The Pulau Seribu patch-reef complex, located 50 km northwest of Jakarta, is elliptical in plan view, measuring 40 km north-south and 12 km east-west. Individual reefs range in length from 50 m to over 6 km, show a strong east-west lineation due to seasonal winds and currents, and grow up into the intertidal zone.

Facies mapping (based on 250 bottom samples and Landsat image analysis) shows the extent of reef-crest, reef-flat, beach, island, reef-slope, and lagoonal facies. The reef crest is fairly narrow, flat, continuous along strike, and consists of coral-algal boundstones. The reef framework of predominately platy and branching corals is infilled with coral-skeletal packstones and wackestones and represents a small percentage of reef-related facies developed in the reef complex, being overshadowed by extensive reef flats of coral-skeletal packstones. Commonly, beach and island facies of coral-skeletal grainstones occur near the center of individual patch reefs. In front of the reef crest, an apron of reef-derived coral-skeletal packstones is deposited as reef-slope facies. This grades downdip into lagoonal facies of highly burrowed molluscan foraminiferal wackestone and packstone and coral molluscan wackestone and packstone, both with low TOC values that indicate no source rock potential.

Pulau Seribu is an important lithofacies model for better understanding Tertiary reefs in Indonesia, especially the prolific hydrocarbon reservoirs of northern Sumatra.

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Carbonate Facies and Landsat Imagery of Shelf Off Belize, Central America

A reevaluation of Holocene sediments on the Belize shelf is based on (1) a newly constructed composite of 7 Landsat images, enhanced and registered to form a regional base map, and (2) a Holocene facies map based on a rigorous treatment of compositional and textural parameters for approximately 600 bottom samples. The sediments are mapped in terms usually applied to lithified carbonate rocks, allowing direct comparisons with carbonate facies in the subsurface.

By combining Landsat imagery with this facies map, it is possible to point out the following geologic features: (1) major tectonic elements, such as the Maya Mountains, the Yucatan Plateau, several offshore ridges, and 3 large atolls, (2) major physiographic features such as the Belize barrier reef with its reef platform and crest, middle-shelf shoal deposits, middle-shelf patch reefs (including lagoon reefs or rhomboid reefs), (3) Holocene facies patterns with potential reservoir facies of foraminifera-grainstone bars, *Halimeda* grainstones, and branching-coral, encrusting red-algae boundstones, and (4) nearshore clastics and a sharp transition eastward to carbonate sediments.

An understanding of Holocene facies patterns on the Belize shelf is important to the explorationist, because these facies patterns are living examples of exploration fairways and invite comparisons with several petroleum provinces: (1) Cretaceous reefs of Texas, (2) upper Paleozoic skeletal-grainstone bars in west Texas, and (3) Devonian reefs of the Alberta basin.

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North African Geology: Exploration Matrix for Potential Major Hydrocarbon Discoveries

Based on results and models presented previously, it is possible to consider an exploration matrix that examines the 5 basic exploration parameters: source, reservoir, timing, structure, and seal. This matrix indicates that even those basins that have had marginal exploration successes, including the Paleozoic megabasin and downfaulted Triassic grabens of Morocco, the Cyrenaican platform of Libya, and the Tunisia-Sicily shelf, have untested plays. The exploration matrix also suggests these high-risk areas could change significantly, if one of the 5 basic matrix parameters is upgraded or if adjustments in political or financial risk are made.

The Sirte basin and the Gulf of Suez, 2 of the more intensely explored areas, also present attractive matrix prospects, particularly with deeper Nubian beds or with the very shallow Tertiary sections. The Ghadames basin of Libya and Tunisia shows some potential, but its evaluation responds strongly to stratigraphic and external nongeologic matrix variations based on degree of risk exposure to be assumed. Of greatest risk in the matrix are the very deep Moroccan Paleozoic clastic plays and the Jurassic of Sinai. However, recent discoveries may upgrade these untested frontier areas.

Based on the matrix generated by the data presented at a North African Petroleum Geology symposium, significant hydrocarbon accumulations are yet to be found. The remaining questions are: where in the matrix does each individual company wish to place its exploration capital and how much should be the risk exposure?

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Role of Minerals in Generation and Release of Hydrocarbons

The morphology and composition of minerals are known to be of great importance in determining the suitability of rocks as hydrocarbon reservoirs. However, their role in the generation and release of hydrocarbons from kerogen is still poorly understood. Recent studies suggest that the interaction of some clay minerals with the organic matter in source rocks results in a series of processes which can be characterized as follows: (1) catalytic increase in the rate of organic carbon decomposition, (2) control of the chemical nature of the hydrocarbon products, (3) retention of bitumens and asphaltenes that may be carried to depths where the geothermal gradient causes them to be cracked to light hydrocarbons, (4) transform nonporous carbonate rocks to porous reservoir rocks as a result of early catagenic CO_2 and organic acids' release, (5) recrystallize minerals involving release of water, mineral dissolution, and release of trapped bitumen, and (6) influence the formation of mature sweet light oil or immature sour heavy oil.

This evaluation suggests that the character of hydrocarbons produced, which is generally thought to be facies controlled, is a result of both mineral as well as kerogen type within the source rock. Recognition of the above could have important implications in the strategy of geochemical exploration for oil and gas.

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High-Resolution Seismic Data of Atlantic Margin Basement

Reflection seismic data for petroleum exploration have improved resolution of the rift structure of the United States Atlantic margin. Previously conjectural features are not clearly seen and additional features have been recognized. Our best data are from the Long Island–George's Bank area. Generally, the geologic elements visible, looking landward, are: (1) a belt of block-faulted oceanic crust that merges into a wedge of synrift sediments, (2) a basement ridge 10-15 km wide with maximum relief of 1.5 km, at a depth generally below 9 km, under the East Coast Magnetic Anomaly (ECMA), (3) a very wide zone of rising basement, structurally bland except for a major hinge near the updip edge of the ECMA, (4) an updip zone of complicated rift-stage faults with basinward-dipping listric faults, which visibly sole at ~ 14 km, and common listric counter-regional faults, and (5) a major unconformity, the base of the drift sequence, with rift-stage structures extensively peneplaned. Graben fill is 2-stage and includes earlier highly rotated beds separated by an unconformity from mildly deformed sediments. Downdip, the major unconformity at the base of the drift sequence becomes a strong, continuous reflector that downlaps the landward edge of oceanic crust.

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Sedimentary Features and Soil-Like Fabrics in Cycles of Upper Lockatong Formation, Neward Supergroup (Upper Triassic), New Jersey and Pennsylvania

The Upper Triassic Lockatong Formation is composed of cycles of fine-grained sediments interpreted as lacustrine deposits. These sedimentary cycles were deposited in the Newark basin formed during rifting events associated with formation of the present-day Atlantic Ocean. Sedimentary cycles consist of laminated black shale, thin-bedded mudstones with sinuous polygonal mudcracks, brecciated mudstones containing angular fragments of thin-bedded mudstone "float" in a red muddy matrix, massive mudstones with abundant millimeter-scale mud aggregates and analcime or dolomite void fillings. Black shale and thin-bedded mudstones indicate a shallowing perennial-lake environment. Other textures found in these cycles have been attributed to subaqueous dewatering mechanisms. Our study suggests that these textures are the result of subaerial exposure and soil-producing processes in an arid environment.

In modern playa deposits, brecciation results from superimposition of mudcracks and mudcrack fillings; massive muds result from repeated wetting and drying, vesicle development, and clay illuviation. Coatings, around grains and void walls, by aligned clays (cutans) and iron oxides are seen in both modern muds and ancient massive mudstones. These microfeatures increase upward in the ancient cycles in the same manner as recent desert soils.

Desert "soils" overlying lake deposits in the Mojave indicate a transition from pluvial Pleistocene modern arid conditions in which sedimentation is slow and sporadic. Similar periods of long, continued aridity may be inferred for the Lockatong, and other similar formations, in Triassic basins along the east coast of North America.

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Near-Surface and Burial Diagenesis of Mississippian Burlington and Keokuk Formations

The Burlington and Keokuk formations (Osagean) in Illinois and Missouri exhibit a complex diagenetic history of multiple episodes of calcite cementation, dolomitization, dedolomitization, chertification, compaction, and minor Mississippi Valley-type mineralization. Geochemical data and plane and cathodoluminescent light petrography define the complete paragenetic sequence.

The earliest widespread diagenetic event was replacement of lime mud by luminescently zoned dolomite (dolomite I). Dolomite I rhombs were later partially replaced by unzoned, luminescently red dolomite (dolomite II). A regional calcite-cemented stratigraphy of 5 luminescent and nonluminescent zones postdates dolomites I and II and predates upper Meramecian deposition. Between the third and fourth calcite-cement zones, minor dedolomitization was accompanied by a third dolomite generation (dolomite III) that syntaxially overgrew and/or replaced dolomites I and II.

Chertification of lime mud began before replacement by dolomite I. Additionally, chalcedony and megaquartz filled voids and partially replaced the first 5 calcite-cement zones.

Two regional compaction events are observed. The first occurred between calcite-cement zones 3 and 4, whereas the second postdates calcite cement zones.

The preceding events are postdated by minor Mississippi Valley-type mineralization, which includes dissolution vugs partially filled by baroque dolomite, sphalerite, pyrite, quartz, and ferroan calcite.

A mixing zone is proposed for dolomite I based on petrographic timing and complementary stable isotope data. Regional variations in luminescent and nonluminescent calcite-cement zones suggest precipitation in ground-water systems with lateral and vertical Eh gradients. Late diagenesis by hot brines is indicated by minor Mississippi Valley-type mineralization and supported by fluid inclusion data and depleted carbon and oxygen isotope values.

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Structural Relations Between Marfa, Marathon, Val Verde, and Delaware Basins of West Texas

The Marfa, Marathon, Val Verde, and Delaware basins and related uplifts formed the major structural elements of the southwestern continental margin of North America during the Paleozoic. In contrast with the relatively simple relationships where the southern Oklahoma aulacogen intersects the Ouachita orogenic belt, structural relationships in the area of these basins are very complex. Various geologic evidence points to an allochthonous Marathon basin. However, a prominent gravity anomaly is associated with the Ouachita system as it extends from western Arkansas through Oklahoma and Texas into northern Mexico. If this anomaly is the signature of the early Paleozoic continental margin, then the location of the Marathon basin with respect to this anomaly suggests lateral displacements have been only on the scale of tens of kilometers. The Delaware basin seems clearly analogous to the Anadarko basin in that it formed as a result of reactivation of a major crustal flaw (not necessarily a rift). This reactivation was a result of the Ouachita orogeny. The Marfa basin is also flanked by a linear gravity high and basement uplift. The relationship of this anomaly to the gravity high associated with the Ouachita system suggests that the Marfa basin may be more analogous to the Delaware basin than foreland basins such as the Ft. Worth and Arkoma. A prominent gravity high that extends into northern Mexico is associated with the Devil's River uplift, and the relationships between this feature, the Val Verde basin, and adjacent structures suggest major deformation on a crustal scale.

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Neotectonics, Sea Level Change, and Quaternary Natural Gas Occurrence in Coastal Maine

The glaciated, passive continental margin of northern New England is not a likely location for either tectonic activity or hydrocarbon accumulation, but neotectonic action has played a role in creating favorable stratigraphic traps for natural gas in the Quaternary inner-shelf and estuarine deposits of Maine. During late glacial time (13,000 years B.P.), a marine inundation accompanied ice retreat across the isostatically depressed lowlands of coastal Maine and blanketed the area with marine sediment (Presumpscot Formation) up to 50 m thick. Unloading of the ice led to rapid coastal rebound within a few thousand years, and the former sea floor became emergent to present depths of −65 m. A gullied and weathered lag surface on the muddy Presumpscot Formation marks the regression that followed deposition. Since about 8,000 years B.P., sea level has risen in Maine, and within historic times it has been accompanied by seismicity and subsidence rates up to 9 mm/yr. Examinations of over 1,500 km of seismic reflection profiles and limited coring reveal the presence of abundant natural gas in Holocene sediments filling ravines cut into the Presumpscot Formation during emergence. It appears that the gas is derived from and trapped by mud deposited in estuarine depocenters that migrated landward during the Holocene transgression.

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Disrupted Carbonate Hardgrounds in Shallow Carbonate-Shelf Sediments: Origin and Setting of Tepees and Their Associated Fabrics

Carbonate-sediment surface hardgrounds are commonly disrupted and brecciated. Some of these breccias are the result of repeated episodes of fracturing and fracture fill by sediment and/or cement. Each fracture and fracture-fill phase causes the crust to grow in surface area and crumples it into megapolygons whose anteform margins are called tepees. Fracturing is caused by thermal contraction, water-table movement buoying up the crust, mass movement of sediment, and tectonic events. Tepees are commonly ascribed to tidal flats but, in fact, also occur in many settings that can be determined from their fabric and facies associations. (1) Submarine tepees from shallow, carbonate-saturated water occur in fractured, bedded, marine grainstones with acicular and micritic cements. They contain no vadose pisolites or gravity cements, and the hardground surface is altered and bored. (2) Peritidal tepees occur in fractured, bedded, tidal-flat carbonates characterized by fenestral, pisolitic, and laminar algal fabrics close to the marine water table. Fracture fills include gravity-controlled marine travertine and/or marine and terra rossa sediments. (3) Groundwater tepees form in fractured fenestral, pisolitic, and laminar algal crusts over "boxwork" carbonates at the margin of shallow salinas where periodic groundwater resurgence is common. (4) Extrusion tepees, which are also from salina margins with periodic groundwater resurgence, form in crusts coated with laminated micrite that extend from the fractures downward into dolomitic micrite. (5) Caliche tepees, from continental settings overlying soil profiles, form in