sediment point sources and dispersal centers. Turbidity variability along the inner shelf is jointly attributed to variations in coastal runoff, relative tidal sediment flux from individual inlets, and ambient wind-induced hydrographic conditions. The outer-shelf patterns suggest the shelfward incursion of open-ocean waters, the extent of which varies spatially and temporally. Regional turbidity patterns appear to reflect the degree of interchange between the gulfward movement of turbid inner-shelf waters and the shelfward incursion of clear open-ocean waters. The observed variability is compatible with a conceptual model of the regional dispersal system based on seafloor sediment distribution, which suggests both net offshore and net southward alongshore transport on a wind-dominated shelf.

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Three-Dimensional Aspects of Belize Patch Reefs

Rotary-drill rock cores and vibrocores of sediments were used to investigate the origin and sedimentary history of patch reefs and a "rhomboid" shoal in offshore Belize (Central America). All lagoonal patch reefs and shoals examined are localized on preexisting Pleistocene topography. The buried topographic highs are composed of Pleistocene coralline limestone, suggesting a constructional patch-reef origin rather than an erosional or karst origin. The principal Holocene sediment- and framework-builder is the branching coral *Acropora cervicornis*, but *A. palmata*, various massive corals, and the lettuce coral *Agaricia* sp. are also contributors. These accumulations, up to 27 m thick, amplify Pleistocene topography. The accumulations are totally uncemented, and metal probes can easily be inserted more than 5 m into the living reef slope. Steep dips, commonly greater than 45° and extending from the surface to a least 30 m in depth, provide a sedimentary paradox. Even though these reefs are uncemented and periodically subjected to hurricanes, reef debris has not been found in the surrounding lagoonal muds more than a few meters away from the reef "toe." The surrounding coral-free lagoonal sediments, consisting both of clays and carbonate materials, are more than 6 m thick.

Understanding the mechanics of patch-reef formation may provide clues important to oil exploration: (1) many of the rhomboid shoal reefs are of reservoir size even though they are less than 9,000 years old; (2) their position adjacent to a humid mountainous hinterland makes them susceptible to burial by terrigenous clays as the coastal plain progrades; (3) both the clays and carbonate muds are in a favorable stratigraphic position to serve as source beds.

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Dolomitization of Pliocene-Pleistocene Carbonate Sediments, Bonaire, Netherlands Antilles

Dolomitization of sediments may be controlled, in part, by their predolomitization diagenetic history. The Pliocene-Pleistocene dolomites on Bonaire underwent a period of minor freshwater diagenesis prior to dolomitization. During this initial stage of diagenesis, some low-magnesian calcite cement formed. Unaltered high-magnesian calcite skeletal fragments were replaced during dolomitization, aragonite was dissolved, and low-magnesian calcite was at first inert and later locally dissolved. The inclusion crystals and crystal molds of calcite cement in dolomite rhombs, the presence of calcite zones in dolomite rhombs, and the preservation of limestone fragments in dolomitized breccias demonstrate that low-magnesian calcite was not replaced during the initial dolomitization. Cloudy centers and clear rims formed when the dolomitizing fluid changed from near saturation with respect to calcite (cloudy centers owing to inclusions and molds) to undersaturation with respect to calcite (inclusion and mold-free rims).

The concentration of Na^+ in these dolomites is approximately 350 ppm, and the $\delta^{18}O$ values range from +1.97 to +4.1. These data indicate that the dolomitizing fluid was low in Na^+ (relative to seawater) but isotopically heavier than most groundwater and, therefore, probably an evaporation-concentrated fresh water.

The data suggest that dolomitization may be climatically controlled. In humid climates, a sediment in the freshwater-seawater mixing zone may undergo rapid calcification owing to the high PCO_2 in the groundwater. In arid climates, the water will have a lower PCO_2 as a result of limited soil development; therefore, calcification will be slower and chances for dolomitization will be increased.

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Description and Sedimentology of Submarine-Fan Gas Reservoir in Woodbine–Eagle Ford Interval (Upper Cretaceous), Sugar Creek Field, Tyler County, Texas

Abundant gas and some condensate are being produced from fractured sandstones of the Upper Cretaceous Woodbine–Eagle Ford interval at depths of 10,800 to 11,350 ft (3,240 to 3,405 m) in the Sugar Creek field area of Tyler County, Texas. The reservoir sandstone units are complex, single to multiple bodies 15 to 40 ft (4.5 to 12 m) thick and less than a few thousand feet wide within a mud-dominated clastic wedge. The wedge thickens from about 50 ft (15 m) near the Lower Cretaceous shelf edge to more than 1,500 ft (450 m) within 15 mi (24 km) downdip to the south. Subsurface correlation and mapping of the discontinuous, lenticular sandstone bodies indicate that they are best delineated as a series of coalescing, dip-oriented lobes. Deposition appears most likely to have been as prograding submarine-fan lobes, with sediment being channeled from updip delta and nearshore deposits across a narrow shelf and through shelf-edge breaks and then dumped downslope.

Within the major sandstone units, individual beds commonly are 1 to 3 ft (0.3 to 1 m) thick and display sharp contacts with interbedded, thin (1 to 2 in.; 2.5 to 5 cm) shale layers. As viewed in polished core slabs, the sandstones are mostly massive; however, radiography reveals abundant lamination and cross-stratification and some ripple-bedding and soft-sediment-deformation structures. A detailed analysis of sedimentary features and sandstone fabric suggests periodic rapid

deposition of sand by low-concentration to high-concentration, submarine density currents and associated tractive currents.

The fine to very fine-grained sandstones are well-cemented quartz arenites with porosities commonly 10 to 15% and permeabilities commonly around 0.1 to 1.0 md. Abundant fractures in the brittle sandstone provide the necessary reservoir permeability to allow commercial gas production.

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Tertiary Sea-Level Movements Around Southern Africa

Sedimentologic, micropaleontologic, and seismic-profiling data elucidate the history of Tertiary sea-level movements around southern Africa. These new data show that landward movement of the sea began in early late Paleocene time and continued into the early Eocene. The sea probably reached its maximum Paleogene height during the early Eocene, and is today represented by outcrops up to at least 204 m, and probably as high as 360 m, above sea level. A brief regressive pulse occurred during the middle Eocene, and renewed transgression in the late Eocene. A major regression followed, spanning all of Oligocene and early Miocene times. This regression exposed much of the continental shelf. It is clearly represented on seismic-reflection profiles as a widespread unconformity.

The major Neogene transgression began in the middle Miocene but probably only reached the present coastline by late Miocene time. This transgression continued into the early Pliocene, but was interrupted by a brief regressive pulse in the earliest Pliocene. Seas withdrew again in the late Pliocene. Units deposited during the Miocene-Pliocene transgression are today found up to at least 300 m above sea level.

This scheme should be viewed as showing only the gross movements of the seas around southern Africa during the Tertiary. Local subsidence or uplift may have caused one area of the coast to submerge or emerge earlier than another area. Nevertheless, the timing of these southern African transgressions and regressions closely parallels the timing recently established for sea-level movements in other parts of the world.

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Sedimentology of Some Precambrian Iron Formations

Six of the best known Precambrian iron-formation basins of North America display consistent patterns of sedimentation. In three of the basins, the iron formations are almost exclusively lutaceous, contain few sedimentary structures other than lamination, and include representatives of all four of James' sedimentary facies. In the other three basins, the iron formations are predominantly arenitic and contain a much wider variety of sedimentary structures. All four of James' facies are represented among their lutaceous members, but the arenitic portions belong only to the oxide and silicate facies. The predominantly arenitic iron formations are underlain by coarsening-upward, quartzose shelf sandstones, whereas the predominantly lutaceous iron formations are underlain by slate-turbidite sequences and/or pillow lavas. Five of the iron formations are overlain by slate-turbidite sequences, and the sixth is truncated unconformably. Several conclusions can be made. (1) The iron formations vary considerably in their internal sedimentary character and lie conformably between siliciclastic rocks deposited in a variety of marine environments. Hypotheses that restrict the deposition of iron formation to a nonmarine or to a specific marine environment are not likely to have broad applicability. (2) The sedimentary structures and the stratigraphic settings show that the lutaceous iron formations are relatively deep-water sediments; yet some belong to James' oxide facies. The dominance of ferric iron is not sufficient to prove a shallow-water depositional environment. (3) The similarities between the character of a given iron formation and that of the siliciclastic unit beneath it suggest a close environmental relation between the two.

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Slumps on Upper Continental Slope, Northeastern United States—Observations from Submersible

Many large sediment slumps have been mapped along the eastern continental slope of North America. Most of these features have been observed on high-resolution seismic profiles, but few have been observed from submersibles. Although seismic profiling is an effective means for mapping slumps, it has limitations. For example, it cannot be used to resolve small-scale features, especially on slopes greater than 15 to 20°. To define such features, slump and interslump areas along the uppermost continental slope in Lease Area 49 in the Baltimore Canyon Trough area and south of Georges Bank were examined by in-situ observations during 24 submersible dives. These dives revealed slump scars characterized by slopes of 20 to 45°, clay outcrops, and borings and depressions inhabited by a diversity of megabenthic crustaceans and fish. Below the scars, step topography, reverse slopes, and hummocky seafloor were observed. Small slumps were observed at shallower depths (170 to 366 m) than previously had been resolved by seismic profiles. In contrast, areas with no slumps were characterized by smooth, gently dipping (5 to 8°) seafloor and sparse fauna.

Slumps are potential geologic hazards to the siting of exploration wells, production platforms, and pipelines. Thus, this study is particularly relevant in light of recent discoveries of gas on the mid-Atlantic continental shelf.

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Sealing and Nonsealing Faults in Gulf Coast Salt Basin

This study was undertaken to investigate (1) the dif-