Tilted Jurassic fault blocks form the primary hydrocarbon trap at Statfjord as throughout the East Shetland basin. Statfjord field is a structural/stratigraphic trap formed by westward tilting and erosion of a major fault block. Brent deltaic sandstones and underlying Statfjord fluvial to continental sandstones are truncated by mid-late Kimmerian unconformities on the crest and east flank of the structure, which is marked by a major fault system. Overlying and onlapping Jurassic and Cretaceous shales seal the trap. Organically rich Upper Jurassic shales provide an excellent oil source. Reservoirs have separate oil/water contacts. Normal faulting separates Statfjord field from the Brent field on the southwest.

Joint Norwegian and United Kingdom development utilizes "condeep" type gravity platforms and initial offshore loading. Development drilling from Statfjord "A" platform, towed to the location in May 1977, began in late 1978. First production is expected late in 1979.

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Calcification and Significance of Soil Filamentous Microorganisms in Quaternary Calcretes, Eastern Spain

Petrographic studies reveal the presence of various soil-dwelling organisms preserved as calcified filaments in Pleistocene to Holocene calcretes from coastal regions of eastern Spain.

On the basis of gross morphology, occurrence, abundance, and chemistry of relic organic tissues, four organomineral associations may be recognized. The mineral phase is low-magnesian calcite; its fabric occurs as micron-sized needles and rhombs. The organic phase includes four taxonomic groups: filamentous soil fungi (dominant); filamentous soil algae (rare); actinomycetes (common); and root hairs of vascular land plants (common). Filamentous soil fungi are generally 1 to 10μ in diameter, branch dichotomously and are nonseptate. Filamentous soil algae are 2 to 10μ in diameter, unbranched or show false ramifications, and are septate. Actinomycetes are less than 1μ in diameter, branch irregularly and are nonseptate. Root hairs of vascular land plants are 5 to 15μ in diameter, unbranched and nonseptate. All four groups are dominantly chasmolithic.

Morphology of calcified filaments depends on whether calcification is determined by physicochemical or biochemical processes, or both. The calcified product may be a hollow tube or a solid rod, depending on the condition of the organic substrate before, during, and after its calcification. Biochemical control of calcification produces filaments whose morphologies are related closely to those of the organic substrate; physicochemical control of calcification produces filaments whose morphologies may or may not be related to those of the organic substrate.

Calcretes containing calcified filaments indicate that they functioned, at some stage in their evolution, as biologic soils. Such calcretes are paleosols; they record the presence of a former land surface, colonization by terrestrial organisms, and subaerial vadose conditions in ancient successions.

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Slumping in Intercanyon Areas, Middle Atlantic Continental Slope

Analyses of high-resolution seismic reflection profiles show that slump deposits are ubiquitous within the intercanyon areas of the continental slope of the Middle Atlantic Bight. Of 15 widely spaced 3.5-kHz profiles obtained between Hudson Canyon and Chesapeake Bay, 12 define slump deposits that vary from thin, homogeneous or parallel-bedded lenses of sediments, to masses of intermediate thickness containing contorted bedding, to relatively thick slump blocks with discontinuous bedding. These deposits constitute the upper 10 to 90 m of sediments, extend downslope for 2 to 7 km, and are present at water depths ranging from 545 to 1,500 m. Minisparker profiles obtained during a detailed survey of a 9 by 28 km area of the slope between Hudson and Wilmington Canyons define 19 slump deposits in water depths of 398 to 2,190 m that comprise 12% of the survey area. Individual masses are as much as 50 m thick, cover as much as 5.3 sq km, and contain a maximum of 0.11 cu km of sediments. Although some of the slump deposits on the Middle Atlantic slope undoubtedly are relict, stemming from sediment instability produced by rapid deposition during Pleistocene sea-level regressions, the acoustic characteristics of others suggest recent formation. Data from this study indicate that slumping in the intercanyon areas may be quantitatively important in transporting sediments to the deep sea and suggest that recent mass movements may constitute a geologic hazard to future economic development of this part of the continental slope.

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Simple Pyrolysis Technique Using Well Cuttings to Map Source Rocks, Gas-Condensate Maturity, and Abnormal Fluid Pressures Associated with Fracture Reservoirs: Example from Anadarko Basin

P. Trask showed that when small samples of kerogen-rich rock are pyrolyzed in a test tube, oil-like material may be generated and condensed as a brown residue around the walls of the tube. This technique is adaptable to the use of well cuttings and may be utilized to identify source rocks capable of generating oil. For any given source rock, the amount of pyrolysis yield decreases with increased thermal maturity as verified by vitrinite reflectance analysis. Samples from stages of maturity corresponding to the gas-condensate and dry-gas generation "windows" yield no pyrolysis residue because of their inability to generate dark oily liquids.

We have used the test-tube-pyrolysis technique to map quickly and accurately (1) source rocks capable of generating oil, and (2) the maturity threshold of gas-condensate generation in part of the Pennsylvanian section of the Anadarko basin.

The area of gas-condensate generation within the Atoka Formation, as mapped by the pyrolysis technique, is coincident with the presence of (1) abnormally

high formation-fluid pressures, (2) fracture-type reservoirs, and (3) water-free gas-condensate production. Abnormal pressures are believed to be caused by high generation rates, volume expansion during conversion of kerogen to a gas phase, and rock-framework collapse. Indigenous fracturing is caused by a favorable stress condition accompanied by critically high formation-fluid pressure. Water-free hydrocarbon production is the result of the nearly complete saturation of available reservoir space by relatively large volumes of generated and only partially expelled gas-condensate.

We believe that the simple pyrolysis technique and its interpretations are applicable to many basins. The method requires only a library of sample cuttings, a supply of test tubes, and a propane torch (or similar heat source) for implementation.

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Diagenetic Phenomena of Chipola Formation, Calhoun County, Florida

The Chipola Formation crops out along the Chipola River, Ten Mile Creek, and Farley Creek in Calhoun County, Florida. The formation, dated at 16.1 m.y.B.P., is predominantly an unconsolidated, bioclastic wackestone. These carbonate rocks have undergone very little diagenetic alteration, and as a result fossil preservation is excellent. Original mineralogy is essentially unchanged, and most shell material is aragonite or high-magnesian calcite. X-ray analysis of unlithified sediment indicates a composition of approximately 75% aragonite and 25% high-magnesian calcite. Disregarding the age of the formation, the unit is considered to be in a very early stage of lithification.

Cementation occurs locally in the unit by the formation of low-magnesian calcite as microspar. The lithified parts of the formation take on a nodular appearance as bioclastic debris is cemented. "Nodules" are usually less than 15 cm in diameter. Sparry calcite locally may be a void-filling cement, but this is usually confined to lithified burrows. Cementation within burrows is apparently controlled by the presence of organic mucus in the sediment. Early stages of pseudosparitization can also be observed in shell material. Alteration to pseudospar appears as a migrating or advancing "front" through the shell material.

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Depositional Environments and Diagenesis of Grand Rapids Formation, North-Central Alberta, Canada

The Lower Cretaceous Grand Rapids Formation of north-central Alberta consists of three massive sandstone members: upper A, middle B, and lower C. Maximum thickness of the formation is 90 m. In the subsurface, the A and B sands are bitumen impregnated and form the Wabasca oil sand deposit, with reserves estimated at 10.5×10^9 cu m (66×10^9 bbl).

The Grand Rapids Formation was deposited in a broadly regressive setting, interrupted by two transgressive pulses that resulted in shales forming between the three sandstone members. The C sand and the lower part of the B sand were deposited under offshore marine conditions which gradually shallowed to distributary channels, nearshore bars, and coastal swamps at the close of B sand deposition. The shales between the A and B sands were initially formed in brackish environments, which changed to an offshore marine environment as the result of transgression. The A sand consists of nearshore marine deposits overlain by distributary and tidal-channel sands. Coal seams that cap the A and B sands in the outcrop area indicate a coastal-swamp to interdistributary-bay setting.

The clay mineral assemblage in the sandstones consists of kaolinite, illite, montmorillonite, and minor chlorite. In general, the bitumen-saturated sandstones have lower clay content with a larger proportion of kaolinite and less montmorillonite than the nonsaturated, water-bearing sandstones. Examination of the sandstones in thin section and by scanning electron microscopy shows that most clays are either authigenic or have authigenic overgrowths giving the appearance of authigenic minerals.

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Megascale Variability of Sediments on United States Atlantic Continental Shelf and Slope—Multivariate Study

The Atlantic continental shelf of the United States provides an excellent laboratory for application of statistical techniques designed to augment the megascale distribution of spatially oriented geologic data.

Multivariate methods have been applied to data from over 2,000 surface-sediment grab samples in a baseline study conceived both to discern regional trends of textural and mineralogic parameters and to evaluate the relative usefulness of these statistical strategies. The data include textural information on mean grain size, sorting, skewness, and various mineralogic constituents, whereas the statistical techniques employed include cluster, ordination, and trend surface analysis.

Distinct sedimentary facies were first determined by Q-mode cluster analysis, based on the similarity among individual samples utilizing Sorenson's coefficient as the similarity index. To interpret the relations among sedimentary facies, the clusters were plotted in n-dimensional space by Q-mode ordination, employing a highest dissimilarity criterion. The method suggests, for example, that the sediments from the shelf south of Cape Hatteras can be classified on the basis of water depth and calcium carbonate. The sedimentary facies include: a low $CaCO_3$ inner-shelf facies, an outer-shelf facies with variable $CaCO_3$ content, a shelf-break facies, an biogenic upper-slope facies, and a lower-slope facies. Plotting the spatial distribution of these clusters shows the trend toward low $CaCO_3$ content in sediments on the shelf off Georgia, thereby emphasizing the inverse relation between clastic influx and $CaCO_3$ content.

As would be expected, trend surface analysis ignores local variations in sedimentary parameters in favor of extracting the regional gradient. The trend from fine sand nearshore to coarser sand on the shelf below wave