shore 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.

Any interruption of our foreign energy supplies would have a dramatic effect on our economy and security and would show the dangerous results of the lack of a coherent and positive energy policy.

There are very few discovered but undeveloped oil reserves in the U.S. except on the North Slope, and those probably cannot be made available before 1976. Though the recent NPC-AAPG study indicates almost 200 billion bbl of undiscovered but expectable recoverable U.S. reserves, any large increase in exploratory effort to find them cannot have any great effect on our crude deficit before 1978 because of the necessary lead times. It is obvious, however, that certain steps can and should be taken immediately to encourage or to cause such an increase so that the period of danger to our economy and security will be as brief as possible.

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Consolidation Studies of Deltaic Sediments

The Texas Colorado River delta, which built across Matagorda Bay between 1929 and 1941, was selected for consolidation research. The objectives were to observe structural changes which occur when deltaic sediments undergo primary consolidation, and to correlate these consolidated sedimentary structures with those reported from ancient deltaic environments.

Double cores were collected along a traverse parallel with the main river channel in the southeast lobe of the delta. One core was split lengthwise, described, and radiographed. An analogous undisturbed section of the second core was then selected for consolidation.

Consolidation, through vertically compressing the sediments, partly creates new structures or makes poorly visible structures more discernible. It was noted in some cases that convolute laminations and recumbent folding formed after sections containing parallel laminations were consolidated. It was also observed that apparent homogeneous sections, after compaction, changed structurally to reveal parallel laminations.

Consequently, it should be realized that consolidation will affect unconsolidated sediments and that these changes should be considered when comparing recent and ancient environments.

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Drilling Funds and the Energy Crisis

(No abstract submitted)

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Significance of Reservoir Diagenetic Alteration for Petroleum Exploration, Gulf of Alaska Tertiary Basin

The Tertiary clastic section of the Gulf of Alaska sedimentary basin is considered an important potential future petroleum province. Considerable work in the onshore area has been carried out by industry preparatory to a projected sale of federal leases on the continental shelf. Examination of numerous samples collected from measured sections in Oligocene to Pleistocene strata has shown that the sandstones are mineralogically immature and unstable. Diagenetic alteration of these potential reservoir sands at shallow to intermediate depths of burial has resulted in the ubiquitous formation of authigenic clay rims and coats around detrital grains and of pore-filling zeolite cements. These diagenetic alterations adversely affect both porosity and permeability and will provide a major limitation on the thickness of the sedimentary section than can be considered prospective. A compaction versus depth gradient, which is related to the sandstone porosity gradient, can be determined in offshore areas by combination of seismically derived interval, velocity depth profiles, with a velocity-density calibration based on well data from the Hecate Strait (a geologically similar Pacific Margin basin lying off British Columbia). The resultant density configuration can be cross checked by gravity modeling along the same seismic line. Work on a line off Cape Yakataga shows that the prospective section is characterized by a high velocity and density gradient, indicating rapid loss of reservoir porosity with increasing depth of burial, as predicted by the onshore diagenetic model. Semiquantitative evaluation of the compaction profile using the onshore reservoir data suggests that even in the youngest sections porosity decreases to less than 20% at depths of 5,000 to 8,000 ft.

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Depositional Systems and Oil-Gas Reservoirs in Queen City Formation (Eocene), Texas

Regional surface and subsurface studies indicate that thick deltaic (Queen City Formation) and thin shelf (Reklaw and Weches Formations) sequences compose the stratigraphic interval between the top of the Wilcox Group and the base of the Sparta Formation. In East Texas, the Queen City Formation accumulated as part of a high-constructive, lobate delta system; and in South Texas, as part of a high-destructive, wave-dominated delta system. In South Texas, principal facies are meander-belt sand, lagoonal mud, stacked coastal barriers, and prodelta-shelf mud facies; in East Texas, delta plain, delta front, and prodelta facies are dominant; and in Central Texas, the principal facies are strandplain sands originated by southwestward longshore drift of sediments from the high-constructive delta system.

Facies distribution, composition, and size of the deltas in East Texas are similar to lobes of the Holocene high-constructive Mississippi delta system and to ancient deltas in the lower part of the Wilcox and in the Jackson Groups of the Gulf Coast basin. Fluvial-deltaic sediments of South Texas are comparable to Pleistocene high-destructive wave-dominated facies on the Surinam coast, to the Holocene Rhone delta system, and to ancient deltas in the upper part of the Wilcox Group.

Queen City deltas prograded gulfward over shelf muds and glauconites of the Reklaw Formation; they are overlain by comparable shelf facies of the Weches Formation. In East Texas, deltaic facies wedge out eastward; terrigenous clastics of the high-destructive deltas extend southward into Mexico.

Hydrocarbons are produced from thin strike-oriented sands downdip from the belt of maximum sand thickness of the high-destructive deltas in South Texas; only a minor amount of oil and gas has been obtained from delta front and distributary channel sands of the high-constructive deltas in East Texas.

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Petroleum Exploration and Environmental Conservation

U. S. faces energy crisis.—U. S. energy demands will nearly double by 1985. All our principal sources of fuel will be needed to meet the demand; if domestic supplies cannot keep pace, we face increasing reliance on foreign oil.

Energy and public lands.—Much of U. S. energy potential, including offshore oil and gas reserves, is on publicly owned lands. Potentially productive acreage in the federal and state domain should be made available to industry in a manner designed to maximize timely development.

Environmental delays.—A principal factor in delaying exploration of frontier areas is environmental concern. Many environmental objections are founded on the argument that oil and gas development is incompatible with other uses of the same land or water area.

Compatible use.—If exploration is to proceed at a pace consistent with national needs in the future, the concept of compatible multiple use of lands must be established as national policy. Industry must demonstrate from available examples that this concept is sound and results in maximum benefits to public and private interests.

Geologists must contribute.—Petroleum geologists should bring their knowledge to bear on public environmental issues and work for reasoned solutions based on scientific fact. Much exploration today awaits public consent; geologists must aid in showing public that energy-environmental problems can be