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PALEOECOLOGY, STRATIGRAPHY, PRODUCTION—GETTING IT ALL TOGETHER IN OFFSHORE LOUISIANA

Statistical studies based on the mapping of paleoecologic zones, sandstone conditions, and production in offshore Louisiana indicate a positive correlation among these parameters. Oil and gas production for given depth is associated with a narrow range of preferred environments of deposition and sandstone development. For example, in the depth range 10,000–12,000 ft in the eastern offshore area (Ship Shoal through Main Pass), about 70% of all oil wells are completed where the section contains 10–30% sandstone and is in the inner neritic environment.

An IBM 1130 computer with attached Calcomp plotter was used to prepare (1) structure and environment maps of various biostratigraphic surfaces, (2) environment maps of the interval between biostratigraphic surfaces, and (3) environment maps at constant depth slices. To aid in statistical comparisons, the following maps were constructed in 2,000-ft-thick depth intervals: (1) average weighted environment; (2) sand percentage, net sand, sandstone-shale ratio, and number of discrete sandstones; and (3) oil and gas completions.

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EARLY MIOCENE DEPOSITIONAL ENVIRONMENTS INTERPRETED FROM EXPOSURES IN CANE RIVER DIVERSION CHANNEL, LOUISIANA

A Miocene deltaic sequence, 75 ft thick, is exposed continuously for 4 mi in the Cane River Diversion Channel 25 mi northwest of Alexandria, Louisiana. This outcrop permits a detailed study of the abrupt lateral and vertical variations of lithologic character, sedimentary structures, bed geometry, and diagenetic alterations in a prograding deltaic sequence. From this study, the sedimentary features of channels, point bars, levees, swamps, and distributary mouth bars have been characterized and compared with those of modern deltaic environments. Deltaic paleoenvironments commonly are found in the subsurface, *e.g.*, the oil producing Wilcox of central Mississippi and Louisiana. This study provides a model to aid in understanding the seemingly random occurrences of lithologies and their related correlation problems of the subsurface.

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TURBIDITY GENERATION AND DISTRIBUTION IN TAMPA BAY MONITORED WITH TOWABLE OPTICAL TRANSMISSOMETER

Turbidity in Tampa Bay was monitored for 6 months using a towable 1-m optical transmissometer system. The system provided for continuous chart readout and allowed short-term water-mass migrations to be mapped quantitatively. Transmission readings ranged from 80% in the open Gulf of Mexico to zero in Hillsborough Bay.

Five major sources of turbidity were identified: (1) resuspended bottom sediment, present both naturally over shoals and caused artificially by dredging and other developmental activities, most important; (2) suspended phytoplankton ("seston") important locally, especially in Hillsborough Bay, where the pollutional nutrient input is excessive and promotes plankton blooms; (3) sewage outfalls and miscellaneous inputs related to urbanization; (4) river-borne tripton; and (5) surf-generated fine debris.

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"G_2" CHANNEL SANDSTONE, MAIN PASS BLOCK 35 FIELD

The Main Pass Block 35 field is in the Gulf of Mexico about 50 mi southeast of New Orleans in 10 ft of water. The general structure of the field is that of a rollover anticline on the downthrown block of a south-dipping contemporaneous fault which at the "G_2" level has about 200 ft of displacement. The Miocene "G_2" sandstone, the largest single reservoir in the field, is a classic example of oil production from a stream channel. The channel has a maximum width of about ½ mi, and its edges are closely defined by dense well control. The gas-oil contact is at 6,636 ft subsea and the oil-water contact at 6,690 ft subsea. Nineteen wells or sidetracks have been completed in this sandstone, and ultimate recovery will exceed 12 million bbl of oil.

The "G_2" channel sandstone is a clean, well-sorted, fine-grained quartz sandstone with up to 20% feldspars and minor amounts of clay and carbonate. Average porosity is about 34%, and average permeability is in excess of 3 darcys. Bottomhole pressure data indicate that continuity within the channel is excellent. In contrast to the channel sandstone, the associated natural levee and backslope deposits are very fine-grained sandstone or siltstone. Average porosity is about 26%, and average permeability is about 75 md. The "G_2" sandstone series is part of a delta system which was advancing from the northeast toward the southwest. Following deposition of the "G_2" channel sand, the delta abandoned this channel and the entire area subsided. The overlying shales are of marine deposition.

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LOWER CRETACEOUS SLIGO REEF TRENDS IN CENTRAL LOUISIANA

Reef limestones within the Lower Cretaceous Sligo Formation form a trend within the Gulf Coastal province and have been traced in the subsurface from Mexico to Mississippi. This trend probably continues beneath the Gulf of Mexico in the general vicinity of the West Florida shelf.

The Sligo forms 2 reef trends in central Louisiana. The main biohermal trend extends roughly east-west through Vernon and Rapides Parishes, then southeast through Avoyelles, southern Catahoula, and southern Concordia Parishes. It has a maximum known width of about 40 mi and a maximum known thickness of about 500 ft. The few deep tests that have been drilled within this reef indicate a fossil assemblage consisting mostly of caprinids (sessile pelecypods) and algae plus miliolids and other small forms in a sparry or micrite matrix. Up to 50% of the Sligo in this trend is dolomite, and porosity is generally less than 9% in tests drilled to date.

North of the main reef is another biohermal trend up to 250 ft thick which forms an arcuate pattern through eastern Natchitoches, Winn, southern Jackson, and western Caldwell Parishes. The term "patch reef" has been applied to some local thickenings within this

trend. It is possible that this reef extends southeastward into Franklin and Catahoula Parishes, but subsurface data is lacking to substantiate this. The lithology of the northern reef is similar to the main reef in that it contains about the same fossil assemblage in sparry, granular, or micrite matrix. Some zones within and on the north edge of the reef contain an abundance of oolites and algal pisolites. In part the limestone is slightly dolomitic, but there are no dolomite zones as in the main reef. In some localities within the northern reef, porosity and permeability are very high.

Commercial oil and gas production has not been found in the main biohermal trend in central Louisiana, but the possibilities have by no means been exhausted. In contrast, the Black Lake field in Natchitoches Parish was discovered in the northern bioherm in 1964. This is a major gas-distillate-oil field within a stratigraphic-structural trap, containing ultimate reserves of approximately 150 million bbl of oil equivalent. This discovery set off an active wildcat play in search of additional traps of the Black Lake type, so far without success.

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SURFACE FEATURES OF QUARTZ SAND GRAINS FROM NORTHEAST COAST, GULF OF MEXICO

The surface textures of quartz sand grains from locations along the Florida Gulf Coast have been compared with those from other environments. High-magnification studies consistently show the predominance of chemical over physical textural features, which is to be expected in low- to moderate-energy coastal environments. Because of multiple reworking of these sediments, detailed environmental interpretations are difficult but not impossible. Distinctions are commonly quite subtle.

The great influence of the crystal structure of quartz on the physical and chemical surface features precludes the normal method of rapid scanning of several grains per sample by the electron microscope. Therefore, a statistical approach is suggested using a combination of Nomarski differential interference-contrast microscopy and scanning electron microscopy. A relatively high percentage of the total surface areas of large numbers of grains can be studied in detail by this method.

Stereopairs of scanning electron micrographs illustrate numerous surface textural features produced by a variety of sedimentary processes and environments.

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GEOLOGY OF JURASSIC, FLOMATON-JAY AREA, ALABAMA AND FLORIDA

Flomaton field, in Escambia County, is the first major gas condensate discovery from the Jurassic Norphlet Formation in Alabama. Structurally the field is a NW-SE trending low-relief salt anticline bounded on the north and east flanks by a major down-to-the-basin fault which is part of the Pickens-Gilbertown-Pollard regional fault system. The Norphlet sandstone reservoir is about 60 ft thick within the field and produces CO_2 and sour gas with a high condensate yield.

The paleostructural history of the area indicates that early Louann Salt movement and faulting occurred, probably as a result of gravity slide and basinward salt creep, forming structures necessary for trapping hydrocarbons. Jurassic deposition was affected by these early structural features and pre-salt topography.

Norphlet clastics were derived from the northeast and deposited by braided stream systems. As the Smackover seas transgressed the area, the upper part of the Norphlet was partly reworked. In the Flomaton area, the Smackover Formation is a dark-brown, dense, micritic limestone. The overlying Haynesville Formation can be subdivided into an upper member consisting of predominantly red, coarse clastic material and a lower member consisting of fine, red clastics and evaporites. At Flomaton, over 300 ft of bedded salt has been drilled in the lower Haynesville causing many drilling and completion problems. The Cotton Valley Group marks the top of the Jurassic and consists primarily of coarse gravelly clastics.

Exploration activity in southwest Alabama during 1969, 1970, and 1971 led to additional discoveries from the Jurassic. Among these is Jay field in Santa Rosa County, Florida, 7 mi southeast of Flomaton field. Jay produces oil from Smackover dolomite and is the first Jurassic discovery in Florida. The discovery well produced 1,710 BOPD and has resulted in one of the most active exploration plays in the United States.

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LOWER MIOCENE STRATIGRAPHY AND PETROLEUM POTENTIAL, OFFSHORE GALVESTON AND JEFFERSON COUNTIES, TEXAS

Lower Miocene sediments in the southeast Texas coastal area can be divided into 2 distinct trends. The basal Miocene interval from the top of the Oligocene *Discorbis* upward to the *Robulus chambersi* is a predominantly regressive-marine sequence that reflects the gradual progradation of Miocene sands into this area. The overlying sequence from *Robulus chambersi* to *Amphistegina (B)* consists of deltaic and delta-related sediments that reflect continued marine regression and seaward progradation of a large early Miocene delta system.

In the nearshore Galveston and High Island areas, the basal Miocene interval contains a series of potential reservoir sandstones, most of which are above the abnormally pressured zones and occur at depths of less than 9,500 ft. Farther offshore, the younger *Amphistegina (B)* sandstones become favorable exploration objectives.

Several lower Miocene biostratigraphic zones are identifiable throughout the area and an attempt has been made to relate each zone to particular lithologic conditions or depositional environments. Because of the general southward movement of the shoreline during the Miocene and a relatively limited supply of sand, prospective Miocene sandstone trends in the southeast Texas offshore occur in narrow "belts" approximately parallel with the present coastline. Identification of these favorable trends is essential to a successful exploration program in this area.

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PLANKTONIC FORAMINIFERAL BIOSTRATIGRAPHY AND PALEOMAGNETICS OF LATE PLIOCENE AND EARLY PLEISTOCENE STRATA AT LE CASTELLA, ITALY

Late Pliocene to early Pleistocene stratal segments were measured and sampled along the coast at Le Castella, Italy, to determine their planktonic foraminiferal