stones and marsh deposits also occur lateral to the littoral sandstones.

The presence of thin, littoral marine sandstones with widespread marsh sediments suggests a depositional environment similar to the modern chenier plain of South Louisiana. The entire Muddy sequence is transgressive toward the east and southeast over a low-relief topography developed on the underlying Skull Creek Shale.

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CRETACEOUS AND TERTIARY DEEP-SEA SEDIMENTS FROM ATLANTIC OCEAN

The sediments drilled during Leg 14 of the Deep Sea Drilling Project off northwestern Africa and northeastern South America comprise a wide range of Cretaceous and Tertiary deep-sea facies. The major processes controlling the distribution of these facies are the changing patterns of supply and preservation of biogenous matter, terrigenous influx, and erosion and redeposition on the ocean floor. The sequence of mid-Tertiary to Quaternary sediments can be described as an evolution from a "north Pacific" to a typical "Atlantic" facies, contingent upon a change in deep-sea circulation from ascending (estuarine) to descending (lagoonal), and a decreasing orogenic influence. For older sediments, recent counterparts are not available in many cases, and the reconstruction of the ancient environments involves unfamiliar sets of geochemical, climatological, and geographic variables, in addition to diagenesis.

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THREE-DIMENSIONAL STYLOLITES AND MIGRATORY ROUTES OF OIL AND GAS

Stylolite seams are mutually interpenetrating sutures, illustrated in the literature as cross sections resembling a stylus. Typical two-dimensional views are those of sutures shown on polished marble and limestone. Three-dimensional views of stylolites are provided by many limestones in the Virgin Member, Moenkopi Formation (Lower Triassic), of southern Nevada. They are well developed in outcrops at Blue Diamond Hill and southwest of Las Vegas. Essentially all seams display a columnar stylus fluted with striations resembling slickensides. In cross section, stylolites range in size from a few millimeters to as much as 15 cm. In plan view, they are polygonal, ranging from pentagonal to octagonal, to some with more sides. Many Virgin Limestone stylolites parallel the stratification, but others are oriented at various angles. Seams bifurcate, braid, regroup, and display diverse patterns of solution channels. Some stylolites parallel cross-stratification.

As interpreted, stylolites are solution-compaction phenomena, and the amplitude of sutures or length of fluted columns is a measurement of the amount of compaction resulting from removal of carbonate sediment. If interlocking columns are 15 cm high, this represents the thickness of bedding unit removed during solution-compaction. Stylolites, being postdepositional, early compaction features are avenues along which oil and gas migrate. Hydrocarbons migrate early during depositional history in depocenters. Stylolites studied in carbonates of the Virgin Member show migratory routes of hydrocarbons, including some which carried oil to fill bioherms.

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STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENTS OF MOENKOPI FORMATION IN SOUTHEASTERN UTAH

In southeastern Utah the Triassic Moenkopi Formation is composed mainly of red and yellowish-gray siltstone, sandstone, mudstone, and limestone. Continuity of individual units in this formation provides a basis for regional correlation. Five members are recognized here: Hoskinnini Member, "lower slope-forming member," Sinbad Limestone Member, "ledge-forming member," and "upper slope-forming member."

The Moenkopi Formation was deposited on a fairly uniform and gentle west slope that was bordered and at times covered by an epicontinental sea. Prominently stratified mudstone and fine siltstone were deposited when the rate of subsidence slightly exceeded the rate of deposition. Mudstone or massive sandy siltstone was deposited from a suspension load or by gravity flow. Ripple-marked and platy siltstone was deposited when subsidence and deposition were nearly equal and currents distributed thin layers of sediment over tidal flats, floodplains, and sea bottom. Horizontally stratified or low-angle cross-stratified sandstone is indicative of beach, bar, or shallow-marine environment. Prominently cross-stratified sandstone was deposited by restrictive currents such as those found in fluvial and tidal channels and some offshore bars. Fossiliferous carbonate was deposited in shallow marine waters.

Using these data, the following conclusions can be drawn. The Hoskinnini Member was deposited in a quiet body of water but was disturbed after deposition. The "lower slope-forming member" was deposited on a large tidal flat and in shallow marine waters; the sea transgressed farther east and deposited the Sinbad Limestone Member. As the sea retreated, a large delta spread across much of the basin of deposition and the complex "ledge-forming member" was deposited. Lithology of the "upper slope-forming member" indicates a widespread low-energy tidal, sabkha, and shallow marine environment.

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CONTINENTAL SEDIMENTATION IN TECTONICALLY ACTIVE GEOSYNCLINAL BASIN, GLACIAL OUTWASH PLAIN OF NORTHEASTERN GULF OF ALASKA

Active stream systems on the glacial outwash plain of southeastern Alaska are building individual fans that exhibit a systematic variation in gradient, morphology, and suites of sedimentary structures from glacier terminus to ocean. The upper fan is characterized by a single, incised stream channel. The central fan, delta-shaped in plan view and occupied by braided streams, is the locus of most active deposition. It is subdivided into a gravel-depositional (upper) area and a sand-depositional (lower) area. A marsh or swamp area, with both braided and meandering streams, may be present at the fan terminus.

Bar morphology changes downstream from sheet bars to longitudinal bars to a complex of longitudinal and linguoid bars. Side and point bars are found in meandering streams. Mega-ripples are common in channels on the lower fan and the sand-depositional central fan, but are rare elsewhere.

A downstream succession of sedimentary structures is (1) well-imbricated, poorly sorted, coarse gravel

with crude bedding, (2) interbedded fine gravel and plane-bedded sand and some large-scale planar crossbeds, and (3) a repeated sequence of large-scale festoon crossbeds overlain by sandy ripple-drift capped by a silt drape. Although absent on the upper-central fan, overbank deposition is present as sandy ripple drift on the lower-central fan, and is important on the lower fan as silty ripple drift, undulatory bedding, and silty-clay laminations.

The outwash plain is in a positive tectonic area (except possibly the Copper River delta) and may be viewed as a regressive series of coalescing fan-deltas.

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RHYTHMS IN DEEP-SEA SEDIMENTS FROM GULF OF MEXICO AND CARIBBEAN

Rhythmic patterns observed in unconsolidated marine deposits in cores, collected from the western abyssal plain of the Gulf of Mexico and from the Beta Straits in the Caribbean, are based on sedimentary structures rather than on lithology.

From the present knowledge of contourites, nepheolites, pelagites, and turbidites, it is believed that the silty clay intercalations from the Gulf cores, as well as the sandy intercalations from the Caribbean cores, can be interpreted best as incomplete turbidite sequences. This interpretation is based primarily on the incomplete sedimentary facies model as developed for ancient turbidites. The thin clay seams commonly found in recent deposits, as well as some other features not known in ancient turbidites, normally become invisibly thin from the effect of consolidation.

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CORRELATION OF NEAR-SURFACE SEDIMENTARY STRATA BY ELECTRIC LOGGING

Instruments and techniques to measure the electrical resistivity of unconsolidated marine sediments have been developed at Texas A&M University. Electrical logging can be performed *in situ* and upon extruded cores.

The *in-situ* device using several electrodes makes point resistivity measurements while stationary within the bottom sediments and is thus independent of ship's motion. A minimum number of cores is required to establish the stratigraphy and to calibrate the probe resistivity measurements. The shipboard or laboratory logging system can be used to take continuous readings along a core and also can be used to measure the resistivity of discrete sample units.

The comparison of electrical resistivities of sediments, in particular the formation resistivity factor, with the geotechnical properties of the sediments reveals correlations which indicate that some of these geotechnical properties may be predicted from future resistivity measurements. A series of rapid *in-situ* measurements then can be made, greatly reducing the number of cores necessary to complete the survey.

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DIAGENESIS OF CARBONATE MUDS IN LAGOONS OF NORTHEAST YUCATÁN PENINSULA, MEXICO

Carbonate muds deposited in extensive coastal lagoons bordering the northeast Yucatán Peninsula have been subjected to a variety of diagenetic environments. The sediment in each of these environments is characterized by a particular suite of diagenetic features which provides additional insight for determining the early processes involved in carbonate-mud diagenesis.

Several finely crystalline cements are present in the supratidal and back-lagoon sediments associated with the lagoons. Those formed in the vadose zone are typically calcite and include calichelike cryptocrystalline cement, microstalactitic druse, and "needle-fiber" (whisker crystal) cement. Submarine cements are composed of Mg-calcite and consist of grain-skin druse and void-filling blocky spar. Coalescent neomorphism results in the gradation from micrite to microspar in both subaerial and submarine environments; in the submarine environment the mineralogy apparently remains Mg-calcite, whereas a conversion from Mg-calcite to calcite occurs in the vadose zone.

Dolomitic and Mg-calcite cemented crusts have formed on the beaches, on tidal-flat surfaces, and in the subsurface in sediments influenced by hypersaline waters. In places, fresh water draining from the mainland and flowing through the lagoonal sediments has resulted in the formation of pisolithlike calcite concretions.

Aragonite constituents are being leached from sediments in contact with hypersaline interstitial waters rich in Mg, whereas Mg-calcite grains are dissolved in sediments affected by fresh water. Dissolution of fine mud and corrosion of coarser skeletal grains also occur in association with mangrove peats.

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SEDIMENTOLOGY OF A MIDDLE DEVONIAN SHALE, ERIE COUNTY, NEW YORK

The predominance of clay minerals, pelleted texture, burrow traces, and pyritized material in the Wanakah Shale member of the Ludlowville Formation suggests a soft, granular sediment. An analysis of the fossil assemblages reveals a relation between the distribution, growth, and persistence of animals and the character of the substrate. Several brachiopod species are aggregated on bedding surfaces and some microcommunities are present, largely composed of suspension feeding epifauna. A detailed study of taxonomic composition, functional adaptations, and taphonomy of 3 microcommunities leads to the conclusion that the depositional site received continuous rather than episodic addition of sediment.

The high brachiopod mortality in early growth was the consequence of smothering in the soft, "floc" zone covering the sediment. The sizes of brachiopods involved (2.0 mm) suggest a minimum thickness of approximately 1–2 mm for this zone. Survival to maturity of 2.0-mm brachiopods was high, setting a maximum floc thickness and annual sedimentation increment of approximately 2 mm/yr. The preservation of large, articulated brachiopods in positions normal to substrate requires a minimum annual sedimentation rate of approximately 1 mm/yr. The sea bottom was sufficiently oxygenated for benthic life, but the presence of penecontemporaneous sulfide suggests that the interface between oxidizing and reducing environments was very near the sediment-water interface. Turbulence was very low.