slope in the Alaminos Canyon area, Gulf of Mexico, indicate sand input from the ancestral Colorado-Brazos and Mississippi River systems. The clay minerals in the area were derived from indeterminate sources and were incorporated in coarse samples through resuspension of former sediment. Vermiculite, as well as tubular hallaysite, were identified in clay samples. The first mineral is unreported in the northwest Gulf, and the latter is only known from the Mississippi delta in the northwest Gulf area.

The "hummocky" nature of the bathymetry in the area resulted from salt diapirism and scouring by tractive and/or density flow. Sand-size sediment was transported to the area from river systems by longshore drift during the Holocene transgression or through channels still identifiable on the present continental shelf. The lineation of one of these features, the Outer Colorado-Brazos Channel, is probably due to salt tectonics and not the result of a barrier spit as previously reported.

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Oil-Column Calculations in Stratigraphic Traps

Oil columns can be calculated for simple stratigraphic traps if the rock and fluid properties are known or can be estimated. Because oil migration is prevented by capillary pressure in small pores of the trap facies, direct measurements of capillary pressure allow oil columns to be calculated, but such measurements are rare. An alternative is to determine pore size from porosity and permeability data using an empirical equation, and then to compute the capillary pressure by an estimate of fluid properties.

An example of oil-column calculation is from the Milbur field, Burleson County, Texas, a lower Wilcox stratigraphic trap. Using core analysis from a nearby well, an oil column of 40-80 ft would be expected for the trap, and this estimate agrees reasonably well with an actual oil column of 60-75 ft for the field. The most important part of such calculations is the realization that the trapping facies itself can have significant porosity and permeability and yet form an effective barrier to oil migration. The result is that the best reservoir may occur downdip from dry holes with porous water-bearing sandstone and oil shows, rather than updip at the pinchout.

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Geothermal Power in the Southwest

In this era of great concern over the environment and the energy crisis, much attention is being directed toward geothermal power as a partial panacea for both predicaments. Of approximately 1,100 known geothermal occurrences in the United States, most of which are in and west of the Rockies, a relatively small percentage are classified as dry steam reservoirs, capable of producing hot unsaturated steam which poses minimal effluent disposal problems. Others, such as the Salton Sea field in southern California, pose critical waste brine difficulties, which will probably be solved only by reinjection. A major geothermal field, *e.g.*, the Geysers in northern California, is expected to produce steam adequate to generate from 1,000 to 2,000 megawatts of electricity, with 50-year gross revenue from steam sales on the order of $2 billion.

There are known geothermal occurrences in the southwestern states of Texas (less than a dozen), New Mexico (57), Arizona (21), Nevada (185), and southern California (about 30). It is likely that additional geothermal prospects will be developed by the use of sophisticated geologic mapping, coupled with such geophysical methods as studies of temperature-gradients, microseisms and ground noises, resistivity, and remote sensing, and chemical methodology useful in determining maximum water temperature in the system and the age of that water.

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Recent and Ancient Turbidites and Contourites

Fossil turbidites have been recognized and described from many areas all over the world. A turbidite model, comprised of a fixed succession of sedimentary structures, was established a decade ago and seems to be usable, although some changes have been suggested.

Turbidites are generally assumed to be deposited by turbidity currents, but the presence of these currents in the marine realm has not been definitely established. Submarine canyons presumably are the major, if not only, important transport route for moving "shallow" water material to "deeper" basins. Questions arise about the origin of turbidity currents when studying canyons in which gradual filling followed by sudden emptying has occurred. The material in the canyon head moves downward slowly, comparable to glaciers. Besides this slow sliding, traction currents and debris flow have been suggested. Where turbidity currents start, and if they absorb the slow moving canyon fill, are questions that cannot be answered yet. Other problems are the relation between fluxoturbidites, or gravities, and turbidites, and the use of the terms "proximal" and "distal" turbidites.

In comparing recent turbidites with ancient ones, many discrepancies appear, most of which can be eliminated by considering the influence of primary consolidation on sedimentary structures.

Studies indicate that the use of electrical logging and seismic records do not allow detailed interpretation of deposits such as turbidites. The resolution of the records is not fine enough, although their application for basin analyses and overall trends is necessary.

Recently a new genetic term, "contourites," was introduced for sediments redeposited by contour currents. Recent and ancient contourites are compared with turbidites and only minor differences exist. A combination of parameters may allow a distinction between the two types and it is possible that both can be found in the same area.

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South Texas Eolian System—Model of Coastal Eolian Processes

Few oil and gas reservoirs have been interpreted as sands deposited within eolian depositional systems. Eolian facies may, however, be more common in ancient basins than heretofore recognized. Continued documentation of Holocene eolian systems, such as the South Texas system, provides a model for reevaluating the genesis of numerous unfossiliferous, well-sorted blanket sand bodies, many of which are associated with ancient, paralic depositional systems.

Pleistocene paralic depositional systems along the South Texas coast dictate the nature and distribution of facies patterns, environments, and processes exhibited by the overlying Holocene South Texas eolian system. A dominant southeast wind, high summer temperatures, and high rainfall deficiency combine with an abundant supply of Pleistocene sand to provide the proper framework within which extensive eolian deflation and dune migration can occur.

Eolian lobes are supplied with sand from Pleistocene barrier-strandplain facies and fluvial meanderbelt deposits. Loess sheets are derived from distant lobes, as well as from deflation of local Pleistocene deltaic and fluvial facies. Deflation of thick Pleistocene fluvial-deltaic sand facies is commonly stabilized when erosion reaches the shallow groundwater table. Maximum deflation occurs on the upwind, coastward margin of the system, especially where only thin Pleistocene paralic sands are available to supply dune trains; mud deflated by strong offshore winds is moved into clay dune complexes and eventually carried downwind to develop loess sheets. This extensive upwind deflation of the system is accompanied by windward accreting clay-sand ridges with nuclei composed of either beach-ridge remnants of a Pleistocene barrier-strandplain system or remnants of inter-blowout areas developed during early phases of the deflation of the coastward margin of the system.

Principal source of sand and loess is, therefore, local, representing reworking of underlying, older sands. A sand source resulting from longshore convergence and inland transport from Padre Island accounts for only the minor, local infilling of Laguna Madre in the land-cut area, and is not the principal source of eolian sand throughout the system. Facies fabric within Pleistocene depositional systems provides principal control of environments, sedimentary processes, and resulting facies within the subsequent eolian system.

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PRESSURED SHALE AND RELATED SEDIMENT DEFORMATION—MECHANISM FOR DEVELOPMENT OF REGIONAL CONTEMPORANEOUS FAULTS

Regional contemporaneous faults of the Texas coastal area are formed on the seaward flanks of deeply buried linear shale masses characterized by low bulk density and high fluid pressure. From seismic data these masses have been observed to range in size up to 25 mi wide and 10,000 ft vertically. These features, aligned subparallel with the coast are *en échelon* or branching in pattern, and represent residual masses of undercompacted sediment between sand-shale depoaxes in which greater compaction has occurred. Most regional contemporaneous fault systems in the Texas coastal area were formed during times of shoreline regression when the duration of fault development extended over short periods of geologic time, and where comparatively simple down-to-the-basin fault patterns were developed. In cross-sectional view, faults in these systems flatten and converge at depth to planes related to fluid pressure, and form the seaward flanks of underlying shale masses. Data indicate that faults formed during time of shoreline regression were developed primarily through differential compaction of adjacent sedimentary masses. These faults die out at depth near the depoaxis of the sand-shale section.

In areas where subsidence exceeded the rate of deposition, gravitational faults developed where basinward sea-floor inclination was established in the immediate area of deposition. Some of these faults became bedding plane type when the inclination of basinward-dipping beds equaled the critical slope angle for gravitational slide. Fault patterns developed in this manner are comparatively complex and consist of numerous antithetic faults and related rotational blocks.

Nondepositional (structural) faults are common on the landward flanks of deeply buried shale masses. Many of these faults dip seaward and intersect the underlying low-density shale at relatively steep angles.

Conclusions derived from these observations support the concept of regional contemporaneous fault development through sedimentary processes where thick masses of shale are present and where deep-seated tectonic effects are minimal.

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DIVERSITY-EQUITABILITY ANALYSIS AS PALEOECOLOGIC TOOL

Diversity-equitability analysis of microfaunal data as used by Beerbower and Jordan shows promise of being a rapid and useful technique for mapping paleoenvironmental gradients. It may even provide a more satisfactory definition of environmental boundaries than biofacies analysis based on taxonomic composition.

Faunal diversity is calculated as Shannon's information theory average uncertainty measure. Using this diversity measure, a few equally common taxa can yield as high a diversity index as many unequally common taxa. Lloyd and Ghelardi's equitability index may be used to separate these two diversity components and refine seemingly homogeneous data.

Recent microfaunal data from Barnstable Harbor, Massachusetts, and the northern Gulf of Mexico have been subjected to diversity-equitability analysis. From Barnstable Harbor, contours based on the equitability index can be related rather clearly to tidal action within the harbor. A diversity-equitability plot of published Holocene Gulf of Mexico data reveals that some environments may be characterized by a unique D/E range. Although these results must be considered preliminary, an analysis of parts of the lower Miocene sequence in Block 24 field, High Island area, offshore Texas, shows that the technique merits further consideration and is potentially a very useful tool for both identifying and mapping ancient environments.

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PALEOMAGNETISM OF LATE PLEISTOCENE-HOLOCENE SEDIMENTS, GULF OF MEXICO

Detailed paleomagnetic studies have been made on 15 sediment cores selected along north-south lines in the eastern and western Gulf of Mexico. The piston cores were sampled at 20-cm intervals immediately upon extrusion and measurements of natural remanent magnetization (NRM) were made using a 5hZ spinner magnetometer. Excursions of the geomagnetic field are recorded at 2 levels in many cores. Extrapolation of the ZY boundary in the western Gulf indicates that the younger feature is between 13.5 and 17.5 $\times 10^3$ years BP, and is consistent with the age determination of the Laschamp event. Dates are not available for the eastern Gulf cores, but the depth of the paleomagnetic feature correlates with the expected sedimentation rates. The older feature is less distinct and further extrapolation of the ZY boundary places it between 20.0 and 24.0 $\times 10^3$ years BP. This age is within the range of a geomagnetic feature that is not the Laschamp.

These results show that with extreme care, paleomagnetic measurements may be used as a stratigraphic tool in the Gulf of Mexico. Several points should be considered. First, because of the high sedimentation rates, the 2 young features described herein are the only ones expected in piston cores from this region. Second, direction scatter is quite pronounced in the upper 1/2 m and lower few centimeters of several cores. Correlations at these levels are difficult. Finally, as measurement of the geomagnetic features described lasted for only a short time and did not traverse a full 180°, dense sampling is recommended to assure their definition.

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ECONOMIC AND OTHER FACTORS AFFECTING PETROLEUM EXPLORATION

There is today almost universal agreement that we are facing a potential energy crisis, both imminently in the U.S. and possibly worldwide after the turn of the century. All studies of energy supply and demand indicate such tremendous growth in demand that conventional sources will be hard pressed to supply it.

The short-range annual growth rate in domestic and free-world demand for petroleum is estimated at 5% and 7 1/2% respectively, resulting in 19 million and 57 million bbl/day total demand in 1975. By 1980 U.S. demand will be nearly 25 million bbl and free foreign need nearly 90 million bbl/day.

The areas which will supply this demand, especially for the U.S., are quite uncertain because of the bewildering variety of political, legal, and environmental factors—as contrasted with purely economic ones—which will be of critical influence. Therefore, it is difficult to forecast the areas and the amounts and costs of exploration and development, as well as prices and earnings.

One thing is certain, however, there will be a growing shortage of domestic crude and an increasing dependence on foreign supplies. Both the cost and dependability of the latter are questionable in view of political considerations and the policies and actions of OPEC.