

dip of the scarp face is shown to decrease with depth under the abyssal plain sediments. The basin is depicted as a modified oceanic region. A transition from oceanic to continental crust is assumed with a fault or flexure (indicating differential movement of the platform and basin) present near the base of the scarp.

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#### DEPOSITIONAL ANTICLINES, FLORIDA STRAITS

Recent high-resolution seismic-reflection profiles have revealed the presence of base-of-slope depositional anticlines in the Florida Straits. Depth profiles across Santaren and Nicholas Channels are deepest along the sides of the channels at the slope base. Channel axes are somewhat shallower due to anticlinal deposits of sediment.

A large anticline of deposition in an area of approximately 3,100 sq km (900 sq naut. mi) has formed adjacent to the Miami Terrace escarpment. Presumably the high energies of the Florida Current have produced this feature on a grand scale by a mechanism believed to be widespread, but little recognized. It is suggested that these asymmetrical base-of-slope anticlines of deposition find their counterparts in ocean-basin seamount-moat-swell sequences, along deep sea channels which are flanked by levees of asymmetrical depositional anticlines, and in most other depositional areas of the sea floor where deep currents flow along scarps of locally steep slopes.

The base-of-slope depositional anticline concept, as applied to "reverse drag" anticlines associated with scarps in the Gulf of Mexico and in the ancient sediments of the Gulf Coast, appears to satisfy the data better than previously proposed models. It is concluded, therefore, that depositional anticlines are widespread in space and time.

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#### GEOLOGICAL STUDIES OF SOUTH FLORIDA CONTINENTAL MARGIN AND WESTERN STRAITS OF FLORIDA

Seismic-reflection profiles off the western coast of Florida south of 27° N lat. have been recorded during two cruises of Texas A&M University's R/V *Alaminos* in May 1967 and June 1968. They show that the anticlinal ridge present near the top of the West Florida escarpment, which has been proposed to be an extension of the Washita-Fredericksburg reef trend, may possibly be traced southward to the latitude of the Florida Keys.

Several crossings have been made of a large knoll in the western end of the Straits of Florida. Preliminary analysis of the real-time records, without benefit of playback, indicates the presence of a terrace at a water depth of 840 fm, and the possibility that an anticlinal feature, remarkably similar to that seen on the Florida escarpment toward the north, is present.

Reexamination of earlier data from the Campeche Bank and comparison with those presented here reveal several similarities and provide evidence that the Campeche Bank and the Florida escarpment once might have been connected. However, the presence of deep-water Lower Cretaceous in northern Pinar del Rio Province, western Cuba, may indicate that no connection ever existed. If the two escarpments ever were connected, it is not known whether grabenlike faulting, erosion, or both caused the separation of

these two features. More information is being sought in geomagnetic and sedimentological studies now in progress.

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#### DISTRIBUTION OF MINOR STRUCTURES IN GULF OF MEXICO SEDIMENTS

Minor sedimentary structures are studied by means of X-ray radiography from cores collected from various physiographic provinces of the Gulf of Mexico.

The Gulf can be divided into two large petrographic provinces meeting at DeSoto Canyon and Campeche Canyon. The western part is a terrigenous clastic province and the eastern is a carbonate province. For a study of the sedimentary structures it is necessary to divide both petrographic areas into their proper physiographic provinces.

The sedimentary structures and characteristics distinguished are: thin bedding (regular, irregular, lenticular), lamination (parallel, lenticular, irregular), coarse-grained laminae, turbidites (single, multiple, vague), convolute lamination, load casts, degassing structures, mottled, slump, homogeneous, burrowing, mycelium, shells, and shell fragments.

Several of these characteristics can be found in almost any area but some of them are of restricted occurrence. Cores collected from one province reveal only slight variations in their content of sedimentary structures.

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#### ORIGIN AND CONFIGURATION OF ALAMINOS CANYON, NORTHWESTERN GULF OF MEXICO

A submarine canyonlike feature, called "Alaminos Canyon," is located at the change in trend of the Sigsbee scarp between 94° 15' and 94° 30' W long. The approximately N-S-trending system terminates just south of 26° N.

Bathymetric and seismic-profiling records reveal the existence of a complex area in which many single and multiple canyon sections can be observed in a single tract across the area. The sides of the depressions are steep in some places, and a few terracelike features are found. Subbottom profiles show that some depressions are half or completely filled with sediments. Diapiric structures and faults also are observed.

Sediment cores collected in the deepest parts of the canyon present a lithologic character which is a combination of a *Globigerina* ooze and a clayey pelite. No sand layers have been found.

The interpretation of this complex area ranges from that involving a complex submarine canyon system and one involving a hummocky area underlain by salt diapirs. It seems likely that an interpretation utilizing both hypotheses is required.

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#### INFLUENCE OF SAMPLING ON GEOLOGIC INTERPRETATION BASED ON PISTON CORING IN GULF OF MEXICO

Examination of samples taken on the northwest slope of the Gulf of Mexico with a newly developed flexible liner coring device indicates a possible source

of error in the interpretation of recent basin deposition. Visual and radiographical comparisons of samples from a piston corer with samples from a gravity corer used at the same stations confirms the existence of highly incompetent layers previously only suspected. The detection of these layers in a more consolidated sedimentary column, as well as undetected shortening of samples obtained by piston and gravity corers, is important if the sedimentary history and the engineering properties are to be examined.

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#### MAJOR TRANSITION ZONES OF GULF OF MEXICO: DE SOTO AND CAMPECHE CANYONS

Deep well information throughout the Gulf of Mexico coastal plain has indicated that the Gulf margins can be divided into two distinct provinces, the subsided southeastern section which is underlain by carbonate rocks and the northwestern section that is underlain mainly by terrigenous clastic rocks. In the latter area there is complicated surface and subsurface structure controlled mainly by the influence of upward salt migration. Recent geophysical studies in the offshore areas indicate that DeSoto Canyon is the transition zone between the terrigenous clastic and carbonate provinces in the northern Gulf and that the Campeche Canyon plays a similar role in the southwestern part of the basin. Most salt diapirs in the region lie west of a line connecting the two canyons, but recent work suggests the presence of some diapiric structures east of the line.

The geophysical data from the DeSoto Canyon indicate that erosion has played an important part in its development. Two mechanisms for the formation of the canyon are suggested: (1) the loop current of the eastern Gulf of Mexico and associated circulation in the northeastern Gulf have sufficient velocity along the bottom during specific periods of time to effect a scouring action and/or keep sediments in suspension; and (2) erosion by turbidity flows takes place during periods of low sea-level stands associated with glacial stages. The fact that the DeSoto Canyon extends across parts of two distinct geologic provinces, the northeast Florida platform and the Mississippi cone, adds credence to an hypothesis involving erosional rather than tectonic processes.

Although there are insufficient data available to determine the origin of the Campeche Canyon, it is suggested that, unlike the DeSoto Canyon, its topographic expression probably is more the result of adjacent salt tectonics than of erosion. Some workers suggested that an alignment from the DeSoto Canyon to Campeche Canyon may represent a fracture zone across the Gulf basin. The hypothesis that this alignment forms the southeastern boundary of the Gulf of Mexico salt province is contradicted by the presence of diapirs in northwestern Matanzas Province, Cuba, and by the discovery of some possible diapiric structures in the Florida Straits and Yucatan Channel.

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#### STABILITY AND GEOTECHNICAL CHARACTERISTICS OF MARINE SEDIMENTS, GULF OF MEXICO

Studies of shear strength and consolidation characteristics of marine sediments were made from the following four major provinces of the Gulf of Mexico:

Mississippi fan, Gulf abyssal plain, Texas-Louisiana continental slope, and Mexican continental slope. These studies indicate that the sediments in these regions, to a depth of 10 m below the sediment-water interface, are stable in their present environment.

Shear-strength *versus* normal-stress plots indicate that minimum average values of  $\phi$  (angle of internal friction) ranges from 11° for the Texas-Louisiana and Mexican continental slope sediments to 10° for the Mississippi fan and abyssal plain sediments. Average values of  $\phi$  ranged from a high of 20° for the Texas-Louisiana continental slope sediments to 16° for Mississippi fan and abyssal plain sediments.

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#### HABITAT OF OIL IN CARBONATE ROCKS

Entrapment of oil in carbonate reservoirs can be explained by analysis of (a) depositional environment, (b) diagenetic changes, (c) structural history, and (d) fluid mechanics.

Favorable reservoir rocks in carbonate environments include reefs, bioherms, oölite bars, and porous skeletal calcarenite. Production of organic material in such environments (with the exception of oölite bars) is prolific, but under normal conditions a major part of the organic soft parts are destroyed by bacteria scavengers and early diagenesis, whereas skeletal parts are preserved. Early diagenesis modifies the texture and the original porosity of carbonate deposits by recrystallization, solution, cementation, and replacement. Under favorable conditions, dolomitization enhances the reservoir characteristics of the carbonate sediment.

Hydrocarbons are found in cyclic carbonates which were deposited on unstable shelves and subjected to recurrent sea-level fluctuations with periodic influxes of terrigenous clastic material. Under a cyclic regime of sedimentation, a reservoir-type carbonate facies can be covered by sapropelic shale, evaporite, or basinal facies. This stratigraphic relation, in addition to providing an adequate seal, also can be suitable to preservation of organic soft parts within the reservoir facies. In the writer's opinion, cyclic sedimentation in carbonate rocks could explain *in situ* accumulation of hydrocarbons in carbonate rocks under certain favorable conditions.

The oil generated in carbonate rocks is subject to secondary migration as a result of structural deformation. An understanding of fluid mechanics is very useful for explanation of some peculiarities of oil distribution within the carbonate traps.

Tectonic setting of the carbonate shelf, relative to the stable nuclei and the mobile margins of the continents, has a profound influence on the type of trapping mechanisms likely to be found in the carbonate rocks.

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#### REINTEGRATION: SYNTHESIS EDP TECHNIQUES IN GEOLOGY

Information elements observed, defined, classified, and recorded by the variety of geological sciences are in focus with the aid of computer, mathematical, and information sciences. These information elements now can be tested for validity, reinforced in meaning, displayed for understanding, and combined semantically. Information elements normally kept segregated in specialty data files now can be integrated in new in-