known, little is gained by examination of additional sections.

4. Type sections, usually considered the objective basis of chronostratigraphy, define the level of confusion which will exist in a stratigraphic system and serve only an archival function in probabilistic stratigraphy.

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SIGNIFICANCE OF PALEONTOLOGICAL RECORD OF DEEP SEA

The cores recovered by the Deep Sea Drilling Project provide a reservoir of material for paleontologic investigation offering unparalleled opportunities to learn about the global aspects of biostratigraphy, paleobiogeography, paleoecology, paleoclimatology, paleoproductivity, changes in ocean-water chemistry, and diagenetic processes. At the time of inception of the Deep Sea Drilling Project, marine plankton fossil groups were generally poorly known except for planktonic forams. In the last few years, the calcareous nannoplankton have also been used to establish zonations for Jurassic to Holocene strata and a radiolarian zonation of the Cenozoic has been worked out. It is now feasible to evaluate differences in age-equivalent fossil assemblages in the different areas of the ocean, in different climatic zones, at different depths, and in different sediment types. Biogeographic differences, particularly between the southern ocean and the North Atlantic and North Pacific, have been detected. Distinct climatic zonation of the oceans became well established during the Late Cretaceous and has been subject to periodic intensification during the Cenozoic. The end of the Cretaceous, end of the Eocene, and the Pliocene were times of especially rapid change and evolution. The accumulations of siliceous ooze indicate regions of high productivity. Dissolution of calcareous pelagic fossils is selective, removing some species from the assemblage before others are attacked; this phenomenon offers a method of determining fluctuations of the calcium carbonate compensation depth and a means of investigating diagenetic processes in deep-sea sediments.

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GULF COAST PHOTOGEOLOGIC APPLICATIONS

A practical approach to air photo interpretation for subsurface geologists and geophysicists working in the Gulf coastal plain documents the dynamic nature of the Gulf coast surface. Surface-subsurface relations include up- and down-to-coast fault situations and their surface expressions and an explanation is given for the surface indications of deeper structure where it is not reflected in the shallow beds by seismic and well data.

The specific photogeologic criteria used for recognition of surface structure in the Gulf Coast can be demonstrated by air photos of oil fields from South Texas, North and South Louisiana, Mississippi, Alabama, and Florida. These air photos are from areas of current exploration interest such as Flomaton in southwest Alabama, the Cretaceous reef trend in central Louisiana, and the Sunniland field in south Florida, as well as some undrilled prospect situations. There are practical ways in which surface information can be used to advantage in geophysical and geological prospecting.

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DIAGNOSTIC SEDIMENTARY STRUCTURES OF MESOTIDAL BARRIER BEACHES

Depositional shorelines can be subdivided conveniently into 3 groups on the basis of tidal range: hypotidal, 0–5 ft; mesotidal, 5–10 ft; and hypertidal, > 10 ft. In terms of worldwide distribution, the 3 groups are relatively equal in occurrence. This paper deals only with mesotidal barrier beaches and is based on field studies in New England and southeastern Alaska and on a literature survey of the barrier beaches of the world.

Tidal range is significant in the formation of beach structures in that it determines the distribution and concentration of wave energy over the beach profile and generates topography that affects ebb- and flood-current systems. Beach profiles change markedly with changes in tidal phase. The most dramatic changes in the beach profile, and the most rapid sediment migration (exclusive of storm conditions), occur at spring tides. Neap tides produce unique morphologic features such as neap berms and berm-ridges.

A large diurnal inequality of the tides, such as occurs in southeastern Alaska, has a striking effect on beach morphology and on the disposition of primary structures over the beach profile. This inequality results from 4 levels of concentration of wave energy during a 24-hour period.

The most fundamental unit in producing primary structures on mesotidal beaches is the ridge-and-runnel system. High-angle beds that dip landward are produced as the ridge migrates toward shore. A complex association of structures is affiliated with the migrating ridge. Some models of the associations of primary structures produced under differing conditions of tide, beach composition, and wave climate are derived from these field and literature studies.

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COASTLINE SEDIMENTATION IN TECTONICALLY ACTIVE GEOSYNCLINAL BASIN, GLACIAL OUTWASH-PLAIN SHORELINE OF NORTHEASTERN GULF OF ALASKA

The outwash-plain shoreline of southeastern Alaska consists primarily of 2 types of coastal morphologic areas: (1) places where outwash streams border the shore, and (2) beach-ridge plains. The outwash streams provide an abundant supply of sediment to the longshore drift system. Beach-ridge plains develop as a series of prograding spits, most of which indicate sediment transport from east to west. The spits trail away from the streams that originate at the termini of large piedmont glaciers, such as the Bering and the Malaspina. Once a stream channel is abandoned, or a new outlet is found, the beach-ridge plain is eroded back at the rate of several feet per year.

The beach processes are dominated by southeasterly storms which generate exceptionally strong longshore drift from east to west. The cycle of erosion-deposition on the beaches is similar to that of the New England coast; that is, the post-storm profile is flat to slightly concave upward, the beach recovers by the landward migration of a series of ridge-and-runnel systems, and the maximum constructional phase is a broad depositional berm. The cycle is shorter on the Alaskan coast, presumably because of greater storm frequency. The large diurnal inequality of the tides has a striking effect on beach morphology, because wave energy is concentrated at 4 different levels during a 24-hour period.

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PLANKTONIC FORAMINIFERAL ASSEMBLAGES AND PLEISTOCENE TEMPERATURES

The faunistic compositions of recent planktonic foraminiferal assemblages from the Atlantic Ocean between 0–46°N lat. correlate with average ocean temperatures at 50-m depth. The correlation between temperature and faunistic assemblages provides the basis for an independent method of reconstructing paleotemperatures during the Pleistocene. In this model, Parks' distance coefficient is used to construct a similarity matrix comparing every recent sample station with every other station based on the abundance of species and phenotypes. Relative to the station(s) of highest diversity there is a linear relation between the similarity of all stations and average ocean temperatures at 50-m depth.

Pleistocene assemblages contain the same species and phenotypes as found in recent sediments. Comparison of the similarity of Pleistocene assemblages with recent assemblages in the manner suggested allows an estimate of the ocean temperatures at 50-m depth during deposition of the assemblages. The model, tested in an equatorial core suggests faunistic paleotemperatures which are ± 1° from isotopic paleotemperatures of *G. sacculifer* from the same core. The temperature range between glacial and interglacial periods in the equatorial Atlantic is 5–6°C. In the Caribbean, during the last 100,000 years, the faunistic paleotemperature ranged between 20 and 27.5°C, a somewhat larger variation than that found in the equatorial Atlantic.

The results of this study provide an independent estimate of paleotemperatures during the Pleistocene Epoch. Comparison of faunistic and isotopic paleotemperatures for the cores examined are consistent with Emiliani's estimate of paleotemperature variations, whereby 70% of the isotopic variation is directly related to changes in ocean temperature.

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COMPOSITE BEDDING IN LOWER ORDOVICIAN RESEDIMENTED CONGLOMERATES OF QUEBEC

Lower Ordovician conglomerates and sandstones of the Cap des Rosiers Formation occur in a sequence of fine-grained sandstone and siltstone turbidites near Grosses Roches in Quebec. The conglomerates lie on eroded turbidites, and the presence of rip-up structures, channeling of underlying sediments, grading, poor sorting, very large blocks, and some chaotic fabric in the conglomerates suggests that they were formed by deposition from gravity-controlled slides or flows.

There are 3 lithologies in the conglomeratic facies: (1) polymict conglomerate, (2) medium- to coarse-grained quartzose sandstone, and (3) fine- to medium-grained dark-gray sandstone with slump balls. Most of the conglomerate beds and many of the coarse-grained sandstones show extensive internal layering. The layering is defined by thin sandstone lenses in the conglomerates and by pebbles in the sandstone. Detailed logging of a 100-m thick section shows that layers are traceable for distances of up to 80 m along strike; but most layers are of extremely limited lateral extent. Field evidence suggests that their extent is an original depositional feature rather than the result of erosion by succeeding layers. Erosive structures such as those at the bases of conglomerate beds are not common between layers within beds. Thin turbidite beds and thick sandstone beds are present between conglomerate beds but not between layers within beds. This pattern suggests that deposition of each conglomerate bed occurred as a series of events which were closely related in time and space, and the beds therefore can be considered composite. An origin by some type of progressive failure at source is suggested.

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DEPOSITIONAL ANTICLINES OF CONTINENTAL MARGINS AND THEIR OIL-PRODUCING COUNTERPARTS

Oceanic wind-driven currents such as the Gulf Stream have shaped immense depositional anticlines at the distal edges of detrital source areas along the present and past continental margins. These currents generally parallel the continents with high velocities, commonly sweeping to the base of the slopes. In contrast, the deeper geostrophic currents shape the continental rises as they move slowly along topographic strike. Occasionally, both systems are intersected by turbidity currents flowing down the margins at extremely high velocities.

A striking example of wind-driven current deposition occurs in the Florida Strait where calcareous sands from the Florida reef vicinity are swept along a trough by the Gulf Stream and then onto a broad anticlinal rise. A similar slope-trough-rise profile is observed at the Anton Dohrn Seamount where the North Atlantic Current has shaped another rise from the available sediments as it veers around this buttress.

A wind-driven current origin can plausibly explain the Poza Rica trend in Mexico. As the Golden Lane reef contributed its Tamabra talus downslope into swift currents of the Chicontepec foredeep, anticlines were shaped at the base of the slope, simulating the Anton Dohrn Seamount.

Significant reserves in anticlines formed by wind-driven currents will be found beyond the reefs and laterally away from the deltas in the "poor" environment where the subtle slope-trough-rise has been unrecognized. Reservoirs such as Poza Rica attest to the excellent structural, reservoir, and source qualities which can be realized in an inspired search for such targets.

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PETROLEUM GEOLOGY, SWEETGRASS ARCH, ALBERTA

The Sweetgrass arch is a positive structural feature extending from central Montana into southern Alberta. Rock units ranging in age from Precambrian Belt to Late Cretaceous Montanan are exposed along the 350 mi axis. The 3 major features are the South arch, culminating in the Beltian exposures on the south end; the Kevin-Sunburst dome and Sweetgrass volcanic uplifts in the center; and a broad, northward-plunging nose in southern Alberta.

Although structural traps would be expected to be the dominant controlling factors in hydrocarbon accumulation on so large a positive feature, the fact is that stratigraphic traps predominate on this arch. Structural closure on the large Kevin-Sunburst dome does not by