from bottom to top: black carbonaceous fossiliferous shale; gray shale locally fossiliferous; gray shale; cross-bedded micaceous sandstone which is interlaminated and interbedded at the bottom with shale. These rocks are believed to represent marine-lagoonal, tidal-flat, distributary-channel, or channel environments, respectively.

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Tidal-Inlet Sediment Dispersal

Tidal inlets along the southeastern coast of the United States from Cape Hatteras to Cape Canaveral (the Georgia Bight) and along the North Sea coast from the Netherlands to Denmark (the German Bight) reflect a range in physical processes from wave dominance (at the flanks of the two bights) to tide dominance (at the center of the German Bight). Studies of the hydraulics, sediment dispersal, and historic morphologic changes of several inlets within the two bights have led to the identification of a continuum of inlet types from microtidal wave-dominated inlets at one end to macrotidal tide-dominated inlets at the other. The factors controlling the inlet types are: (a) the longshore sediment-transport rate caused by the momentum flux of the breaking waves, (b) the onshore-offshore sediment-transport rate resulting from tidal currents, and (c) the flood-ebb asymmetry in tidal-current velocities. This last factor is determined by the hydraulic geometry of the back-barrier bay.

The wave-dominated inlets have all their shoals on the bay side of the inlet throat. The mixed-energy inlets have shoals landward of, in, and seaward of the throat, and there is a distinct increase in the volume of the seaward shoals (ebb-tidal deltas) with increasing tide range. The tide-dominated inlets reflect situations where the longshore sediment-transport rate is completely subordinate to the onshore-offshore transport. In these situations, barrier islands cease to exist and tidally controlled lunate, sigmoidal, and linear sand bodies occur throughout the estuary entrance.

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Eolian Sedimentology Interpreted from Dipmeter Results

The dipmeter is an effective tool for subsurface analysis of sedimentary bedding as well as for interpretation of structure. Improved computer processing of dipmeter surveys allows efficient and reliable dip (arrow) plots for interpretation of structural and depositional dips. Structural tilt and borehole deviation, which make precise analysis of sedimentary dips and transport direction impossible with standard cores, are routinely removed in processing dipmeter surveys for depositional analysis. Statistical analysis of sedimentary dips is possible using polar-frequency plots.

Dipmeter surveys of eolian formations have been analyzed as part of a systematic study of depositional environments. Applying eolian sedimentologic principles to dipmeter data allows regional analysis of eolian formations in hydrocarbon exploration and detailed modeling of eolian reservoirs. Dipmeter surveys clearly reveal cyclic dune and interdune deposits and distinguish lateral and longitudinal dune types, which may have different reservoir characteristics. Lateral-type dunes—barchan, transverse, and parabolic—are elongate perpendicular to the wind direction and are characterized by cross-bedding with a unimodal distribution of dip azimuths about the wind direction. Longitudinal, or seif, dunes are elongate parallel with wind direction and are characterized by a bimodal distribution of cross-bedding dip azimuths about the wind direction.

A polar-frequency plot of sedimentary dips from two dipmeter surveys of a thick North American eolian system revealed an association of the angle of dip with the relative azimuth position about the transport direction. The high-angle dips (10 to 40°) have the narrowest deviation of dip azimuth and should be used to interpret the transport direction. The medium-angle dips (5 to 10°) have a bimodal azimuth distribution with a greater deviation about the transport direction. The low-angle dips ($<5°$) have a greater bimodal deviation of dip azimuth about the transport direction. These results tend to support an interpretation of foresets of barchanlike dunes.

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Paragenetic and Stability Relations Among Authigenic Minerals—Indicators of Pore-Fluid Geochemistry

Both clay and nonclay authigenic minerals are common in the pores of early Paleozoic sandstones of the upper Mississippi Valley. The paragenetic and stability relations among these minerals provide clues to the diagenetic history, especially to the variations in pore-fluid geochemistry. The chemical compositions of authigenic mineral phases indicate ionic content of pore fluids. Paragenetic relations show the changes in the ionic content through time. In the early Paleozoic sandstones studied, five stages of authigenic mineral formation are evident. From oldest to youngest they are: (1) K-feldspar with some quartz, (2) illite-smectite-chlorite, sometimes with calcite or dolomite, (3) quartz (overgrowths), (4) pyrite, and (5) kaolinite. This paragenetic sequence indicates that pore fluids initially had a high Ph and K content, and that K concentration relative to Si and Al, as well as Ph, decreased through time. Kaolinite, for example, has formed only where pore fluids are presently fresh. Reversals in the paragenetic sequence, that is, some illite formation after quartz or some quartz formation after kaolinite, document slight fluctuations in pore-fluid chemistry.

Stability relations are useful for interpretation of diagenetic history and pore-fluid geochemistry only if disequilibrium exists between authigenic mineral species. Disequilibrium is common because solution is retarded by the slow movement of pore fluids. In early Paleozoic sandstones authigenic kaolinite may be precipitated before complete solution of K-feldspar or illite has occurred.

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