The question of possible source(s) for oils in Gulf Coast Tertiary reservoirs is related to the question of early versus late migration. What was the time relation between generation, migration, reservoir deposition, and trapping? Combinations of inferences, interpretations, and facts suggest several possible scenarios consistent with the geology and the geochemistry, indicating that the oils were probably derived from more than one source. The integration of geochemistry with geology is leading us to a better understanding of the entire system, and is showing us the value of looking this gift horse in the mouth.

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High-Resolution Seismic Methods in Coal Exploration

Reflection seismic methods have been used with great success in the exploration for oil and gas for over 40 years. Recently, "oil-country seismics" have been adapted to the coal mining industry. In the United States, the method is little used because it is a relatively new application of seismic exploration, and because little has been written explaining the method, how it works, and what it can achieve. Mining engineers, geologists, and management are concerned with where the coal is located stratigraphically, its thickness, the depth and structure of the seam, the presence and attitude of faults, washouts, seam splits, or burn areas. Unless geologic parameters are unusually adverse, high-resolution reflection seismic methods will extrapolate core-hole information when core-hole costs are high, and can reduce the number of core holes necessary by as much as 50%. Where overburden is thick it can locate new core holes to provide maximum information. Where faulting is present it can determine strike and hade. Further, it may locate washouts and seam splits depending on depth and associated geologic conditions. The high-resolution reflection seismic method will provide an improved picture of the geology ahead of the coal face for the mine planners, thereby maximizing production and profit.

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Mass Wasting on Continental Rise of Eastern South America

Although slumps and associated deposits appear to be widespread beneath parts of the continental slope, recent studies of sedimentation and near-bottom processes on the continental rise of eastern South America indicate that mass wasting (slumps, slides, debris flows, etc) is of only limited or local extent. This conclusion is based on detailed examination of moderate- to close-spaced 3.5-kHz echograms and seismic reflection profiles plus examination of several hundred piston cores. Zones identified as mass-wasting deposits are usually of small regional extent (<50 km) and are confined to the upper rise or to regions adjacent to many of the large seamount chains (e.g., North Brazilian, Fernando de Noronha, and Columbia-Trindade Ridges) which cross the rise. Thus, on the basis of available data, the continental rise of eastern South America does not appear to have large, widespread slump or debris-flow complexes that cover thousands of square kilometers and extend hundreds of kilometers downslope as they do on other parts of the Atlantic continental rise (e.g., northwest Africa and eastern United States). However, the present data spacing on the South American Rise may preclude recognition and delineation of the regional extent of many mass-wasting deposits.

An exception appears to be the Amazon Cone, a large deep-sea fan that crosses the continental rise off the Amazon River. Recent studies have delineated two major zones of failure and associated debris-flow complexes which extend 300 km downslope and are up to 100 km wide. The morphology of these features is complex, and recognition is complicated by the fan channels and their associated levees plus the high (>50 cm/10^3 year) Quaternary sedimentation rates. The eastern slide or debris-flow complex heads at about 2,500-m depth (middle fan) and appears to terminate downslope against the Ceará Rise at a depth of about 4,200 m. The associated debris flow near the Ceará Rise is particularly well defined, and scarps are recognizable at the head of the complex. Three cores from the region of the flow indicate that the age of the flow is older than late Wisconsin. The slide or debris-flow complex on the western side of the cone appears to head near a depth of 500 m in a narrow (~25 km) scar. The associated debris flow extends to at least 3,750 m. A core indicates a late Wisconsin age for the flow. The occurrence of these two large slide or debris flows emphasizes the possible importance of mass-wasting processes to the formation and growth of large deep-sea fans even though such processes have generally been disregarded in most deep-sea fan models.

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Paleoenvironmental Implications of Oceanic Sedimentation Rates

Examination of long cores collected by deep-sea drilling shows that, at least during the Cenozoic, oceanic sediments accumulated at rates which varied widely in space and time, and that there are many gaps in the sedimentary record. Locally, sedimentation may be extensively controlled by ocean circulation and chemistry. Comparison of data from different regions, however, reveals broad, globally synchronous fluctuations in rate of sediment accumulation, the oceans apparently oscillating between periods of high (middle Eocene, early Miocene) and low (Oligocene, Paleocene) accumulation. Hiatuses in the record are common during periods of generally low accumulation. Such global changes in the rate of deep-sea sediment accumulation can be related to both sea-level fluctuations and global climatic changes, and their influence on sediment supply and ocean circulation.

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Origin and Development of Barrier Islands on West-Central Peninsula of Florida

The origin of barrier islands has been discussed and debated in the literature for nearly a century. Virtually all interpretations have been based on stratigraphic and geomorphic data. Two small barriers have formed in Pinellas County during the past 2 decades. Both aerial photography and field data show that these islands originated as shallow subtidal shoals. Continued accumulation of sediment occurred through normal low-energy waves and currents with assistance from occasional intense storms.

North Bunces Key became intertidal in 1957 and showed marked growth after Hurricane Donna in 1960. It is now 1.5 km long and rises more than 1 m above mean sea level. South Bunces Key was subtidal until 1974. It is 1.3 km long and rises nearly a meter above mean sea level. Anclote Key, which is 35 km north of Bunces Keys, is 4 km long and shows remarkable geomorphic similarities to North Bunces Key. Caladesi Island, located 9 km south of Anclote Key, is 6.5 km long and displays a "drumstick" configuration. Interpretation of depositional environments from 17 cores reveals that this island also originated as a shallow shoal on the inner shelf. Initial development of Caladesi Island has been dated at 5,000 to 7,000 years B.P.

Data from the modern environment and the stratigraphic record lead to the postulation that shoaling of shallow linear sand bodies has been a common mode of origin for barrier islands along the west-central peninsula of Florida.

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Statistical Zonation of Oil Shale on Basis of Chemical Characteristics

Several objective statistical techniques have been used to isolate zones of distinctive chemical characteristics within the saline facies of the Eocene Green River Formation. The data consist of measured concentrations of Al, Si, Na, K, Ca, Sr, Fe, and S in 374 composite samples collected at 0.61-m intervals in a 232-m section of the saline facies from a core of the Green River Formation, Piceance Creek basin, Colorado. The techniques were also applied to the oil-yield (Fischer assay) data for the entire core. The first statistical technique used was analysis-of-variance zonation. Zone boundaries determined by this technique separate portions of the core that have maximum between-zone variance and minimum within-zone variance. The second technique involves computation of moving correlation coefficients between two variables over successive 31-sample intervals. This technique isolates zones of strong positive and negative associations among geochemical variables.

On the basis of these two statistical techniques, the saline facies and underlying Garden Gulch Member of the Green River Formation have been divided into six geochemical zones. The most useful variables for zoning are Si, Al, Fe, S, Na, and oil yield. Concentrations of silicon and aluminum exhibit considerable variation and are positively correlated throughout the saline facies, expressing a strong correlation between quartz and dawsonite. The minerals most characteristic of the saline facies of the Green River Formation are dawsonite and nahcolite. Concentrations of iron and sulfur (present mainly as pyrite and marcasite) are positively correlated with oil yield in zones of higher salinity (as indicated by zones containing highest concentrations of nahcolite) and negatively correlated with oil yield in zones of lower salinity. This suggests that the effect of organic content on iron diagenesis, probably through controls on pH and Eh, was optimum during periods of higher salinity.

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"Kriging" of Top of Reservoir from Seismic and Borehole Data

This paper is part of an ongoing study to assess the performance of a natural sandstone reservoir considered for underground storage of gas. The specific problem dealt with is contour mapping the top of the structure in order to assess the closure zone. Data are from 56 wells, most of which were drilled in the central part of the dome, and four seismic surveys. A particular difficulty encountered is the small number of reliable velocity measurements.

The method used is "kriging," an optimal interpolation procedure based on random-fields theory. Its advantage over conventional methods is the use of the variogram, a structure function that depicts the spatial variability of the phenomenon under study. This method results in an interpolation algorithm tailored to each particular data set. Furthermore, error variances are attached to kriging estimates, telling how reliable the estimates are.

Depths to the top of the structure are obtained by adding estimated thicknesses of the intermediate layers to estimated depths of the seismic marker. Kriging of the thicknesses is performed after aggregation of the intermediate layers into approximately uncorrelated sets. For seismic-marker depths, three different methods, combining seismic and borehole information, can be used.

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Interpretation of Pleistocene Coastal-Barrier Complexes from Holocene Models, Southeastern Delaware

The Pleistocene Columbia Group in Sussex County, Delaware, has long been identified as a complex of nearshore marine and coastal deposits. However, interpretation of the internal geometry of the sedimentary lithosomes has proved to be difficult because of the extreme variability of these units. Environmental lithosome models of the morphology and internal geometry of the Holocene transgressive shoreline complex along the present Delaware coast provide an analog for the interpretation of the Pleistocene sedimentary sequences.

On the basis of sedimentary structures, lithologic se-