shallow-bank environments.

Evidence of recurring scour by current erosion is found in the Florida Straits. Erosional events apparently occurred in middle Cenomanian, middle Paleocene, early-middle Eocene, and middle Oligocene, which are times of lower eustatic sea level. This evidence of Florida current scour indicates that the current was present as far back as the Cenomanian.

A carbonate bank margin and reef complex has been present along the Bahama Escarpment since Middle Jurassic. Apparently these organic buildups seeded on structural relief on oceanic basement created during the spreading-center jump along the Blake Spur anomaly. The bank margin apparently has retreated at least 15 km below the A^u unconformity.

Active faulting at least through the Late Cretaceous and perhaps into the Tertiary, occurred along the Great Abaco fracture zone. These relatively young tectonic events, along with the post-Albian faults in Providence Channel, indicate interactions between the Atlantic and Caribbean plates and extensions of faulting far to the northeast of Cuba and the greater Antilles.

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Importance of Regional and Local Structure to Devonian Shale Gas Production from Appalachian Basin

Over 1 Tcf of high-quality natural gas has been produced from Devonian shales during the past 100 years. The shale is its own source, seal, and reservoir; natural features within the shale form the reservoir. Organic shale is the prime requisite for production, but productivity relates to the presence of open fractures so that one can presume that abnormally productive trends correspond to open fracture zones. This presumption is supported by the direct association of linear zones of high production with linear basement structure detailed in three fields studied. The blanketlike nature of the lower production ubiquitous in southern West Virginia and eastern Kentucky probably relates to a fracture facies developed within the shale and controlled by shale lithology and Appalachian tectonics.

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Depositional Environment of Albian Sandstone, Baltimore Canyon Trough, Mid-Atlantic OCS

The Albian sandstone, found throughout the Baltimore Canyon Trough, was studied using data from well logs, cores, and cuttings from COST and exploration wells from common-depth-point seismic lines. The sandstone is 300 m at the thickest point and covers at least 10,000 sq km; its top is at depths of 1,600 m to 2,900 m. Although the sandstone is mostly Albian in age, in some wells its top is about middle Cenomanian and in others the sandstone is partly in the Aptian. The sandstone overlies a shale and grades upward from silt to a medium to coarse sandstone with interbedded shales. At the top of the Albian sandstone is a well-sorted coarse- to medium-grained sandstone averaging 24 m thick that can be correlated in all the wells studied. Grain-size analyses of the uppermost sand were done on the cuttings using an automated rapid sediment analyzer; results indicate deposition in an environment intermediate between beach and fluvial environments. The top of the Albian sandstone is marked by an unconformity with overlying marine shales. During a time of global sea-level rise, sediments continued to accumulate near the shelf edge creating the thick sand sequence in the center of the Baltimore Canyon Trough. A major sea-level drop, and subsequent rise, during the Cenomanian coincided with the end of sand deposition.

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Geochemical Framework and Source-Rock Evaluation of Mid-Atlantic OCS

Geochemical analysis of exploration and deep stratigraphic test wells has provided new information on organic richness, thermal history, and type of source material in much of the Baltimore Canyon Trough. The total organic carbon content and concentrations of light-gas through high-molecular-weight hydrocarbons in Jurassic, Cretaceous, and Tertiary samples define zones of marginal to excellent richness. Levels of thermal maturation, primarily determined by thermal alteration index and vitrinite reflectance data, indicate that burial below 3,500 m is generally required for petroleum generation. Microscopic analysis of kerogen also delimits oil-prone and gas-prone organic facies.

Measured parameters when mapped by a computer contouring program show geochemical trends in strata of different ages. In addition, some geochemical zones of exploratory interest that were originally observed in the COST wells can be extended to oil company wells. Cretaceous and Cenozoic rocks have little petroleum potential in this area because of their thermal immaturity. However, organic-rich units in Jurassic strata may have generated significant quantities of natural gas or oil in some parts of the basin.

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Thermal and Mechanical Evolution of U.S. Atlantic Continental Margin

The postrifting tectonic subsidence of the U.S. Atlantic continental margin appears to be due to thermal contraction following continental breakup. This subsidence is greatly increased by the effect of sediment loading. Models for the response of the lithosphere to loads show that the rigidity of the lithosphere is a strong function of temperature. Hence the flexural rigidity at the U.S. margin should vary in both space and time. The thermal structure and subsidence of the margin has been modelled using a two-dimensional extension model where the amount of extension has been allowed to vary across the margin and lateral conduction of heat has been included. The equivalent elastic thickness of the lithosphere has been approximated as the depth to an isotherm. Thermoelastic effects of the cooling lithosphere, as well as the flexural loading of the sediments, have been included. The lateral flow of heat and flexure have contrasting effects. The lateral heat flow tends to cause uplift of the coastal plain region landward of the hinge zone and to increase the subsidence rate in the regions of the transitional crust. In addition, the effects of lateral heat flow modify the thermal history of the sediments and heat flow. Flexure, on the other hand, causes subsidence of the coastal plain and decreases the sediment accumulation beneath the transition zone. The stratigraphy of the U.S. margin is seen to be the result of the complex interaction of these effects as their contributions vary through the history of the margin.

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Sedimentologic Processes in Wilmington and South Wilmington Submarine Canyons as Indicated from DSRV *Alvin*

Three submersible dives in DSRV *Alvin* were made on the continental rise seaward of Atlantic City, New Jersey: two in Wilmington Canyon and one in South Wilmington Canyon. The dives, made on features observed in midrange sidescan sonar records reveal a sharp contrast in physiography between the two canyons and provide an insight to the sedimentologic processes associated with canyon development.

On the upper rise, Wilmington Canyon is characterized by a well-developed meander pattern with alternating steep and gently sloping side walls. The steep channel walls correlate with the outside (concave) part of a meander bend and are segmented by numerous steep-walled, steplike depressions. Therefore, undercutting at the base of the channel wall, accompanied by localized slumping, is inferred. These depressions are missing on the gently sloping channel walls. Unconsolidated sediment, in excess of 1.3 m thick, is present in the channel axis but is generally missing in the depressions on the channel wall. The high quartz sand content (30%) in the channel sediments and the paucity of unconsolidated sediment in the depressions indicate recent activity.

In South Wilmington Canyon various deformed and displaced(?) sediments support a previous suggestion of large-scale slumping. These features include upturned clay horizons at the base of the wall, stratigraphically overlain by disaggregated gravels, a loosely bound gravel conglomerate, and oxidized sandstone horizons. A tubular object 1 m long, tentatively interpreted as a tree root cast, was recovered from the sandstone. A meander pattern was not found in South Wilmington Canyon.

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Cretaceous Ostracoda from Wells in South Carolina

A fauna of approximately 70 species of Cretaceous ostracods has been recovered from 40 wells and a few outcrop samples in the South Carolina coastal plain; 51 of the species are assigned to, or are believed to be referable to, described species. The rest of the species are given affinitive assignments, or are left in open nomenclature.

In the present collection, 20 of the species are tentatively considered to be restricted to beds of Navarroan (approximately Maestrichtian) age; 13 additional species are possibly restricted to beds of Tayloran (approximately Campanian) age; and 7 other species are restricted to beds of Austinian (approximately Santonian and Coniacian) age. One species of the collection is representative of pre-Austinian deposits.

Several of the species also occur in the COST Atlantic wells and are useful for correlation with offshore Cretaceous deposits.

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Sediment Transport on Georges Bank and Southern New England Shelf

Four bed-form provinces have been identified on Georges Bank by means of sidescan-sonar and echo-sounding techniques: large sand waves, small sand waves, megaripples, and featureless sea floor. The large sand waves are on the bank crest where tidal currents exceed 70 to 80 cm/sec; they are bordered, north and south, by areas of small sand waves and/or megaripples where tidal currents are 40 to 80 cm/sec. Featureless sea floor is present farthest from the bank crest where tidal currents are less than 40 cm/sec.

Directions of sediment transport can be inferred from bed-form asymmetry and from surface-sediment texture. On the crest of the bank large sand waves are on northwest-striking ridges. The asymmetry of these sand waves indicates southward transport on one side of the ridges and northward transport on the other, implying erosion from the troughs separating the ridges, and growth of the ridges. The asymmetry of the small sand waves along the south side of the bank indicates that sand is also transported southward away from the bank. Though the asymmetry of megaripples could not be determined in the study, the presence of megaripples between the sand-wave provinces and areas of featureless sea floor suggests decreasing effectiveness of sand transport away from the bank crest. This pattern of sand transport is supported by surface-sediment texture, which becomes progressively finer both north and southwest away from the crest of Georges Bank. One end of the sediment-transport path is the southern New England shelf where silt and clay are deposited. Here tidal currents drop from 30 to 6 cm/sec, permitting the fine suspended sediments to accumulate.

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Structural Aspects and Hydrocarbon Potentials of Basins on Continental Margins Off Labrador and Newfoundland

The continental shelf of Labrador and Newfoundland is underlain by several discrete subbasins. On the western margin of the Labrador Sea, north of the east-trending, east-plunging Cartwright arch, the continental shelf is underlain by up to 10 km of Upper Cretaceous to upper Tertiary marine clastics that constitute the Hopedale-Saglek basin. These sediments overlie a narrow rifted basin of early to middle Cretaceous age, informally called the Erik graben.

Further south, between the Cartwright arch and the axis of the Avalon uplift, the continental shelf is more complex. This region contains the St. Anthony basin, an Appalachian successor basin with upper Paleozoic coal measures and red clastics; the somewhat sinuous, generally northeast-southwest trending Avalon basin containing mixed facies of Mesozoic and Tertiary age; and an unnamed, early Tertiary depocenter having a NNW-SSE trend which is infilled with mostly fine-grained marine clastic rocks.

Hydrocarbon occurrences discovered can be explained in terms of the nature and thermal maturity of probable source rocks and the time of trap formation. Liquid hydrocarbons have only been found in significant amounts in the Avalon basin where traps are supra-adjacent to mature Upper Jurassic source rocks. However, in this basin Lower Cretaceous deltaic sequences can be expected to generate gas. In the remaining basins the sequences contain organic matter that is largely terrestrial and/or at a low level of thermal maturity. In these basins, a low potential for gas is likely.

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Hydrocarbon Model for Scotian Shelf

The Scotian Basin, which in part underlies the Scotian Shelf offshore eastern Canada, contains up to 12 km of Mesozoic and Cenozoic sedimentary strata and has all the prerequisites for hydrocarbon occurrence. Data sets—stratigraphy, structure, organic geochemistry, kerogen type and maturity, geothermal history, and oil and gas occurrence—show that the hydrocarbons encountered in the wells drilled to date are in