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A Late Cretaceous Calcarenite Beach Complex Associated with Submarine Volcanism, Wilson County, Texas

A Late Cretaceous, submarine, igneous extrusion and an associated biocalcarenite beach facies occur in the subsurface of the North Poth area, Wilson County, Texas. The volcano and reworked volcanic material built a framework upon which a well-formed carbonate beach developed in the Austin Formation.

The volcanic material was extruded on the shallow sea floor. Prevailing wave energy from the northeast reworked the volcanic materials that were deposited as a fringing platform off the flanks of the extrusion. West of the volcano and stratigraphically above the reworked volcanics is a 35-ft (11 m) bioclastic calcarenite. It was deposited as a barchanoid-shaped beach which lapped on the accumulated reworked volcanics.

The maximum thickness of the Austin Formation in the vicinity of the North Poth volcano is 300 ft (92 m). The Austin Formation thins rapidly toward the volcano; there it is less than 20-ft (6 m) thick near the crest. A considerable amount of draping around the volcano is indicated by the structure of the Austin Formation. Much of the draping is due to differential compaction.

The North Poth, Northwest Poth, East Poth, and the Helen K. Fields appear to be related to this igneous extrusion. Oil has been produced from the Buda and Austin Formations and from the biocalcarenite facies of the Austin Formation. Occurrence of oil appears to be related to porosity in the reworked volcanics and beach complex and to fractures in the Austin Formation. The fractures probably are associated with differential compaction of sediments over the volcano.

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Gulf Coast Stratigraphic Traps in Lower Cretaceous Carbonates

Prolific oil and gas production is being obtained from carbonate patch-reef reservoirs within Lower Cretaceous formations along the Gulf Coast from Florida to Mexico. Many of these reservoirs are trapped stratigraphically where facies changes within a formation or patch-reef unit establish an updip permeability barrier. Examples of such traps from the literature illustrate oil and gas fields in Florida, Mississippi, Louisiana, and east Texas. A geologic model provides the explorationist with an actual drilling target suitable to a multiple-well exploratory program.

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Geothermal Conditions and Their Implications for Basement Tectonics in Gulf Coast Margin

Tectonic interpretations of new heat flow data from Louisiana, Mississippi, Alabama, and panhandle Florida, and radiometric dates for subsurface igneous rocks from Mississippi suggest a complex basement configuration of both continental and oceanic crust for the Gulf Coast region. Original (early Paleozoic) North American continental terrain, characterized by average heat flow (~1.0 heat flow units), is postulated to extend no further south than a northwest-trending boundary linking the truncation of the southern Appalachian Mountains with the Ouachita Mountains. A northwest-trending zone of thinned continental basement and thick sedimentary deposits with anomalously low heat flow and Mesozoic volcanic rocks exists in southern Alabama and pinches out in northern Mississippi (Black Warrior basin and central Mississippi deformed belt). South of that belt, a zone of high heat flow (1.5 to 2.1 hfu), subsurface Mesozoic basalts, and feldspathoidal rocks characterizes northern Louisiana and west-central Mississippi. This zone is distinguished by mobilized, thermally conductive salt diapirs and alkalic igneous rocks. The Wiggins uplift with Paleozoic granitic rocks in southernmost Mississippi and its westerly continuation in southern Louisiana yield average heat flow values and are interpreted to represent residual fragments of a South American continental mass that was convergent in the late Paleozoic Era and divergent during the early to middle Mesozoic Era.

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Stratigraphy and Structure of Rosita Gas Fields, Duval County, Texas

Deep Wilcox sandstones in the Rosita field produce large quantities of gas from highly faulted reservoirs at depths of 9,500 to 15,300 ft (2,895 to 4,660 m). The producing sandstones were deposited downdip from a large, active growth-fault system. Six full-diameter cores and 25 electric logs were used to interpret structure and environment of deposition.

Structural movement along listric normal faults resulted in structural closures and stratigraphic thickening. These faults and rollover structures form hydrocarbon traps. Thick sequences of sandstones and shales show a basal shear zone, overlain by a folded and contorted zone, and finally, a normal bioturbated section. The sequence ranges from 10 to 50 ft (3 to 15 m) in thickness and may indicate soft-sediment deformation by slip along nearly horizontal glide planes. The extensive deformation suggests that the entire Wilcox section moved intermittently shortly after deposition under the force of gravity. Numerous deformed slides are present within major fault blocks. High pore pressure probably facilitated movement of these slide blocks.

The depositional environment of Wilcox sandstones in the Rosita field was probably outer neritic to upper bathyal. This interpretation is supported by regional stratigraphic location and trace fossil morphology. The style of deformation is also compatible with an outer-shelf or upper-slope morphology. The producing sandstones are classified as lithic and feldspathic graywackes. Variation of texture and composition is small. Low permeabilities of 0.001 to 2 md can be attributed to high authigenic-clay content.

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Detailed Evaluation of Two Texas Lignite Deposits of Deltaic and Fluvial Origins

The Wilcox and Jackson Groups are the most important lignite-bearing geologic units in Texas. Depositional systems interpreted for these units in east Texas are fluvial and deltaic, respectively. Assessment of the geologic characteristics of a lignite deposit in both the Jackson and the Wilcox Groups indicates positive correlations with the regional depositional models. Regional evaluations of the Jackson Group associate high-sand areas with lignite occurrence. In the Wilcox Group, lignites are associated with low-sand areas.

A Jackson Group deposit in east Texas reflects two distinct processes of lower delta plain deposition. Thin, discontinuous lignite seams apparently formed in small interdistributary areas, which were commonly inundated by sediment during overbank flooding and crevassing. Thick coal seams, deposited on sand platforms, are laterally continuous and represent lignite deposition during periods of delta lobe abandonment. A change in position on the delta plain from stratigraphically older to younger seams is reflected in both seam characteristics and comparisons of average heating values.

A Wilcox deposit in east Texas shows most of the characteristics of an alluvial plain setting. The individual seams are lenticular; the thickest lignite occurs in the center of the lignite bodies but decreases abruptly along the margins. Adjacent to the lignite bodies are channellike barren areas that are filled with either mud or sand. Channels are normally parallel to the individual lignite bodies. Large, irregular and circular mud-filled areas completely surround some of the lignite seams. Overall quality of the lignites in this environment is found to be variable, but generally low in ash and high in heating value.

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Environment of Deposition and Reservoir Properties of Woodbine Sandstone at Kurten Field, Brazos County, Texas

A combination of stratigraphic and diagenetic events has trapped oil in thin-bedded, clayey sandstones of the Upper Cretaceous Woodbine-Eagle Ford Formations. Five sandstone units occur in Kurten field and are designated from top to bottom as "A" through "E." Foraminifera and nannofossils indicate these units to be late Turonian. The "C" and "D" units are elongate north to south, 4.5 mi (7.2 km) wide, over 10 mi (16 km) long, and 40 ft (12 m) thick. The "B" and "E" units are thinner and trend northeast to southwest. Grain size coarsens upward in the "B," "C," and "D" units, averaging 0.14 mm and ranging from 0.09 to 0.18 mm. Grain size fines upward in the "E" unit. The sandstone's average composition is 66% quartz, 1% feldspar, 2% rock fragments, and 28% matrix. Sedimentary structures in the "B," "C," and "D" units grade upward from laminated and bioturbated siltstones to clean sandstones with flaser cross-beds. The "E" unit consists of repeated bedsets similar to "cde" turbidite divisions. Sedimentary structures and bioturbation indicate that the units are offshore bars which have been formed by a combination of river mouth bypassing, storm-surge turbidity flows, and longshore currents.

The porosity is largely diagenetic and occurs in the clayey beds. It appears to have been formed by freshwater leaching along an erosional unconformity overlain by the Austin Chalk. Permeability becomes progressively poorer away from the unconformity and a permeability barrier ultimately forms a poorly defined updip limit for the field, making Kurten a combination diagenetic and stratigraphic trap. Relatively widespread occurrences of offshore bars suggest that similar traps may be fairly common in ancient shelf sediments.

SEPM Abstracts

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Porosity Reduction Through Ductile Grain Deformation: An Experimental Assessment

At the time of deposition, sands in high energy environments commonly have porosities of 40 to 55%. This depositional porosity is reduced following burial by cementation and compactional processes. In sands with a high percentage of ductile grains, ductile grain deformation can be a major compactional process and can have an appreciable effect on porosity and reservoir characteristics. To test the significance of this process, a series of sands were manufactured containing variable percentages (5 to 50%) of ductile grains mixed with equal-sized quartz. These mixtures were compressed in a biaxial compression system at pressures of from 4,000 to 20,000 psi (27,580 to 137,900 kPa), simulating burial to depths of up to 20,000 ft (6,096 m). As expected the results showed a negative correlation between porosity and pressure for samples with the same ductile content. A strong negative correlation was also apparent, however, between porosity and ductile grain content in samples compressed at the same pressure. Porosity values of medium-grained sands compressed to 10,000 psi (68,950 kPa) ranged from 24% in sands with 20% ductile grains to 9% in sands with 50% ductile grains. In samples compressed to 20,000 psi (137,900 kPa), porosity values ranged from 9% in sands with 10% ductile grains to 1% in sands with 50% ductile grains. Experimentation with other types of ductile grains and grain sizes indicates these variables are also significant but do not alter the basic relation between ductile grain content and porosity. These data suggest it may be possible, with knowledge of ductile grain content from outcrop or shallow well samples, to predict porosity reduction due to ductile grain deformation in deeper, downdip reservoirs. The data may also have application in determining depth at which cementation occurred.

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Structural Patterns in South Florida

Analysis of surface features in south Florida indicates a clear pattern of structural control (faulting, fracturing, or bending). This control is visible in lake outlines, stream channel directions, stream patterns, stream occupation of a non-stream trough, drainage pattern discontinuities, ground surface offsets, coastal offsets, confluence geometries, and ground slopes. The two dominant linear orientations are N50°E and N65°W; these form acute angles, facing east and west, of about 65°, and are taken to be the shears in a first-order strain ellipse. The intersection of two of these trends, immediately west of Lake Okeechobee, provides five or more meters of relief, shapes the western shores of that lake, distorts drainage patterns to the east, north, and west, and produced the basin which the lake occupies.

The long trough, through which the Caloosahatchee River flows, is parallel with one of these first-order alignments, and is marked by a down-to-the-southeast asymmetry. An extension of the northern boundary of the trough is thought to account for the coastal offset in the vicinity of Sanibel Island.

The fault-and-fracture pattern deduced here indicates north-south tension, in accord with the known northward migration of the continental block. Subsurface data indicate that the tectonic pattern is an old one, but the surface features which can be seen today date from Pliocene-Pleistocene time. The maximum rate of deformation in the last few million years has been calculated to be about one millimeter per millenium, and the actual rate has probably been somewhat less.

Second- and third-order orientations, predicted by use of the Moody-Hill hierarchy, have been observed in several stream patterns.