sediment-classification diagram. The map also depicts the precise locations of the hundreds of sediment-sampling points from which data were obtained.

3. Composite Environmental Suitability Map: Brazoria County Geopressured-Geothermal Prospect Area, which uses a series of transparent-translucent overlay sheets on which specific environmental characteristics are shown in varying shades (intensities) of gray to map relative environmental suitability for geopressured-geothermal fluid production and disposal activities.

4. Lavaca and Lower Guadalupe River Basins Environmental Geologic Map, which consists of units that are defined in terms of substrate lithology, soils, landscape morphology, biologic assemblages, and geologic processes. Derivative maps prepared from the environmental geologic map include substrate materials, active geologic processes, and biologic assemblages.

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Deep-Sea Deposition in Density-Stratified Cratonic Basin, Bell Canyon Formation (Permian), Delaware Basin, Texas–New Mexico

Sand and silt of the Bell Canyon Formation were deposited in a euxinic, deep-water, density-stratified basin. Laminated silt formed by suspension deposition from density interflows which moved along thermohaline interfaces; silty sand was deposited by bottom-hugging density underflows in submarine channels. The geometry of sandstone bodies is controlled by the configuration of nearly parallel, erosional channels oriented at high angles to the basin margin which range from less than 0.5 km to more than 8 km in width, 1 m to greater than 35 m in depth, and extend more than 70 km basinward. Channel erosion and sediment transport are interpreted to have resulted from long-lived density underflows which had many irregular fluctuations in flow strength. The flows may have originated as saline water was flushed from evaporitic shelf lagoons during storm ebb flow. The channels differ from modern and ancient submarine-fan channels attributed to turbidity-current processes in several ways, including: (1) the lack of radial or branching distributary-channel pattern; (2) few proximal to distal changes in grain size, bed thickness, and sedimentary structures; (3) the presence of abundant large-scale cross-stratification; (4) the lack of graded beds and Bouma sequences; and (5) the absence of clay-size detritus, levee, or overbank deposits.

More than 100 oil and gas fields produce from the Bell Canyon Formation in west Texas and southeast New Mexico. Most reservoirs in the northern Delaware basin are stratigraphic-hydrodynamic traps which occur where deep sandstone-filled channels are incised into less permeable interchannel siltstone. Similar types of elongate, basinal, sandstone bodies confined to linear channels might be expected in other cratonic basins where there is a high potential for density stratification of basin waters and the generation of saline density currents.

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Sedimentologic Studies in Jurassic of Tunisia

Modern sedimentologic interpretation of the Tunisian Jurassic is based on excellent field studies by Tunisian and French geologists from 1955 to 1972. Jurassic facies north to south across Tunisia were formed where the African craton sloped into the southern edge of the Tethyan Sea and to the south in a restricted marine and evaporitic basin on the African shield itself. Thickness of the system varies abruptly off banks and into starved basins between 300 and 1,000 m.

The Lias of central Tunisia forms a broad and typical carbonate platform separating the pelagic facies of the north from the major interior evaporite basin. A great north-south escarpment through southern Tunisia beautifully exposes these evenly bedded, restricted marine carbonate rocks and gypsum. Through the Middle and Late Jurassic the northern starved basin and slope facies (respectively radiolarian shales and Ammonitico Rosso) expanded into central Tunisia. Carbonate banks and patch reefs developed along the north-south axis west of the Sahel and its extension in the Jurassic ranges from Zaghouan to Bou Kornine uplifts. These probably rimmed the western margin of an ancestral Pelagian block. Bathonian slope deposits here consist of debris flows near Tunis, and the Kimmeridgian of Jebel Zaghouan shows a local reefy facies grading abruptly into turbidites and pelagic limestones to the north and west. These abruptly changing facies indicate a moderately unstable (rifting?) margin with intermittent reef growth. The Bathonian debris flows record a tectonic pulse which can be correlated with marked changes in thickening and elimination of strata along the Tebaga-Djeffara lineament, an important structural feature separating the southern evaporite basin from the northern unstable platform and basinal area.

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Biogenous Sediments Recovered by Deep-Sea Drilling

The Deep Sea Drilling Project has provided about 60,000 m of cores that contain a record of biogenous sedimentation over a major part of the world ocean during the past 150 m.y. Subduction and subsidence bias the record in older strata toward sediments deposited near rise crests, and technical drilling problems bias the samples toward low latitudes. After factoring out the effects of plate motions and subsidence, the main features of maps of post-Jurassic biogenous facies reflect primarily the patterns of oceanic fertility and of dissolution of carbonates with depth. These in turn respond to changes in the interacting climate and the deep and surface oceanic circulation systems, which are ultimately determined by the changes in locations, shapes, and interconnections of the ocean basins and their marginal seas.

One great value of the cores is in their being samples whose biostratigraphic age is precisely known, whose paleolatitude, paleolongitude, and paleodepth can be specified, and whose pressure-temperature and pore-water history during burial and diagenesis generally can be far better constrained than for most sediments on land. Biostratigraphers and paleoenvironmentalists have been more active in exploiting these properties than have sedimentary petrologists interested in understanding the processes of diagenesis and lithification of calcareous and siliceous sediments.

Lithologic criteria indicate very small volumes of oceanic biogenous sediments of post-Jurassic age are exposed on land, and it is questionable if any but relatively tiny amounts of any age have ever been added to the continents.

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Deep-Sea Drilling in Antarctic—Late Tertiary Paleoclimatic History

Bold efforts by *Glomar Challenger* to drill in little explored regions of the southern ocean and its environs have considerably advanced knowledge of the earth's paleoclimatic history despite notable logistic problems encountered in working at high latitudes. Of special interest has been the discovery of evidence for the initiation of Southern Hemisphere glaciation during the Oligocene (DSDP Site 270) and the documentation of a particularly severe late Miocene glaciation of Antarctica which may have exceeded all others in intensity. Paleontologic evidence for reduced sea levels and sea temperatures associated with late Miocene glaciation was early noted among foram assemblages from New Zealand, and subsequently confirmed by oxygen isotope analysis (DSDP Site 284). Closer to the continent, late Miocene deep-sea sediments are characterized by strong bottom-current winnowing and multiple hiatuses; contained microfossils are highly fragmented and of low diversity (DSDP Sites 266 and 274). Farther away on the Falkland Plateau, the upper Miocene section is more complete but separated from the overlying Pliocene by a marked disconformity produced by a climatically intensified Antarctic Circumpolar Current (DSDP Site 329), whereas in an adjacent basin, the unconformity was probably produced by accelerated Antarctic Bottom-Water flow (DSDP Site 328).

Equally important to the definition of major climatic events has been the establishment of high-latitude biostratigraphic zonations based on prevalent microfossil groups, particularly diatoms, radiolarians, and silicoflagellates. Keyed into paleomagnetics and the less well-represented calcareous microfossil zones, these new high-latitude biostratigraphies set the stage for future exploration in this area.

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Stratigraphic Models for Modern Back-Barrier Environments

Kiawah Island, South Carolina, is a mesotidal barrier island composed of prograding beach ridges backed by extensive salt marshes, tidal creeks, and muddy tidal flats. The salt marsh–tidal creek complex is well developed along the length of the island and between bifurcating beach ridges. The major subenvironments of the back barrier are sandy high marshes adjacent to relict beach ridges, rooted and burrowed low marshes, tidal flats and associated oyster bars, active tidal creeks with sandy point bars, and inactive tidal-creek channels (cutoffs) being filled with fine-grained sediment.

Four stratigraphic models based on examination of 60 vibracores penetrating up to 6 m, 20 box cores, numerous channel cutbanks and surficial sediment distributions have been developed to describe the relations of Kiawah's back-barrier environments. (1) The active tidal-channel model consists of a coarse, cross-bedded shell lag underlying muddy-sand point-bar deposits. Bioturbated muddy sand containing shell hash and organic material commonly overlies the point-bar deposits and is capped with rooted, highly burrowed, fine-grained low marsh deposits. The basal unit of this entire sequence and of most cores is a lagoonal-bayfill mud containing *Rangia*. (2) The cutoff channel model contains a fining-upward sequence developed as a result of decreasing flow through the abandoned channel. Low marsh may also cap this sequence. (3) The tidal-flat model is best developed in shallow, open lagoonal areas. In this sequence, active channel-fill and point-bar deposits are capped by thick tidal-flat sediments. (4) The "mature" marsh model is developed where beach ridges are absent and low marsh is predominant. This sequence consists of channel-fill, fine-grained point-bar deposits, tidal-flat deposits, and very thick, rooted and burrowed low marsh sediments. The predominance of sandy point-bar and channel-fill deposits in this low-energy back-barrier area is significant and can be related to the reworking of beach ridges by meandering tidal creeks.

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Utility of Diatoms in Petroleum Exploration

Within the past decade diatoms have played a new and important role in the multidisciplined biostratigraphic approach to the search for petroleum. Diatoms have characteristics unique to the microfossil world. They are microplants; their tests are composed of silica; they live as sessile and vagile benthic and planktonic organisms; their optium environment is in the cool to cold water in the middle and high latitudes in addition to areas associated with nutrient-rich upwelling oceanic waters; and they are widely distributed geographically. Therefore, diatoms have been used biostratigraphically to date and correlate Mesozoic and Cenozoic rocks in various geographic areas where they occur to the exclusion of other microfossils. They also serve as a check on other microfossils where they do occur together. They can be used to determine whether rocks are of marine, brackish, or nonmarine origin and to determine if these rocks were deposited in shallow or deep water. One of the most important biostratigraphic uses of diatoms is in dating various sparker lines on a sparker profile. They can also be used to define the limits of various types of zones and to determine important datum levels.

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