nism, (2) deep-sea environments, and (3) frequency and dynamics of depositional events.

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Regional Aspect of Sediment Distribution Across Middle East During Middle Triassic Time

Middle Triassic rocks across the Middle East provide information on regional paleogeography based on the distribution of different depositional facies that are clearly related to the structural history of the region. Several structural provinces have been recognized: the Arabian-Nubian massif, the Middle East platform, and the Tethyan trough.

Except for the central part of interior Syria and central and northeastern Iran, the Middle Triassic rocks of the Middle East represent shelf sediments consisting of three major depositional systems. A belt of mixed clastic-carbonate rocks with evaporite deposits of nonmarine, supratidal, tidal-flat, and lagoonal origin is present in the central part of Saudi Arabia. This belt grades into carbonate-evaporite facies of the Arabian Peninsula, southwestern Iran, northern Iraq, and the area of the Syrian-Turkish border. The carbonate-evaporite facies grades into strata which are predominantly open-marine carbonate rock of the Tethyan sea shelf facies over most of Iran, northern Iraq, most of Syria, probably Lebanon, Jordan, Palestine, and the Sinai Peninsula. Several positive and negative areas are within this platform: the Jawf-Rutbah-Mardin high, the Central Arabian embayment, and the Southeastern Saudi Arabia uplift.

The basinal marine sediments of the Tethyan trough facies include Alpine-Mediterranean deposits in central Syria and a terrigenous flyschlike sequence in central and northeastern Iran. The northeastern to northwestern part of central Saudi Arabia holds promise for new petroleum exploration because of a possible great thickness of Permian-Triassic rocks of the carbonate-shelf facies capped by Middle-Late Triassic evaporites.

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Post-Middle Cretaceous Seismic Stratigraphy and Geologic History of Deep Gulf of Mexico Basin

A seismic stratigraphic analysis of 5,000 n. mi of regional multifold reflection data allows an interpretation of the post-middle Cretaceous geologic history of the deep Gulf of Mexico basin. Five horizons that are major unconformities along the southern margin of the basin were mapped throughout the deep Gulf and used to define five depositional sequences (seismic units). Ages for the two youngest horizons were obtained by direct correlation with DSDP holes—Pliocene-Pleistocene and late Miocene. The other horizons are tentatively correlated with proposed major global unconformities and eustatic sea-level changes—middle Oligocene, early Tertiary, and middle Cenomanian. The middle Cenomanian horizon is the most prominent subbottom reflector in the deep Gulf. It represents a striking unconformity on the seismic data along the base of the Campeche and Florida Scarps against which the younger sequences thin, onlap, and pinch out. Isopach maps of the units indicate a combined maximum thickness of 7 to 8 km for the post-middle Cretaceous sediments in the central basin. Variations in individual unit thicknesses and seismic facies reflect regional changes in depositional patterns through time: during the Late Cretaceous through middle Tertiary the main sediment source was in the west, and deposition consisted mainly of homogeneous, probably fine-grained sediments changing upward to alternating sand and mud; in the middle Tertiary there was a major influx of sand and mud from both the north and west; following a late Miocene–Pliocene starved-basin interval, fine-grained turbidites from a northern source built the thick Pleistocene-Holocene Mississippi fan.

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Future Exploration Opportunities in Gulf of Mexico

Those directly responsible for evaluating recent lease sales in the Gulf of Mexico are painfully aware that the quality of prospects and amount of potential reserves are significantly reduced from what they were several years ago. We believe, however, that this may not be an irreversible situation, in that significant reserves may lie in the undrilled structures of the continental shelf, slope, and abyssal plain of the Gulf of Mexico.

Portions of the South Florida basin and deep waters of offshore Louisiana and Texas are specific areas in the Gulf of Mexico that we feel warrant further investigations by industry.

Subsurface facies and structure maps constructed from available well control, regional CDP seismic, gravity, and magnetic coverages indicate favorable conditions exist in these frontier areas for the entrapment and generation of hydrocarbons. The testing and development of these deep-water and/or deep-drilling objectives will require advanced drilling and production technology.

The most economic means by which to initiate the evaluation of these frontier areas is through stratigraphic-test programs (i.e., COST-type wells). Through the use of stratigraphic tests, better "direct" scientific knowledge can be obtained that would supply the needed exploration incentives and business inducements for industry to invest capital dollars in what may now appear to be prohibitive, high-risk areas. If successful, it would also give industry the lead time required to develop and refine technologies needed to operate in these less than favorable environments.

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Exploration in East Malaysia over Past Decade

In the past decade two large oil fields and several large gas fields have been discovered on the continental shelf of East Malaysia together with some smaller oil and gas fields. Geologically, the shelf contains most of the postgeosynclinal younger Tertiary sediments of the

Northwest Borneo orogene. The shelf widens to more than 300 km toward the south in Sarawak and measures about 100 km in the north in Sabah. Structural deformation is most severe onshore and decreases toward the offshore, where all the currently producing East Malaysian fields are located.

The two largest offshore oil fields, the Baronia field in northern Sarawak and the Samarang field in southern Sabah, are both situated in areas characterized by synsedimentary tectonics. Production is from upper Miocene coastal-plain and coastal sands, which have been charged with hydrocarbons from land-plant-derived source rocks.

The large gas fields are located offshore central Sarawak, and the gas is trapped in upper Miocene carbonate reefs.

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Recent Advances in Passive-Margin Research

Recently available multichannel-seismic data have provided a detailed look at many Atlantic passive margins. DSDP holes and COST wells have provided geologic calibration. Reefal–carbonate-bank underpinnings provided a mechanism for slope migration seaward of the original continental edge, especially in the Jurassic–Early Cretaceous. Tertiary defacement by erosion and mass-wasting has caused large landward retreats of the slope. These events are nearly coeval on both sides of the Atlantic Ocean, indicating their significance.

Deeper crustal layers are identified on the modern reflection and refraction data. Intermediate seismic-velocity layers, 7.1 km/sec, near the continental edge on both sides of the Atlantic might be characteristic of transitional-type crusts, or merely continuations of layer 3b under the slope and shelf.

Deep-cutting, listric normal faults are observed where the soles of the faults merge into a lower crustal layer (6.3 km/sec velocity). Thinning with listric faulting of apparent continental crust has brought the mantle (8.2 km/sec) to within 14 km depths. Viscous creep in the lower continental crust appears necessary to account for the measured thinning.

Detailed analysis of the multichannel data permits sequence identification within the thick margin sediments. Sea-level cycles can be identified, and correlations reveal the configuration of genetically related stratigraphic units. Such analyses define the subsidence history and paleobathymetry of the margins. Some passive margins start with an uplift and rifting phase, whereas others are rifted through previous deep basins without uplift or volcanism. Other margins are dominated by volcanism in the early stages, and outer-ridge structures have formed.

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Depth Migration of Seismic Data

Conventional time migration of seismic data results in the incorrect positioning of reflectors where there are significant lateral variations in the velocity of the overburden. In such situations the basic migration procedure should use the provided velocity information and obey the wave equation with adequate accuracy to produce a cross-sectional representation of the reflectors in true depth.

A method involving finite-difference approximations to the wave equation has been implemented for obtaining migrated depth sections. The initial seismic data have the properties of an upcoming wavefield recorded at the earth's surface. This is projected downward in small increments of depth, making appropriate corrections for the transmission of the seismic waves through the assumed velocity variations within the layer. Thus, at an intermediate stage of processing, the data consist of an imaged depth section above the depth Z, followed by "conventional" unmigrated seismic data associated with shooting and recording at depth Z.

This depth-migration procedure applies to both two- and three-dimensional common depth point stacked data, where it is expected to be particularly important for oil field development projects. The method has also been developed for application to conventional unstacked two-dimensional data which have been recorded on a uniform grid with a shot at each receiving group. Although this latter mode becomes relatively expensive, it does offer the possibility of improved detailing of zones of exploration interest overlain by complex geology with rapid lateral velocity variations. The method also can be reversed to yield synthetic seismic data consistent with a given geologic model.

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Surface Turbidity and Hydrographic Variability on South Texas Continental Shelf, Gulf of Mexico—Time-Sequence Study

Regional surface-water turbidity patterns and associated hydrography were monitored on the south Texas continental shelf over an 18-month period (fall 1975 to spring 1977). During six monitoring cruises, quasi-synoptic surface measurements were made of water transmissivity, suspended-sediment concentrations, temperature, salinity, and drifter trajectories. Time-sequence patterns of these parameters illustrate substantial temporal and spatial variability; temporal variations occur at both the seasonal and annual time scales.

Turbidity and hydrographic patterns indicate a surface-sediment dispersal system regulated by a shelf-water exchange process consisting of opposing lateral movements of inner-shelf and outer-shelf water masses. Relatively turbid inner-shelf waters reflect the offshore and alongshore transport of coastal-derived sediment. The inner shelf has a regional gradient of shoreward-increasing turbidity; superimposed local gradients are established at major tidal inlets that serve as prominent