Simsboro Formation and the Calvert Bluff Formation (a major lignite host) of the Wilcox Group between the Colorado and Trinity Rivers constituted a test case to evaluate water availability and quality. Aquifer geometry (sand versus mud) was determined by comparing environmental geology maps and subsurface sand-percent and net-sand maps constructed from electric-logs. The combined maps correlate well and show that the Calvert Bluff consists of a complex interfingering of coarse channel sands and fine interchannel muds. Sand outcrop areas several tens of square kilometers separate much larger interchannel areas with few and minor sands. The Simsboro consists of two parts—a thick multilateral sand (300 to 700 ft or 90 to 212 m) in most of the southern outcrop belt and a series of channel sands (100 to 200 ft or 30 to 60 m) interspersed with muds in the northern belt. Sands of the northern Simsboro belt are more like the Calvert Bluff channel sands than like the thick Simsboro sands.

Available hydrologic data suggest that Simsboro and Calvert Bluff sands have high hydraulic conductivity (6 to 20 m^3/m^2/day); interchannel muds have low hydraulic conductivity (1 to 2 m^3/m^2/day). Water compositions in the Simsboro and Calvert Bluff are similar and evolve similarly. Near-surface water has a Ca-Mg-HCO_3 composition, low in total dissolved solids (<500 mg/l). The water evolves over a depth range from 300 to 1,200 ft (91 to 364 m) to a Na-HCO_3 water (~1,000 mg/l). Change in composition probably results from ion exchange with clays (Ca^{++} for $2Na^+$) and solution of calcite (which contributes more Ca^{++} for exchange and increases HCO_3^- concentration). Correlation of composition with amount or percent sand has not been demonstrated. Poor-quality water is largely restricted to shallow wells (<100 ft or 30 m) in muddy parts of the Calvert Bluff.

HENRY, JAMES D.

Enhanced Oil Recovery

In the United States, known fields contain about 300 billion bbl of oil which will not be recovered because of economic and technological limitations. This oil is the target of Enhanced Oil Recovery (EOR).

However, even given reasonable improvements in oil price policy and process technology, the success of EOR projects is not guaranteed. The high cost of the injected materials and the necessity of maintaining certain critical conditions at the injection front will require much more geologic assistance to the reservoir engineers than has been provided for conventional recovery processes.

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Queen City Formation in East Texas Embayment—Record of Riverine, Tidal, and Wave-Dominated Processes

Five distinct facies are recognized in Queen City exposures between the Trinity River valley and Louisiana boundary. These facies (fluvial, deltaic, tidal flat, barrier, and tidal delta) display distinctive suites of physical and biogenic structures, with substantial differences in paleocurrent pattern.

Fluvial influx was mainly from the northwest, possibly with minor contributions from the Sabine uplift on the east. A marginal alluvial plain was transected by sandy braided streams and sinuous mixed-load channels. Very small, high-constructive shoal-water deltas and crevasse subdeltas developed mainly along the northwestern embayment margin, prograding rapidly across the shallow shelf. Barriers may have originated as destructive components of delta abandonment or as contemporaneous strike-fed features marginal to the main delta complex in the west. In either event, barriers are poorly preserved, possibly because of transgressive ravinement, but more likely because they were never developed on a major scale. Flood-tidal deltas formed at the mouths of microtidal estuaries. Like some modern analogs, they are significantly larger than comparable mesotidal features. They also exhibit features reflecting storm processes. Extensive back-barrier or bay-margin intertidal and subtidal flats and shoals reflect the interplay of tidal and wave-generated processes, leaving a characteristic record of variable physical energy and flow patterns.

Regional depositional patterns were largely controlled by (1) location of the east Texas embayment with respect to the major deltaic depocenter, resulting in an eastward decrease in sediment supply; (2) configuration of the broadly funnel-shaped embayment which may have augmented tidal range; and (3) transition from overall progradational character, with local transgressions, to a major marine transgression that culminated in shelf sedimentation of the overlying Weches Formation.

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Distribution of Volcanic Activity in Time and Space in Gulf Coastal Province

Volcanic activity has been an integral part of the history of the Gulf coastal province, which may come as a surprise to many who consider the Gulf Coast to be a mature quartzose sedimentologic province. Volcanic products, including intrusive and extrusive igneous rocks, tuff, glass, bentonite, and volcanic rock fragments, are known from nearly every geologic stage since the beginning of deposition of the Gulfian Series.

Violent activity has been recorded in two periods of Gulf Coast history: (1) during Woodbine-Eagle Ford-Austin time in the Mississippi embayment and (2) during Oligocene to Miocene time in the Rio Grande embayment. The opening of the Gulf of Mexico during the Triassic was accompanied by volcanism. The southwestern Gulf of Mexico has been the site of the latest activity, in the 17th and 18th centuries.

Volcanic activity has not driven off adjacent accumulations of oil and gas as might be suspected. However, it may have impact for exploration and production of oil and gas. Consideration of local volcanic sources can alter current sedimentologic models of the Gulf coastal province. Accelerated diagenetic processes can compli-