posits require a tectonic-climatic-environmental model which has no definite modern analog; this causes difficult interpretational problems.

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NEOCURRENT TRENDS AND STRUCTURAL CONTROL OF SEDIMENTATION IN WILMINGTON SUBMARINE CANYON, EASTERN UNITED STATES

Neocurrent trends, patterns of sediment transport in the geologically recent past inferred from preserved vectorial properties, indicate that sediment is moving predominantly toward the west-southwest on the outer shelf off the U.S. east coast. Sediment is being trapped by the north-south-trending head of the Wilmington submarine canyon. Seismic-reflection profiles, direct observation of the bottom with camera and underwater television, and sampling reveal that (1) a greater thickness of the unconsolidated sediment wedge drapes the eastern canyon wall and (2) the percentage of pebbles, coarse sand, and shell exceeds that on the west flank. Coarse sediment, largely of relict origin, consists of Pleistocene and Tertiary materials some of which have been reworked recently from the canyon walls.

Cognizance of the structural framework is essential in interpreting the morphologic and sedimentary patterns of the canyon. The sharp northward bend of the canyon head and its shelfward migration is controlled largely by faulting (probably pre-Quaternary) and Pleistocene drainage as shown in subbottom profiles. Draping of deeper, probably pre-Pleistocene, subbottom reflectors into the outer part of the canyon head suggests that this canyon formed before the Pleistocene. A morphologic high (Nyckel ridge) forming the southern margin of the canyon on the slope and upper rise is recognized as a compound flexure of structural origin. This feature is not a simple depositional levee as has been suggested. It serves as a locus for bottom current activity on the lower slope and rise and controls the textural distribution in the area. Intrabasinal slumping off this ridge is important.

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NORTH SEA EXPLORATION PROGRESS

In the British North Sea five confirmed major gas discoveries have been made. Gas is being produced from two fields, and two other discoveries are being linked to land. The basal Permian (Rotliegende) sandstone is the main reservoir; the Triassic Bunter is of secondary importance. Oil shows have been reported but no economic discovery of liquid hydrocarbon has been made, despite the drilling of about 100 exploration wells.

In the Norwegian and Danish sectors oil shows have been found in more westerly wells, but no economic discoveries have been reported. In Dutch offshore waters the first tests have been drilled on attractive structures, but, in contrast to the adjoining land areas, poor reservoir conditions are reported.

Interest is being extended to more westerly parts of the European continental shelf, particularly the Irish Sea area, where major thicknesses of Mesozoic and Tertiary sediments are likely to be present in narrow basins between Paleozoic high-standing areas.

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MIDDLE AND EARLY LATE CAMBRIAN ALGAL BIOSTROMES AND REGIONAL DOLOMITIZATION IN GREAT BASIN

Middle and early Late Cambrian stratigraphic sections from southeastern California, across eastern Nevada, to northern Utah are characterized by the rhythmic repetition of dolomitic algal biostromes and dolomitized pelletiferous calcisiltite. Stratigraphic and petrographic criteria indicate deposition on a very wide, shallow, low-gradient shelf on which extensive calcareous algal mats formed. Penesaline conditions, resulting in part from the combination of the width and shallowness of the shelf, led to production of brines and syndiagenetic dolomitization of the algal mats.

Syndiagenesis is suggested by associated intraformational breccias composed chiefly of dolomitized algal debris in a matrix of calcisiltite and by a few erosion pits cut to depths of several inches. Subaqueously formed cracks across wrinkled mats, probably caused by the drag of passing waves, appear to represent an incipient stage in the formation of the breccias.

The pelletiferous calcisiltite is a more seaward deposit and is believed to be composed largely of detritus washed from the algal-mat environment. Seaward refluxion of the brines led to the dolomitization of these rocks.

Rhythmic repetition of these environmentally controlled lithic types reflects a set of conditions which alternately inhibit and enhance algal growth.

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ALGAL-BEARING CARBONATE RESERVOIRS OF PENNSYLVANIAN AGE, WEST TEXAS AND NEW MEXICO

Leafy, platy, or phylloidal algae have been observed in many well cores from hydrocarbon reservoirs at various localities in the Permian basin of west Texas and southeastern New Mexico. These algae have a significant bearing on the quality, and in some cases the existence, of the reservoir. Three examples have been chosen to illustrate these relations.

Nena Lucia field, Nolan County, Texas, produces from massive limestone of Desmoinesian (Strawn) age on the east side of the Midland basin. Inferences of eolian depositional environment published previously are not supported, for the dominant reservoir lithofacies is algal calcareous wackestone. Saunders field, Lea County, New Mexico, produces from both massive and well-bedded limestone of Permo-Pennsylvanian age on a well-defined structure just north of the Delaware basin. Although diverse elements contribute to the different porous zones, platy or phylloidal algae are a dominant factor in some of the zones. Conley field, Hardeman County, Texas, produces from three separate formations, including a limestone reservoir in the early Missourian (Canyon) Palo Pinto Formation. This unit is particularly noteworthy for the profusion of algae and the nearly complete dependence of reservoir development on the organisms. Though much smaller in volume, this reservoir is petrologically very similar to that described from the Aneth field complex of the Paradox basin.

Phylloid algal reservoirs commonly are surrounded by nonporous mudstone and wackestone and thus fall in the class of reservoirs wherein sediment genesis is an important factor in pore origin. An initial pore net-

work controlled by plate morphology helps localize later diagenetic events, which ultimately produce a well-connected, predominantly large-pore network. This provides for large initial production rates and relatively high recovery factors, which are very desirable reservoir attributes from an economic standpoint.

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Cycles in Gasperian (Mississippian) Basin-Edge Sediments of Indiana

Basin-edge sediments of the Gasperian Stage (Upper Mississippian) in southwestern Indiana consist of four limestone formations that alternate rhythmically with three terrigenous formations. Each formation exhibits an aggregate of supratidal to subtidal lithofacies having characteristic fossil assemblages and diagnostic parameters of depositional turbulence. Areal distribution patterns of lithofacies for each widely correlative stratigraphic unit have analogs in known lithotope patterns of modern inner shelf sediments. Certain Gasperian patterns were influenced by antecedent topography. Lithofacies succeed one another in predictable sequences representing distinctive regressive and transgressive lithotopes of seven principal cyclothems. Two successive, homotaxial cyclothems are represented wholly by carbonate facies. Other cyclothems maintain greater individuality and are partly or entirely terrigenous. Lithofacies of all but one cyclothem are arranged asymmetrically with either prolonged transgressive or prolonged regressive phases. Sudden lithotope shifts are discernible. Local influxes of terrigenous sediments coupled with progressive changes in strike of the contemporaneous shoreline from N25° W to N5° W effected disappearance of three cyclothems toward the north.

Although Gasperian formations maintain essentially the same sequential order throughout the Illinois basin, those exposed in Indiana differ fundamentally from equivalent strata near the structural axis of the basin in thicknesses, proportion of carbonates, strike of sedimentary bodies with respect to paleoslope, and magnitude of shoreline migrations. Gasperian sediments in Indiana accumulated in a relatively stable coastal region influenced by shoreline processes. This area differs from the basin center which other authors have shown to be the locus of terrigenous deposition in an unstable deltaic regime.

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Stratigraphic Correlation and Reservoir Distribution in Mid-Atlantic Part of Atlantic Coastal Plain–Continental Shelf Geosyncline

Analyses of stratigraphic correlation, reservoir distribution, and facies change in Mesozoic and Cenozoic sediments in the subsurface of the Salisbury embayment can be used as a model for stratigraphic projection into the submerged part of the geosyncline. The sediments studied are unlithified with a thickness greater than 7,700 ft near the coast. Onshore Cretaceous marine and nonmarine sand and clay correlate with a published geophysically identified semiconsolidated sediment unit as thick as 14,000 ft. Paleocene, Eocene, and Miocene sediments project into a zone of up to 5,000 ft of unconsolidated sediment. A thin veneer of Quaternary marine and nonmarine sediments covers almost the entire coastal plain-shelf area. Limited onshore evidence suggests that lithified Triassic or Jurassic sediments comprise a significant deeper part of the offshore basin.

Correlations range from simple, long-range correlations of widespread, uniform, marine units to difficult, short-distance correlations where abrupt facies changes in marine and nonmarine sediments take place. Identification of the Upper-Lower Cretaceous boundary is in doubt and previously has been placed at different levels within a stratigraphic interval 3,000 ft thick. The diversified and complex terminology applied to sediments on the northwest geosynclinal flank demonstrates the complexity of correlation in this area of abrupt facies change. Detailed geophysical log correlations also suggest the presence in the subsurface of this area of abrupt facies changes in marine and nonmarine stratigraphic units. Local minor unconformities may be common in the margin of the geosyncline.

A salt-water wedge protrudes to within 20 mi of the basin edge and commonly is found at depths greater than 1,000 ft. Excellent reservoir conditions occur throughout the onshore stratigraphic section.

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Recognition of Pre-Pleistocene Glacial Environments

Pleistocene glacial deposits are identified easily; however, the existence of pre-Pleistocene glacial deposits has been challenged for several reasons. Recognition of earlier widespread glacial deposits is associated by many workers with continental drift, a process that complicates paleomagnetic and paleoclimatic reconstruction. In addition, pre-Pleistocene glacial deposits can be interpreted environmentally in several ways. Alleged tillites containing poorly sorted clasts, striated rock fragments, and rock flour are similar to deposits formed by subaerial and subaqueous mass movements. Few criteria alone are decisive; therefore many environmental criteria must be sought.

Among the more important physical characteristics of glacial deposits are ultramicroscopic markings on the surfaces of quartz sand grains; massive, nonsorted debris with abundant rock flour, silt, sand, and blocks; striated stones; deflection and penetration of laminae by stones; stone shape; presence of erratics; extraordinarily large boulders; ice-molded structures; striated and polished pavements; and thickness and extent of stratigraphic units.

The more important chemical criteria include comparisons of chemical and mineralogical composition of clasts and matrix, differing mineralogy of the stones, and oxygen-isotope ratios of fossil shell material.

Biological criteria include fossil invertebrates and vertebrates capable of existing in cold climates; and the identification of fossil floras which may be characteristic of cold climates.

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Submarine Lithification of Jamaican Reefs

Widespread lithification of recent reef framework is occurring just below the reef-water interface in all zones of the reef to depths of at least 70 m on the north coast of Jamaica. Several different framework-