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Log Evaluation of Wells in Tuscaloosa Trend of South Louisiana

The Tuscaloosa trend of south Louisiana provides many challenges to oil and gas operators. The formations are found below a depth of 16,000 ft (4,877 m). At these depths, temperatures approach 400°F (204°C) and pressure gradients range from 0.459 to 0.96 psi/ft. Production tests have shown the presence of CO_2 and H_2S and have revealed that formation water salinity ranges from 11,500 to 120,000 ppm NaCl. These salinity variations occur both vertically and laterally.

The combination of depth, high temperature, and varying pressure gradients along with the presence of CO_2 and H_2S has complicated drilling, usually resulting in the use of oil-base mud below a depth of about 16, 000 ft (4,877 m). The logging tools used to evaluate these formations must operate in this hostile environment. Various combinations of tools are applicable to Tuscaloosa evaluation, with limitations. Difficulties in calculation of formation water salinity arise from logs run in oil-base mud.

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Atchafalaya Delta—Louisiana's New Prograding Coast

Building of the Atchafalaya delta constitutes one of the most significant geologic events in historical times within the Mississippi Delta complex. Periodic upstream diversions, such as the present Atchafalaya River, result in switching of the major loci of active deposition and are among the fundamental mechanisms of Mississippi delta growth.

Prior to 1950 Atchafalaya sediment was trapped in intrabasin lakes and swamps. Thereafter, progressive basin filling prompted silt and clay deposition in Atchafalaya Bay and initiated the subaqueous phase of delta building. This developmental stage continued until the appearance of sand-dominant subaerial lobes in 1972, after which rapid subaerial growth occurred.

Development of the Atchafalaya delta is related to major flood pulses of the Mississippi River. Interpretation of Landsat imagery and aerial photography indicates extensive subaqueous and subaerial growth during years of major floods. This trend is supported by subaerial transect measurements, which reveal maximum bar aggradation of 0.44 m and up to a 40% reduction in channel cross-sectional area due to levee migration and mid-channel bar formation during floods. In addition, major floods serve to repair lobes eroded during severe winter cold-front passages.

River-mouth processes are frictionally dominated. Channel-mouth bifurcation, accompanied by coarse-particle deposition, is the major process of lobe initiation. Larger lobes are the result of coalescence of numerous distributary-mouth bars and adjacent channels. Major channels, separating large lobes, supply sediment to areas bayward of the existing lobes. As the bars coalesce, the distance from the river mouth to the head of the emerging bar decreases and the bifurcation angle increases.

Retreat of this part of the Louisiana coast has occurred since the Bayou Black depositional phase of the Lafourche delta lobe, 1,000 to 2,000 years ago. The Atchafalaya delta, prograding at a maximum rate of 6.5 sq km/year, is helping offset the 42.2 sq km/year loss of Louisiana wetlands.

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Seismic-Stratigraphic Mapping of Gulf Coast Stratigraphic Traps

The mappability of a seismic-stratigraphic trap depends not only on the thickness and the stratigraphic position of the objective unit, but the velocity contrast with nearby beds. Analysis of band-pass filtered sonic logs provides a useful technique for determining the portion of the frequency spectrum that carries the basic stratigraphic information. Depending on local stratigraphy, both high (75 to 125 hz) and low (0 to 10 hz) frequency components may be important in defining the trap. The filtered sonic can be used to predict the seismic mappability of stratigraphic units.

Review of seismic-stratigraphic data over fields in the Gulf Coast indicates that determining the mappability of a feature depends on complete understanding of the trap. At Walker Creek field, Smackover porosity is not resolved with a 60-hz filtered sonic. Because the basic reservoir-seal relation is low frequency, however, the field limits are clearly expressed on real seismic-stratigraphic data. Alternatively, recognition of the pinch-out of the 20-ft (6.1 m) thick Spanish Camp Sand at South Lissie field serves as an excellent example of a trap expressed as a high frequency feature.

These simple examples illustrate clearly that both high and low frequency components are required for successful seismic mapping of Gulf Coast stratigraphic traps.

WEBER, ANTHONY

Pachuta Creek (Smackover) Field, Mississippi

The Pachuta Creek oil field, located in T2N, R14E, Clarke County, Mississippi, was discovered in 1968. Since that time, the field has yielded over 24 MM bbl of oil from the Smackover Formation. Eighty-one wells have been drilled in the field, with a good coverage of seismic data. However, previous studies of the Pachuta Creek area have been unable to thoroughly integrate the geophysical and geologic data into structural maps. This difficulty is due to the dynamic nature of the acoustic velocities associated with the changing lithologies in the area. The creation of average acoustic velocity maps has been accomplished by close correlation of the seismic data with the subsurface well information. These velocity maps represent the average acoustic velocity configuration from sea level to the top of each of three formations: Haynesville, Smackover, and Louann Salt. These average velocity maps provide the key for transforming seismic data (in time) to subsea depths consistent with the subsurface well control. Subsurface structure maps have been constructed at the top of the three formations previously identified. These maps represent a thorough integration of both geologic and geophysical data and provide a means for accurately ascertaining remaining hydrocarbon potential in this area. The algorithms which have been used for the combination of the geologic and seismic data in this study may be used to provide more complete subsurface interpretations in other areas.

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Block 25 Field, Chandeleur Sound, St. Bernard Parish, Louisiana

Block 25 field, Chandeleur Sound, St. Bernard Parish, Louisiana, was discovered by Atlantic Richfield Co. through the drilling of its State Lease 4542 No. 1 well in October 1965. Drilling had been preceded by a common-depth-point seismic survey that revealed a subtle, east-west elongated, rollover structure on the downthrown side of a down-to-the-coast growth fault.

Present water depths in the field area are 10 to 12 ft (3 to 3.7 m).

Two pay sands occur on the structure, the 4,800′ Sand with a total, original hydrocarbon column of approximately 30 ft (9.1 m), and the 5,200′ or BB Sand with a total, original hydrocarbon column of approximately 55 ft (17 m). The 5,200′ Sand is the primary producer in the field. Total oil production from the field to date is more than 18.5 million bbl. The gravity of the oil is 27/27.1° API, and several of the wells are being gas-lifted. Thirty-seven wells are currently producing in the field.

Relief on the structure at BB Sand depth is approximately 65 ft (20 m), which is based on the difference by subtracting the depth of the last closing contour on the BB Sand and the highest point of penetration.

The down-to-the-coast fault which trends east-west and lies on the northern side of the field apparently has contributed to the trapping of hydrocarbons in the structure. The fault has a dip of 55° and an upthrown-to-downthrown displacement which increases from 60 ft (18.3 m) at a depth of −3,507 ft (−1,069 m), to 650 ft (198 m) at a depth of −7,295 ft (−2,224 m).

The geometry of the BB Sand suggests that it is a bar-type deposit. The sand interval thickens abruptly on the southern side of the field. Accumulation has occurred in the structurally high sand area to the north, toward the shore, and in the upper, back-bar members of the BB Sand. The bar has some channeling or breaching.

The source of the hydrocarbons in the pay sands apparently has not been from the sediments above or below the reservoirs. These sediments have been analyzed as immature. It is postulated that the oil accumulated in the 4,800′ Sand and BB Sand reservoirs probably migrated into the Block 25 structure from peripheral areas.

The 4,800′ Sand is *Bigenerina* B, upper Miocene in age, and the 5,200′ Sand or BB Sand is *Textularia* L, upper Miocene in age.

The preceding discussion includes numerous studies done by ARCO geologists, geophysicists, and engineers who have worked on the Block 25 field.

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Regional Tectonic Features of Inner Gulf Coast Basin and Mississippi Embayment—Implications for Potential Low-Temperature Geothermal Resources

The Balcones and Luling-Mexia-Talco fault systems in central Texas delineate the deep reaches of several aquifers that yield low-temperature (up to 65°C) geothermal water. This geothermal region also coincides with a tectonic province that bisects Texas. Besides the normal faults that mark the boundary between the Edwards plateau uplands and Gulf coastal plain, there is at depth the foundered Ouachita structural belt, a hinge zone that repeatedly affected Mesozoic and Cenozoic sedimentation and structures. For example, crustal adjustments across the buried Ouachita trend apparently controlled the location of the strand throughout much of the Cretaceous time. The change from fluvial and deltaic terrigenous systems to open marine and lagoonal systems has an important effect on aquifer properties; dip-oriented sand trends are preferred pathways for groundwater flow. Other geologic features that occur along this tectonic and geothermal trend are igneous plugs, loci of hydrothermal mineralization, and ongoing (aseismic or microseismic) adjustments across faults. In short, just as active tectonic areas are the present geothermal "hot spots" of the world, "relict" tectonic areas are distinguished by a coincidence of geologic features that suggest the local occurrence of low-temperature geothermal resources.

Along other parts of the Gulf Coast basin and within the Mississippi embayment, tectonic, igneous, and hydrothermal features converge in a similar manner. Hot Springs, Arkansas, is a notable example. Other areas also show a similar coincidence, but they have not been recognized as having geothermal waters. Areas such as the headward part or the axis of the Mississippi embayment, and the zone of intersection of the deep Appalachian and Ouachita structural trends are potential targets for production of low-temperature geothermal waters. Tectonic trends commonly coincide with population trends, such as along the inner Gulf coastal plain of Texas and along the fall line of the eastern United States. Hence, there may be an established market for direct use of the low-grade geothermal waters from aquifers superjacent to the inner margin of the Gulf Coast basin.

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Paleoecology of Midway Group in Northeast Texas

Strata of the Midway Group crop out in a belt from Georgia to Mexico, including well exposed, studied sections in northeast and central Texas. The benthic foraminiferal data assembled by Kellough have been subjected to cluster analysis. Based on these analyses, five different biofacies are recognized in eastern Navarro County. The Littig, Kinkaid, and lower parts of the Wills Point Members represent one shallow-water biofacies. Upper parts of the Mexia clay represent a different community in which some increases in planktonic foraminiferial percentage may indicate deeper stages. The other biofacies are variations of marginal-marine and deltaic-marine environments. These shallow-water communities are similar to the Paleocene Atlantic coastal plain biofacies. Only a few characteristic species