gradients range from 1 to 2°F and most are between 1.2 and 1.3°F per 100 ft of depth. At a depth of 10,000 ft the temperature ranges between 190 and 230°F. The most prominent features of the temperature distribution at 10,000 ft is a belt of high temperature about 30 mi wide close to the present coastline. The location of this "hot belt" is puzzling because it is located approximately where the greatest thickness of Cenozoic sediments is believed to occur. Extrapolating the temperature and pressure downward, it seems possible that conditions necessary for regional metamorphism are present in the lower part of the sedimentary column at depths below 40,000 ft. Possibly the recrystallization of the sediments accounts for the high temperature values.

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Supratidal Accumulation of Reef Detritus at Bonaire, Netherlands Antilles

In many areas of the Carribbean with suitable environmental conditions and a gently sloping shelf, four coralline ecologic zones may be identified: a deep, quiet-water *Dendrogyra* zone, an intermediate moderately agitated *Acropora cervicornis* zone, a shallower agitated *Acropora palmata* zone, and a shallow quiet lagoonal zone. Patch reefs grow and trap distinctive coralline debris in the *A. cervicornis* zone, and barrier reefs grow and trap distinctive coralline debris in the *A. palmata* zone.

At Bonaire, with a steeply sloping island shelf and increased water agitation, the same ecologic zones are found. However, the shallower ecologic zones are not everywhere present, and the extent to which they are absent is proportional to the increased agitation of the water. Patch reefs and barrier reefs are not found. Instead coralline detritus is deposited as beach ridges. On the windward side of the island these ridges are composed mainly of corals and coral fragments from the *Dendrogyra* zone, whereas the beach ridges on the leeward side of the island are composed almost exclusively of corals and coral fragments from the *A. cervicornis* zone. The detrital content and geometry of these beach ridges are similar to those of subaqueous patch reefs, except that they are larger and better developed. Modern beach ridges are being built on lithified Pleistocene beach ridges, developing a pinnaclelike complex. Evaporite pans formed behind the beach ridges. Thus, a lagoon to coral mount to shelf sequence is formed that might, if preserved in the geologic column, be misinterpreted as a patch or pinnacle reef development.

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Hydrology of Deep Sedimentary Basins[1]

Continental blocks of the earth's crust are mainly deep basin sediments, generally lithified and commonly metamorphosed. Observed rock transformations required input of heat in an environment of pressure ranging from hydrostatic to geostatic, and most occurred in the presence of water.

The role of hydrology in diagenesis and lithification of deep basin sediments, and in the leaching, transport, and reprecipitation of mineral constituents is now in a period of intensive reevaluation. New techniques of study, vastly improved methods of data collection and processing, and an enormous store of information on widespread conditions through a great depth range provide effective means for such reevaluation.

The hydrologic evolution of deep basin sediments prior to metamorphism occurs in two distinct phases. Discharge of connate water upward and toward the basin margin is the first phase; intake and throughflow of meteoric water comprise the second. The first phase may be considered near completion only when clay-mineral dehydration has entered its final stage. Each phase may span scores to hundreds of millions of years, and different parts of a basin may be in different phases at a specified time.

The hydrologic evolution of a sedimentary basin is related to its configuration and dimensions, its depositional and structural history, the relative thickness and areal distribution of sediments (by type) within it, and changes in its regional geomorphic setting. Evolutionary progress is evidenced by changes in formation-water composition and salinity as functions of depth and areal distribution, changes in the geothermal and interstitial fluid pressure regimes, and reduction of the water content of the rocks. Conditions in basin deposits ranging in age from early Paleozoic to Neogene illustrate these evolutionary processes.

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Enigma of Colorado Plateau Eolian Sandstone

Precise environmental interpretation of Colorado Plateau eolian sandstone bodies remains difficult despite advances in sedimentology. The early interpretation of all sediments of great textural and compositional maturity, and high grain roundness and frosting, that display large-scale cross-lamination as desert deposits has hindered environmental reconstruction. Great sandstone wedges that thicken away from the cratonic margin, such as the vast Navajo-Nugget complex, are particularly enigmatic.

Colorado Plateau eolian sediments represent combinations of four environmental models: mainly eolian, mainly marine, mixed alluvial-eolian, and mixed littoral-eolian. Mainly eolian units (Coconino, Cow Springs) are recognized by limited areal extent, irregular deposit geometry, intricate cross-bedding, lack of prominent planar features, and by scarce paleontologic evidence. Mainly marine units formerly considered to be eolian (Cedar Mesa, White Rim, Glorieta) are characterized by horizontal bedding, lower angle and less intricate cross-bedding, certain stratigraphic relations, and a few marine fossils. Mixed alluvial-eolian sediments (Wingate, lower parts of Navajo) have complex lateral and vertical facies relations with adjacent alluvial units and show evidence of fluvial modification.

Mixed littoral-eolian deposits (De Chelly, Navajo, Entrada) are areally extensive, bear multiple parallel-truncation planes as prominent features, and generally are well cross-bedded (but contain some horizontal or aqueous ripple bedding). Contorted slump structures and thin discontinuous carbonate lentils are conspicuous in some units. Partial intertonguing with marine units, although generally obscure, is characteristic. Parallel truncation planes are produced by repeated widespread marine planation of coastal dune fields by temporary transgressive oscillations, followed by varying degrees of deflation removal of water-laid beds after subsequent reexposure. Mixed littoral-eolian de-

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[1] Publication authorized by the Director, U.S. Geol. Survey.