The neotectonic activity along the inner continental margin and seismic activity along extensional faults inland from it strongly suggest that slight rifting is still occurring from the opening of the Atlantic. The present downwarping at the continental edge is now concentrated in irregularities, embayments, that possibly developed by sagging over basement structures.

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Organic Matter Type and Hydrocarbon Occurrences on Eastern Canadian Margin

The type of organic matter present in the Mesozoic-Cenozoic sections of offshore eastern Canada is related to the geologic histories of the western North Atlantic Ocean and the Labrador Sea. On the Scotian Shelf–Grand Banks, marine organic matter (amorphogen), largely the remains of phytoplankton and the primary precursor of oil, did not become abundant until the Late Jurassic, and then only where marine conditions were more fully developed. Floods of terrestrial organic material in deltaic sediments considerably diluted the amorphogen in the Early Cretaceous, particularly on the Scotian Shelf. In contrast, amorphogen continued to be common in the East Newfoundland Basin. Major marine transgression led to uniformly abundant amorphogen throughout the Late Cretaceous and Cenozoic of the Scotian Shelf and Grand Banks, with terrestrial organic material only becoming important in the Neogene. Coloration studies indicate that sediments are generally immature in the Late Cretaceous–Cenozoic, except in: (1) areas where the Cenozoic is extremely thick in the East Newfoundland Basin and Labrador Shelf; and (2) where anomalously high geothermal gradients result as from salt intrusion. Older strata, where mature, are generally gas-prone, except where amorphogen is common. The Labrador Shelf shows a similar but later sequence of organic types with amorphogen being common only in the Paleogene. Our results are consistent with hydrocarbon distribution encountered to date in offshore eastern Canada. They also indicate that the relative abundance of amorphogen increases in an offshore direction, of particular importance where the type of organic material is the limiting factor for oil generation as in the Late Jurassic–Early Cretaceous.

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Frontier Exploration—Southeast Georgia Embayment

During 1978 Transco Exploration Co. and its partners successfully bid on five Sale 43 tracts in the Southeast Georgia Embayment. These leases were acquired on the basis of a subunconformity play different from other prospects in the sale area. During late 1979 Transco, as operator, drilled an exploratory well which will influence future exploration of the prospect.

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Biostratigraphic Changes in Spore and Pollen Record in Middle to Upper Cretaceous of Atlantic Coastal Plain as Reflection of Sea-Floor Spreading, Global Cooling, and Evolution of Wind Pollination

During the middle Albian and continuing through the late Cenomanian, changes in the spore and pollen record of the Middle Atlantic Coastal Plain suggest cooling climatic trends. The decrease in temperature is indicated by a reduction in palynomorphs associated with humid tropical conditions and an increase in gymnosperm pollen. These trends are paralleled by a gradual but continuous evolution of angiosperm types from tricolpate to triporate pollen. The latter events may be associated with cooling and increasing seasonality that would favor selective pressures for the evolution from early insect-pollinated angiosperms to well-developed wind-pollinated types by late Cenomanian. This climatically driven evolutionary trend reaches its acme during the Coniacian-Santonian climatic maximum.

Climatic cooling during the middle Cretaceous, as suggested by oxygen isotope studies, is believed to be related to increased sea-floor spreading. Such plate movements resulted in the fractionation of the circumglobal tropical Tethyan seaway as well as an increasing rate of northward and counterclockwise movement of the Middle Atlantic coastal margin during middle to Late Cretacous times.

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The Hibernia Structure

The Chevron et al Hibernia P-15 well discovered hydrocarbons on the Hibernia structure in late 1979. Since that time, the operator Mobil Oil Canada, Ltd., and partners (Gulf Canada Resources, Inc., Petro-Canada Exploration Inc., Chevron Standard Limited, and Columbia Gas Development of Canada, Ltd.) have drilled four appraisal wells on the feature. Results from these wells indicate the presence of a major oil accumulation. Hibernia is located on the Newfoundland Grand Banks 315 km east-southeast of St. John's. Local stratigraphy and seismic structural data indicate potentially productive hydrocarbon zones.

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Stratigraphy and Sedimentology of Upper Cretaceous (Raritan) Sediments of Staten Island, New York

Cretaceous sediments on Staten Island have been considered to represent Raritan and Magothy formational units. Recent investigations of subsurface samples by Cousminer and Connors have resulted in correlations with Raritan Formation members exposed in northern New Jersey. Raritan Formation Members identified by pollen stratigraphy and petrologic studies were the Sayreville Sand Member and the Woodbridge Clay Member. No Magothy formational equivalents were found. New data have been collected from outcrop samples for correlation studies. These outcrops are slowly being destroyed by human activity.

Outcrop samples were collected from three localities and analyzed for grain-size distribution and mineralogic content. The Sayreville Sand Member on Staten Island is a light-colored, fine- to medium-grained, thin- to thick-bedded sand. Variegated clays and silts, thin- to thick-bedded, are layered with the sands. Thin micaceous silt and clay beds containing abundant lignitic fragments and some sulfide minerals are also present. The sands are extensively cross-stratified with small planar beds. Quartz is the principal component of the sand

with minor mica and feldspar. Heavy-mineral analysis indicates high ZTR and SSK ratios.

Stratigraphic and sedimentologic interpretation suggests deposition as channel fill and overbank deposits by meandering streams in a subaerial environment. Sediment source area was probably the crystalline highlands on the northwest.

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Moderate-Temperature Geothermal Resources Beneath Atlantic Coastal Plain

The most promising geothermal resource in the eastern United States is warm water stored in the permeable sediments of Cretaceous and younger age beneath the Atlantic Coastal Plain. Optimum sites for high gradients are locations where the heat flow is high and sediment thermal conductivity is low. Low conductivity is characteristic of most of the Coastal Plain sediments.

Heat flow in the eastern United States varies from about 33 mW/m^2 to 100 mW/m^2. All variations in heat flow in the eastern United States are caused either by differences in the concentrations of the heat-producing isotopes of uranium, thorium, and potassium in crystalline rocks, or by differences in thickness of heat-producing crystalline rocks. The highest concentrations of heat-producing elements, and the highest heat flows, are in the relatively young (ca. 300 m.y.) unmetamorphosed granite stocks and batholiths. Similar granites also are present in the southeast in the basement beneath the Coastal Plain. Thus, optimum sites for the development of moderate-temperature geothermal resources beneath the Coastal Plain require a knowledge of the (1) distribution and thickness of heat-producing granites in the basement, (2) thermal conductivity and thickness of sediments above basement, and (3) nature and extent of aquifers in the sediments above basement.

A site for the first deep geothermal test on the Atlantic Coastal Plain was chosen at Crisfield, Maryland. A temperature of 57°C was found at a depth of 1.26 km. Economic analyses at this site and elsewhere by the Applied Physics Laboratory of Johns Hopkins University, aquifer pump tests, and numerical modeling of the thermal lifetime of a reservoir suggest that geothermal energy may be an important resource at some locations on the Atlantic Coastal Plain.

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Unconformities and Depositional Sequences During Transgression and Regression of Continental Shelf

Major transgressions and regressions are recognized on the basis of vertical sedimentary sequence between major unconformities in the stratigraphic record. The more laterally continuous an unconformity is, the more time significance it is interpreted to have. Studies of transgressions and regressions during the Holocene and Pleistocene provide new insights into the character of unconformities and the interpretation of depositional sequences. In addition, these studies indicate that extensive regressive deposits do not develop during falling sea level.

During transgressions, the base of the transgressive depositional sequence is marked by a subaerially eroded unconformity at the top of the pretransgression deposits. The deposits just above the basal surface are usually back-barrier lagoon or estuarine sediments. Three types of basal contacts can develop depending upon the material directly overlying the unconformity: fringing marsh, distal lagoon, or lagoonal beach sediment. The processes which develop these lithosomes also serve to make the contact lithologically indistinct. In fact, with lagoonal beach and distal lagoon the contact can become gradational owing to erosion and bioturbation, respectively. Considerable topographic relief is present on this surface, whereas paleosoil is rarely preserved. The most lithologically distinct contact developed during the transgression is the ravinement surface caused by shoreface retreat. This contact is also the most laterally continuous and has the least topographic relief; it is underlain by back-barrier lagoonal deposits and overlain by nearshore marine deposits.

During many transgressions and regressions, such as have occurred in the Quaternary, the sequence of back-barrier lagoon, truncated by the ravinement surface and overlain by nearshore marine deposits may be repeated several times in one vertical section. When the ravinement surface is mistaken for a major unconformity and the commonly obscured contact at the base of the lagoonal lithosome is taken as a gradational facies change, the vertical sequence is interpreted as prograding (regressive) shoreline deposits with nearshore marine overlain by lagoon. Each such sequence is interpreted to be separated by a transgressive surface. When the ravinement surface and the basal contact are recognized as such, the section is interpreted as a set of transgressive sequences with lagoon truncated by the ravinement surface, overlain by transgressive nearshore marine deposits.

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Geologic History of U.S. Eastern Continental Margin South of Cape Hatteras

The continental margin off the southeastern United States contains two major basins, the Blake Plateau Basin off Florida and Georgia and the Carolina Trough off South and North Carolina. The Blake Plateau is a large, equidimensional basin that probably is underlain by relatively thick rift-stage crust. It probably was filled dominantly by shallow-water carbonate platform deposits. Reef and carbonate-bank buildups occurred near its seaward edge and the platform deposits interfingered with continental facies deposits near its landward edge. Reef building was interrupted in Barremian time and ended after an Albian-Aptian pulse. Subsequently, deposition did not keep pace with subsidence, and a deep-water plateau was formed. Onset of Gulf Stream flow across the inner Blake Plateau during the Paleocene prevented seaward progradation of the continental shelf across the plateau, and major deep-water erosion removed the old continental slope, creating a steep cliff, the Blake Escarpment. The Carolina Trough is a long, narrow basin underlain by a narrow zone of rift-stage crust, much thinner than that beneath the Blake Plateau basin. This thin crust, presumably the result of major stretching of continental crust in the rift stage of ocean opening, floated deep isostatically and formed a salt-depositing basin early in continental-margin history. Later sediment loading caused the salt to flow into a series of slope diapirs, and withdrawal of the salt resulted in major subsidence of the block of sediment overlying the trough; movement occurred along growth faults.

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Ocean Margin Drilling Program