Mississippi, and Alabama consists of deposits of four principal depositional systems: (1) the Holly Springs delta system which is volumetrically the largest system; (2) the Pendleton bay–lagoon system which extends into eastern Texas; (3) a restricted shelf system east of the delta system; and (4) an unnamed fluvial system which crops out along the flanks of the northward-trending Mississippi trough. Sandstone isolith maps outline the geometry of the delta mass and show at least three lobe complexes separated by mud-rich interdeltaic subembayments.

Detailed facies maps, on which information derived primarily from electric logs is used, allows recognition of seven principal component facies of the delta system: (1) bar-finger sand facies; (2) interdistributary bay mud-salt facies; (3) distributary channel sand facies; (4) prodelta mud facies; (5) distributary mouth bar–delta front sand facies; (6) interdistributary deltaic plain sand-mud-lignite facies; and (7) destructional phase sand-mud-lignite facies. Two principal types of delta lobes differentiated by their areal geometry, internal facies relations, and distributary channel development, can be recognized in the Holly Springs delta system. Bird-foot lobes were constructed where distributaries prograded over thick prodelta mud sequences; thinner, more lobate shoal-water delta lobes formed on shallow, sandy shelves or on foundered plains of older deltas.

A distinct correlation between depositional environment and the production of oil exists in the Holly Springs and Rockdale delta systems, which comprise the lower Wilcox of southeast Texas. Sand units associated with facies of the distal margins of individual delta lobes or with the destructional units are the most prolific reservoirs, and production is therefore centered along the flanks of the major lobe complexes where maximum delta destruction and interfingering with marine mud occurred.

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Wilcox Dipmeter Applications

Thick lenticular Wilcox sandstone bodies of fluvial channel, bar-finger, or marine-bar origin are favored objectives of drilling in the active Mississippi-Louisiana Wilcox (Eocene) play. Correct utilization of dipmeter surveys will facilitate development and exploration drilling for these thick sandstone bodies. Detailed computation with a maximum number of computation levels is necessary; also, detailed analysis by geologically oriented personnel is essential.

An approach to sandstone-trend determination is presented using sandstone cross-bedding and counter-regional dip due to differential compaction. Substantiation is provided by an example area, Milligan Bayou field, Avoyelles Parish, Louisiana.

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Sedimentation in Breton Sound and Effects of Mississippi River-Gulf Outlet

The Mississippi River-Gulf outlet is a channel 36 ft deep and 500 ft wide extending from a point south of Michoud, Louisiana, southeastward across the marshes and Breton Sound into the Gulf of Mexico. The outlet was constructed by the U.S. Army Corps of Engineers to provide additional access to the Port of New Orleans and thereby ease traffic on the Mississippi River. The channel crosses a delta lobe constructed when the Mississippi River flowed down a course east of its present course. The sedimentary environments and the features formed by the destruction of the now abandoned and subsiding lobe have a great influence on sedimentation in the outlet and, conversely, the outlet has had a profound effect on the environments on which it has been superimposed. The outlet has encountered an excessive amount of shoaling in its Breton Sound reach. In an effort to determine the cause(s) of the shoaling and the source(s) of the shoal material, a study was made of the factors influencing sediment distribution in the Breton Sound area (*e.g.*, tides, winds, spoil, and sediment distribution, salinity, current directions, and velocities). The principal source of the shoal material was determined to be the spoil dredged from the outlet itself which returns to the channel by density flow rather than by normal deposition of suspended material.

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Depositional Environments of Sandstones as Interpreted from Subsurface Measurements —an Introduction

A sedimentary rock is a product of its provenance and transportational mechanisms as well as of its environment of deposition. As such, a sedimentary rock reflects the physical and chemical conditions under which the sediment was transported, deposited, and buried. The combined factors of size, energy, and water depth give an indication of the environments of deposition and these factors are represented directly or indirectly on the IES log (in the Gulf Coast, the "base line" corresponding to impervious beds is commonly shale, and peaks on the left correspond to pervious beds, commonly sandstone). Therefore, it is necessary to know graphically the environmental transitions and configurations as shown on the log. These transitions are of three general types. *Type a* appears to be the most common transition in Gulf Coast stratigraphy and exemplifies an abrupt change from one size fraction to another; therefore this transition indicates an abrupt environmental change or a local unconformable surface. *Type b* is a gradual transition from sandstone to shale or *vice versa* through an interbedded sequence of sandstone and shale. On a local scale this transition could be attributed to a gradual regressive or transgressive oscillation. *Type c* is the least common and most difficult to recognize. This transition suggests a gradual size change (*i.e.*, graded bedding) and could appear at the top of a transgressive phase or the base of a regressive phase. Hence nine different combinations, with minor modifications, are possible in a sandstone-shale sequence and these are used to interpret the possible environments of deposition of the beds.

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Bar and Barrier-Island Sands

Elongate sand bodies may be classified as depositional dip sands (alluvial, channel, *etc.*) or depositional strike sands (bar, barrier, *etc.*). Bar and barrier sand bodies generally exhibit several characteristic properties. Among these are shape, relations with surrounding strata, mineral content, grain size and sorting, size and sorting trends, and carbonate and heavy-mineral content. These properties define the sand body and permit its identification. Depositional strike sandstones are excellent potential reservoirs for hydrocarbons. They were deposited in close proximity to source beds, the marine shales, and in many places their plano-convex geometry makes them "natural" traps.

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PLEISTOCENE OIL AND GAS IN COASTAL LOUISIANA

Louisiana onshore marine Pleistocene reservoirs more commonly contain gas than oil. However, total reservoir volume and cash value of the oil greatly exceed those of the gas. Most of the Pleistocene oil is in southeastern Terrebonne Parish in a small dipwise trend containing Caillou Island, Lake Barre, and Golden Meadow fields.

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DIFFERENTIAL PRESSURES: A TRAPPING MECHANISM IN GULF COAST OIL AND GAS FIELDS

The term "differential pressures" as used in this paper, refers primarily to lateral changes in subsurface fluid pressures. These pressure changes generally take place across faults or across lithologic barriers. The magnitude of these differential pressures can be quite large, and the changes can occur within a very short distance.

A systematic study of the subsurface fluid pressures in several Gulf Coast oil and gas fields indicates that differential pressures strongly influence the accumulation of oil and gas. The influence that fluid pressures were found to have on the accumulations of hydrocarbons in the Gulf Coast seems to conform with the hydrodynamic principles developed and outlined by M. King Hubbert (1953).

More specifically, this paper illustrates some practical examples of fault and stratigraphic entrapment of hydrocarbons under hydrodynamic conditions. The application of the principles demonstrated by these examples to subsurface studies should prove useful in the geological evaluation of oil and gas prospects. Subsurface-pressure studies are recommended as a routine method in exploration geology.

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SULFUR DEPOSITS OF ISTHMUS SALT BASIN, SOUTHEASTERN MEXICO

Large deposits of elemental sulfur have been found in several areas in the southwestern part of the Isthmus Salt basin. Sulfur is being produced by the Frasch process from three of those deposits and at least one more probably will be put into production in the near future.

A large part of the Isthmus Salt basin has not yet been thoroughly explored for sulfur. There are good possibilities for finding additional commercial sulfur deposits in the southwestern part of the basin and also in other sectors. Ten private companies, financed largely by United States capital, currently are exploring for sulfur in the southwestern sector.

Stratigraphic conditions throughout the Isthmus Salt basin, and structural conditions in the eastern part, generally are similar to those in the Louisiana-Texas Gulf Coast region which is characterized by a thick section of Mesozoic-Tertiary sediments having a regional gulfward dip and pierced locally by salt domes. Structural conditions in the western part, however, differ markedly from those at comparable depths elsewhere in the Gulf Coast region: there are several large complex anticlines, or anticlinoria, with salt cores, and the salt is shallow in large areas along the crests of the anticlines. Present thickness of the salt in those areas probably exceeds 10,000 ft.

The sulfur deposits are present in so-called cap rock which overlies the salt. There is considerable lateral variation in composition and thickness of the cap rock; in some areas it consists of limestone, sulfate rocks (principally anhydrite and gypsum), and shale; however, in most of the region, insofar as is known, the cap rock consists only of sulfate rocks and shale. Thickness of the cap rock generally is 100–500 ft; in some places it is absent entirely, and in others its thickness reaches more than 1,600 ft (probably involving some duplication by complex folding and/or faulting).

The cap rock outcrops are covered by only a thin mantle of Quaternary continental sediments in several areas on the crests of the anticlines. Elsewhere it is overlain by marine clastic sediments of various ages ranging from Late Cretaceous to Miocene.

The age and origin of the cap rock, and also the age of the underlying salt, are controversial. In the writer's opinion most of the cap rock, including the limestone, consists of Late Jurassic and/or Early Cretaceous sediments deposited in a restricted marine environment. Other writers, following the prevailing hypothesis for the origin of the cap rock of Louisiana and Texas salt domes, have attributed the anhydrite beds to residual accumulation of disseminated anhydrite grains leached from the salt; the gypsum to alteration of the anhydrite; and the limestone and sulfur to alteration of the anhydrite and gypsum. However, the character of much of the cap rock in the large salt anticlines in the western sector of the Isthmus Salt basin indicates that it consists largely of primary sediments rather than of products of residual accumulation.

The elemental sulfur in the Isthmus deposits, like the elemental sulfur in Louisiana and Texas and other regions where it is present in carbonate and sulfate rocks, probably was formed by a complex process involving (1) reduction of the sulfates by bacteria and/or hydrocarbons, yielding hydrogen-sulfide; and (2) oxidation of the hydrogen-sulfide, yielding elemental sulfur.

Production of sulfur from deposits in the Isthmus Salt basin presently amounts to about 5,000 tons per day. Cumulative production to the end of 1967 was approximately 17.1 million tons. The remaining recoverable reserves in known deposits probably amount to more than 50 million tons.

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PETROGRAPHY AND ORIGIN OF LOWER TUSCALOOSA SANDSTONES, MALLALIEU FIELD, LINCOLN COUNTY, MISSISSIPPI

Upper Cretaceous sandstone of the lower Tuscaloosa Formation in southwestern Mississippi is part of a fluvial-deltaic depositional system. At the Mallalieu field, lower Tuscaloosa sandstone is of two types: (1) channel-fill sandstone—thin, lenticular bodies which have irregular distribution across the field; and (2) point-bar sandstone—thick, more continuous bodies which have a ridge-and-swale pattern of sandstone distribution and which laterally are terminated