ganic carbon, 0.32 percent total nitrogen, and 1.68 percent total sulfur. Elemental sulfur generally amounts to less than 2 percent of the total sulfur content. However, one river-sediment sample contained an anomalously high value of 54 percent free sulfur relative to total sulfur content. Elemental sulfur seemed to be the clearest indicator of early diagenesis as it invariably diminished in concentration with shallow depth of burial.

The bitumen content in the bay muds ranged from 160 to 380 ppm of the dried sediment, and the bitumen content generally accounted for less than 0.5 percent of the total organic matter content. In some of the sandy sediments of the bay and barrier island environments; however, the bitumen content ranged from 1 to nearly 4 percent of the total organic matter. The environment least favorable for the accumulation of bitumens seemed to be the fresh-water lake environment which, on the basis of a single sample, yielded 85 ppm bitumen or only 0.13 percent of the total organic matter content.

The alkaline-soluble humic matter, subdivided into humic-acid and fulvic-acid fractions, constituted the largest organic fraction extracted from any of the sediments studied. Quantities of soluble humic substances, ranging from 5,500 to 17,050 ppm of the dried sediment, were found in the finer grained sediments of the bay, whereas a value of 165 ppm was found in one of the sandy sediments. Higher concentrations of soluble humic matter—30,750, 31,600, and 76,300 ppm—were found in the bayou, lake, and marsh environments, respectively. In general, the soluble humic substances in these Recent sediments comprise about 20–50 percent of the total organic matter and a large part of the remaining organic content is believed to be chiefly insoluble humic compounds.

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SOME PROBLEMS IN MARINE GEOLOGY, GULF OF MEXICO

The geologic history, or paleoceanography, of a marine basin such as the Gulf of Mexico is interpreted primarily from the sedimentary record. Many basic research problems in sedimentology can be profitably studied in the gulf because much descriptive work already has been done, and it is a relatively small marine basin which is easily accessible.

Some problems in transport of detrital sediment are (1) possible bypassing of coastal lagoons and (2) the lack of modern cycle detrital sediment on much of the outer continental shelf. Is the modern sediment which reaches the open ocean being trapped in many places on the inner continental shelf? If so, how can the post-glacial deposits in the Sigsbee deep be explained? Is this deep basin sediment bypassing the outer shelf, and if so, what is the mechanism of transport?

The rate of supply of organic debris to the gulf sediments depends on the rate of organic production. High organic production near river affluents and in hypersaline lagoons deserves further investigation. The rate of supply of organogenic calcium carbonate from planktonic organisms and the rate of solution of calcium carbonate are of special interest. An understanding of shelf-edge calcareous reefs may have far-reaching implications.

An understanding of marine processes which affect the characteristics and distribution of sediments will require observations and analyses by new techniques.

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DEVELOPMENT OF BASIN-IN-BASIN HONEYCOMB OF FLORIDA BAY AND NORTHEASTERN CUBAN LAGOON

This triangular, 1,000-sq mi, bimodally windy, subtropical lagoon is a honeycomb of closely spaced, interconnecting, suboval, pan-shaped basins individually upward of 10 mi long and 12 ft deep. It lies north-south between multiple mangrove-swamp belts along the Everglades shoreline and the emergent barrier reef of the Florida Keys and east-west between Biscayne Bay and a zone of broad, marly, sandy and shelly shoals facing the Gulf of Mexico, north of Vaca Key.

Basin walls of Holocene marl (mostly shelly calcareous silt grading above to mangrove peat) stabilized by alternations of mangrove-swamp bands and marine grasses form a honeycomb pattern throughout the lagoon. Walls rise to 2.5 ft and basin floors are as deep as 11–12 ft msl. Bottoms are muddy or floored by shell concentrate. Near the keys are bottom exposures of the underlying hard Pleistocene Miami Limestone.

Basin areas and depths increase irregularly southward from tiny, oval, fresh-water, marsh ponds of the Everglades border, by multiple mergings and irregular loss of separating walls, to form large, nearly smooth-sided bays along the barrier reef with its "keys" cut by tidal inlets. The honeycomb pattern of the geographic map appears below water as a more intricate though fragmentary basin-in-basin structure.

Alignments of basins, trending roughly north-south between nearly continuous mangrove belts which mark former rill-valleys of the Everglades marsh, cross northeast-southwest alignments separated by walls which have been reinforced by shoreline storm-debris ramparts.

Aqueous erosion of a contemporaneously gradually thickening marl-and-peat formation is indicated by suboval basin form maintaining a rough width/depth relation in a windy region (Price, 1947), while sediment accumulating, in step with rising sea level, produced Scholl's (1964) dated regional stratigraphy of the last 5,000 to 4,000 years.

The basin-in-basin honeycomb is the result of conflict between (a) aqueous erosion in saline basins, and (b) the strong sediment potential of tropical paralic vegetation, while (c) the erosion continued during the slow transgression of an 8-mi-wide fresh/salt contact zone like that of today which passed across a rock basin at first lightly carpeted with Everglades marsh. Thus, salt-denuded rill-valley lows developed oriented lakes, which were drowned to form tidal bays. Shoaling of ponds, with mangrove occupation, alternates today with flushing-out of wave-eroded marl. Total volumes of walls and water are now roughly equal.

Patches of a similar basin honeycomb occur along 270 mi of the northeastern Cuban lagoon behind its emergent barrier reef. Pleistocene examples occur in Florida and Cuba. Drowned oriented Carolina "bay" lakes give a somewhat similar pattern along a Chesapeake Bay shore.

No process of accumulation adequate by itself to form such honeycombs is known. The genetic process was the drowning and embayment of oriented lakes formed by similar action from drowned marsh rills.

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ROLE OF MICRO-ORGANISMS IN FORMATION OF LIMESTONE

The modern oölite, coral reefs, calcarenite, calcilutite, and beach rock are cemented with a $CaCO_3$ cement which consists of crystals of aragonite. Experimental evidence supports the view that the crystals of aragonite are formed by organisms which are thought to be actinomycetes.

The Floridan and Puerto Rican beach rocks are formed in tropical and subtropical climates in littoral and supralittoral environments and are confined to high-energy areas where there is daily agitation of water and a supply of fresh nutrients.

The Floridan beach rock occurs as an intermittent shallow shelf on the Atlantic coast from Key West to Key Largo and along the east coast from West Palm Beach to Jupiter. However, the Puerto Rican beach rock is primarily confined to the north side of the island where the formation of beach rock may be related to the path of the currents which bring nutrients to the surface.

The aragonite in these sediments is most likely of a biogenetic origin. However, the partial to complete alteration of the cementing agent to calcite is by penecontemporaneous solution and redeposition. In the alteration of aragonite to calcite, some of the $CaCO_3$ is removed in solution. Consequently, voids are formed within the matrix of the rock and the resulting rock can be very porous because of the development of microporosity.

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RÉSUMÉ OF JURASSIC TO RECENT SEDIMENTATION HISTORY OF GULF OF MEXICO BASIN

The oldest marine sediments that are known to occur on all sides of the Gulf of Mexico basin are of Late Jurassic age. These sediments, mainly carbonates, overlie generally unfossiliferous sandstone, and shale, anhydrite, and salt of unknown age—possibly Jurassic, Triassic, or Permian. The Late Jurassic was deposited only after a probable shield area (which is postulated to have occupied the Gulf of Mexico basin) sank.

The Late Jurassic Smackover Limestone and equivalents were deposited above a very thick salt section. As the bordering lands rose, gravel, sand, silt, and mud of the Cotton Valley (up to 4,000 ft thick) were deposited. Deposition continued unbroken into Early Cretaceous time, beginning with up to 4,000 ft of Hosston and equivalents. In the southeastern part of the Gulf of Mexico, Early Cretaceous equivalents include carbonate, evaporite, and some black shale. After Hosston deposition, carbonates were deposited around the entire Gulf basin, though terrigenous clastics also were deposited in the northern region.

There is no significant regional depositional break between the Lower and Upper Cretaceous. In medial Late Cretaceous time, the sea transgressed farthest, coinciding with a worldwide eustatic sea-level rise. The Mississippi embayment formed and the sea reached southern Illinois.

Mountain-building activity and uplift at the end of Cretaceous time forced the sea from much of the continent. Carbonate deposition continued in the southeast from Paleocene through Miocene, but fine terrigenous clastics were deposited in the north and west (Midway-Velasco). As the mountains of the interior rose, clastic debris supplied to the basin was more abundant and coarser. In general the northwestern gulf shoreline was pushed seaward, though important transgressions occurred in early, middle, and late Eocene times and during the Oligocene. Deltas formed, and the local shifts in Miocene deltaic depocenters caused numerous local transgressions and regressions during that time. Sedimentation rates increased steadily. The Pleistocene deposits reach a thickness of 15,000 ft in the northern Gulf of Mexico.

Although a marine basin has occupied the Gulf of Mexico since Late Jurassic time, the existing gulf may be a very young feature. In fact, parts of the gulf may have been land during much of Jurassic-Pleistocene time.

The depositional and tectonic history, insofar as it is known, of the large gulf basin is described briefly. The need for more information on the geological history of all parts of the basin is apparent to anyone charged with exploring for minerals in this area.

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STRUCTURAL AND STRATIGRAPHIC TRAPS RELATED TO EXTRUSIVE ROCKS IN SOUTH-CENTRAL TEXAS

Paralleling the Balcones fault zone, yet most numerous in the Uvalde salient and the Zavala syncline, are several dozens of ill-defined, olivine-basalt extrusives, most of which have been altered to serpentinite. Oil and gas production from rocks of Late Cretaceous to Tertiary ages exists on the crests and off the flanks of many of these domal features. There are many more domal extrusive complexes known from reconnaissance exploration, but, as yet, untested by the drill bit.

Age and rock type of the objective reservoir rocks are determined by the time when the underlying igneous body was extruded. Structural deformation or stratigraphic development above these effusive masses is primarily influenced by the presence of the extruded rock on an older rock surface. There are more clastic-rock reservoirs than domes. Oil or gas affinity for accumulation in either sandstone or limestone seems random. The serpentinite itself may serve as reservoir rock. Outpourings of igneous magma are concentrated in the Upper Cretaceous. Structure and stratigraphy of the overlying rocks into the Tertiary sediments are affected.

Hydrocarbon production from the domes ranges in depth from a few hundred feet to approximately 4,000 ft. The shallowest production is found above the shallowest extrusives, markedly demonstrating their structural and stratigraphic influence.

Exploration methods include surface geology, magnetic surveys, subsurface geology, and core drill near-surface geology. All methods are extremely effective where that particular geological method may be applied. From the standpoint of geology, land, and drilling, profitable objectives may be explored at minimum costs.

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RELATIONSHIP OF MINERAL COMPOSITION OF SHALES TO DENSITY

(No abstract submitted.)

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COMPARISON OF SOME GULF COAST MESOZOIC CARBONATE SHELVES

(Read by title)