zones described by D. Bukry, although regional, secondary marker species are needed to define some zonal boundaries. Nannoplankton zonation established at these two deep-sea localities provides a standard of reference for much of the Neogene in the eastern Mediterranean.

Reworked Cretaceous and early Cenozoic nannoplankton are present throughout the stratigraphic interval studied, but not in quantities large enough to mask indigenous species which are used for the determination of zonal boundaries. Sedimentation rates at Sites 375 and 376 were highest in the late Miocene and late Pleistocene. Open-marine, warm-water species of discoasters are present in significant numbers throughout the Miocene and Pliocene. Earliest Pliocene assemblages contain numerous specimens of the deep-water genera *Amaurolithus, Ceratolithus,* and *Triquetrorhabdulus*, evidence of the rapid marine transgression immediately following Messinian evaporite deposition.

Nannoplankton in post-Messinian sediments at the drill sites and the Zanclean stratotype at Capo Rossello, Sicily, indicate that the base of the *Amaurolithus tricorniculatus* Zone (base of *Triquetrorhabdulus rugosus* Subzone) corresponds to the Miocene-Pliocene boundary.

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Miocene-Pliocene Molasse, Zagros Mountains, Iran

The Miocene-Pliocene sedimentary sequence in southwest Iran, a thick clastic wedge, is an excellent example of postorogenic sedimentation in the peripheral basin of a suture zone. The molasse records the rise of the Zagros Mountains, which formed as a result of the collision between the Arabian and Persian plates during the Miocene-Pliocene. The sequence is composed of two formations, the Agha Jari and Bakhtyari. Deposition of these units was preceded by deposition of the Mishan Formation, a shallow-marine limestone and marlstone deposit. The Mishan is conformably overlain by the Agha Jari, which consists of repetitious fining-upward fluvial cycles. The cycles comprise lithic sandstones (calclithites) and gypsum-veined marly mudstones. The unit is approximately 2,000 m thick in the study area, but reaches thicknesses greater than 3,000 m in other areas. The Agha Jari is conformably overlain by the Bakhtyari, which consists of interbedded conglomerate, sandstone, and mudstone. The conglomerate beds are characterized by closely packed, well-rounded clasts of Cretaceous to Eocene limestone and chert which were derived from the Zagros Mountains on the northeast. The Bakhtyari clastic units probably represent deposition on an alluvial fan, whereas the finer grained Agha Jari clastic strata represent distal-fan or alluvial-plain deposition.

Previous workers have recorded the presence of an unconformity between the Agha Jari and Bakhtyari Formations, but no unconformity was found in the study area. The contact is gradational, with both formations composing a continuous, coarsening-upward sequence.

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Miocene-Pliocene Syndepositional Tar Deposit in Iran

A fossil-bearing, tar-impregnated sandstone representing the deposit of a Miocene-Pliocene oil seep occurs near the top of the Agha Jari Formation in southwestern Iran. The sandstone is interbedded with typical Agha Jari clastics: red sandstone, siltstone, and marly mudstone. Sedimentologic and stratigraphic characteristics of the unit indicate that the tar was deposited contemporaneously with the sediment. The tar is concentrated in the 3-m-thick sandstone which is exposed laterally for 400 m, and ranges from cross-bedded medium-grained sandstone to interbedded sandstone and poorly sorted gravel. Tar is interspersed between grains and as detrital clasts. Mineralogically, the sandstone consists of calcium carbonate and tar-cemented litharenites. Small vertebrate fossils and some freshwater gastropods are concentrated in the gravel lenses. Other characteristics, such as reworked levee deposits, lenticular gravel beds, and fining-upward sequences, indicate a fluvial origin for the unit. The source of the tar was probably an oil seep which emptied into a small stream or river. Recent oil seeps in Iran serve as analogs and illustrate how such a deposit may have formed.

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Distribution, Morphology, Mechanisms, and Ages of Sediment Slides on Eastern Continental Margin—Cape Cod to Florida

Recent mapping off eastern North America has revealed four areally extensive slide zones between the Blake-Bahama Outer Ridge and Long Island. These slide zones are recognized on the basis of 3.5-kHz records and by the structures present in piston and box cores. The distribution of piston cores containing slump and debris-flow structures indicates that mass movements have taken place in this region on a wide scale and that slumping and sliding of sediments from the slope and upper rise onto the middle and lower rise are ubiquitous in the region during recent geologic time.

The slides appear to originate on the continental slope and upper rise and appear to have occurred in multiphase events. In the area south of Baltimore Canyon a series of apparently disconnected 20 to 30° scarps are present within the stratified hemipelagic sediments of the upper rise and slope. Large volumes of sediment which now cover an area of at least 2,000 sq km moved down through the valleys onto the middle rise (~3,100 m). The sudden loading of material appears to have triggered a series of smaller slides in deeper water (3,100 to 3,600 m), and this sediment then moved down onto the lower rise to depths as great as 4,200 m, forming a narrow mudflow tongue 10 km wide and 100 km long which appears to be disconnected from the shallower flows.

Three very large slide zones, each in excess of 10,000 sq km, occur on the slope and rise: (1) north of the

Blake Outer Ridge, (2) between Washington and Norfolk canyons, and (3) southeast of Long Island. Deposits resulting from these events extend across the rise to depths greater than 4,000 m. In the zone north of the Blake Outer Ridge, the deposits extend onto the Hatteras Abyssal Plain to a water depth of 5,400 m.

The distribution of most of the major slide zones appears to relate to the position of canyon systems and may be due to the rapid buildup of sediment overflowing from the canyons during the last glacial stage. Occasional large intraplate earthquakes such as the 1886 Charleston or the 1929 Grand Banks events may be the direct triggering mechanism. The ages of the slides are as young as middle Holocene. In time, the slope and rise probably will reach an equilibrium point (this may already be the situation), and the frequency of large-scale slides will decrease drastically until the next glacial stage.

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Environmental Regulations for In-Situ Uranium Mining, From Exploration to Restoration

In the past several years, laws have been passed and implemented through regulations to protect and improve the quality of our environment. Accordingly, uranium mining operations are closely controlled by many federal, state, and local laws and regulations. Therefore, persons in the industry should be aware of (1) the federal laws and regulations affecting in-situ uranium mining, (2) the source materials license and environmental statement process, including time and costs, (3) the monitoring requirements, including excursion detection and control, and (4) the restoration process.

The laws and regulations of Texas and of Wyoming differ in permit requirements.

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Progressive Cementation from Marine to Deep Subsurface Environments, Upper Smackover Formation

Several generations of carbonate cement are present in high-energy oolitic grainstones of the upper Smackover in seven wells in Arkansas, Texas, Louisiana, and Mississippi. The complete pattern of cementation reflects progressive lithification during burial. However, no single sample displays all cement types. The earliest cement was precipitated in the marine environment shortly after deposition; it consists of fibrous rims of nonferroan calcite "isopachously" surrounding grains. Small blocky crystals of either ferroan or nonferroan calcite formed after the marine cement. These crystals, which occur on the fibrous rims or irregularly encrust grains, are thought to have precipitated in the "shallow" phreatic environment. Subsequent compaction of the sediments with burial was inversely related to the degree of development of these early cements. Postcompactional cements consist of dolomite and coarse ferroan or nonferroan calcite, both of which are interpreted to have formed in the "deep" subsurface. The dolomite not only occurs as a void-filling cement, but also partially replaces grains. In places, dolomite rhombs transect sutured grain boundaries, providing conclusive evidence of their late origin. The coarse calcite comprises the final generation of cement and is the most common cement type. This cement may be poikilotopic; it commonly replaces dolomite rhombs. Porosity reduction is mainly the result of compaction and pore occlusion by this late calcite cement.

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Pore Space in Holocene Carbonate Sediments

Mean porosity and permeability of Holocene carbonate sediments from Florida and Great Bahama Bank, determined for 74 samples by water-flow rates in a falling-head permeameter, are related to depositional texture as follows: grainstone 44.5% (range 40 to 53%), 30, 800 md (range 15,800 to 56,600 md); packstone 54.7% (45 to 67%), 1,840 md (32 to 9,300 md); wackestone 68% (64 to 78%), 228 md (38 to 6,570 md); very fine wackestone 70.5% (76 to 73%), 0.87 md (0.63 to 1.37 md); supratidal wackestone 63.5% (61 to 66%), 5,590 md (617 to 24,100 md).

The muddiest and finest grained sediments have the highest porosities but lowest permeabilities; this negative correlation between porosity and permeability is the reverse of the situation in carbonate rocks, even those as young as Pleistocene. High porosity and low permeability show a strong correlation with percentage of fines ($<64\mu m$). From capillary-pressure curves it is inferred that many of the pore entrances in muddy carbonate sediments are finer than $1\mu m$, at least after drying.

Cementation rates for simple models of upper-phreatic-zone cementation calculated from the measured permeabilities would require excessive time to produce the degree of cementation present in late Pleistocene rocks of Florida and the Bahamas. Climate, especially rainfall and evapotranspiration, emerges as the rate-controlling factor in the most reasonable models of phreatic-zone cementation.

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Miocene Carbonate Gravity Flows in Blake-Bahama Basin

Intraclastic chalk, radiolarian mudstone, and carbonate silt (inferred sediment gravity-flow deposits) comprise the Miocene section in the Blake-Bahama basin at DSDP Site 391. Greenish-gray radiolarian mudstones, comparable to hemipelagic sediments that form the North American continental-rise prism elsewhere in the North Atlantic, occur as numerous clasts and a few thin intervals indicating that they formed the background sedimentation. The intraclastic chalk and carbonate silt generally lack sedimentary structures, but gravity-flow deposition is indicated by reworked fossils (forams,