radiolarian assemblages and their position on the shelf, as well as radiolarian density and diversity can be used to identify winter, spring, and fall physical oceanographic conditions on the south Texas shelf. Radiolarians can also be used as indicators of physical oceanographic conditions in studies of ancient shelves.

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Anoxic Sedimentation in Eagle Ford Group (Upper Cretaceous) of Central Texas

Anoxic conditions prevailed during Eagle Ford deposition. Environmental indicators include the generally dark color of Eagle Ford shale, millimeter laminations, a general absence of infauna, authigenic pyrite, and the high ratio of pelagic to benthic fossils. Benthic fossils are rare and are represented mainly by the bivalve *Inoceramus* and the foraminifer *Cibicides*. In marked contrast, pelagic fossils occur abundantly. Particularly distinctive are the foraminifers *Globigerina* and *Heterohelix* but ammonites and fish scales also occur.

The Eagle Ford Group exposed along the Balcones fault zone in central Texas is subdivided into two formations. The older formation is the Lake Waco Formation consisting in ascending order of the Bluebonnet flags, Cloice Shale, and Bouldin flags Members, and the younger is the South Bosque Shale. The South Bosque Shale is brown to dark gray or black. This contrasts markedly with the fissile, thinly laminated dark gray shales that characterize the Cloice. Interbedded thinly laminated shale and millimeter laminated, pelletal mudstone are typical of the Bluebonnet and Bouldin Members.

The vertical sequence is interpreted to represent a single transgressive-regressive event with the deepest water conditions existing during deposition of the Cloice. We suggest that minimum water depths during deposition of the group were 60 to 100 ft (18 to 30 m) and that the anoxic conditions resulted from a combination of water depth, upwelling, and possibly silled conditions due to the San Marcos arch.

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Provenance and Diagenesis of Clay Minerals in Sediments from Anclote River and Anchorage, West-Central Florida

Surface and subsurface sediments from a small river basin and lagoon (the Anclote River system in west-central Florida) were examined by X-ray diffraction methods to reveal the factors controlling clay minerals distribution in paludal (swamp), fluviatile, estuarine, and nearshore marine environments.

In the swamp environment, smectite is the predominant clay mineral in surface sediments. Relative concentration and crystallinity of smectite increase with a corresponding decrease in kaolin minerals (including kaolinite, halloysite, and kaolinite-montmorillonite mixed-layer) from the surface down the cores indicating kaolinization is prevalent in the upper swampy sediments. In the fluviatile environment, clay minerals in surface sediments are transported from upper stream swamps and mixed with the residual clays of the bed rock. Subsurface clay minerals in the Tampa Limestone are mainly illite with minor amounts of smectite. In downstream estuarine surface sediments, smectite decreases while chlorite, chlorite-vermiculite mixed layer, and illite increase. This change results from the combined effects of tidal inflow and transport by the river as indicated by the study of suspended sediments in this area. The relatively high concentration of smectite in the subsurface sediments of the lower Anclote River, an estuarine environment, suggests that the distribution pattern of clay minerals in this area may have been affected by the lower stand of sea level during the last glacial period.

Clay mineral assemblages in the Anclote Anchorage are a combination of residual sedimentary clays mixed with riverborne and marine clays. The uniformly distributed clays indicated a mixed and reworked environment (by current and wave) rather than one formed by a uniform, single source.

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Response of Bottom Waters on West Louisiana Shelf to Transient Wind Events and Resulting Sediment Transport

The predominantly longshore near-bottom currents in 10 m of water off the southwest Louisiana coast exhibited seasonal variability. Currents in winter were primarily westward, although easterly currents were generated rapidly by cold-front passages. Velocities increased during the spring, and the current motion was to the south-southwest as stratification developed and mechanisms other than the wind became active in the shallow waters. The summer current regime was characterized by slow, easterly motion in response to generally west and southwest winds.

Sediments were entrained by wave action and bottom currents during transient wind events, such as summer storms, winter cold-front passages, and persistent southeasterly wind events during the spring. The summer storm and spring wind events transported sediments to the west at a rate of approximately 30 km/day. Sediments suspended in early winter were moved east and west by bottom currents, but little net transport occurred. Frontal passages in March and early April transported suspended sediments more than 250 km to the west.

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Early Precipitation of Authigenic Clay by Meteoric Water, Pictured Cliffs, San Juan Basin, New Mexico and Colorado

The Pictured Cliffs, which is exposed around the San Juan basin in New Mexico and Colorado, was deposited in a variety of nearshore environments during the last of a series of major regressions of the Cretaceous epicontinental seaway. The Pictured Cliffs is a prolific producer of natural gas. The permeability of the Pictured Cliffs sandstones decreases from the southwest to the northeast, apparently in response to a progressive increase in the amount of authigenic grain-coating clay to the northeast. Gas-production trends are oriented parallel to depositional strike and cut across present-day structure contours. Thus, it appears that most of the authigenic clay was precipitated before the formation of the San Juan Basin.

Oxygen and hydrogen isotopic analyses of eight samples from different parts of the basin suggest strongly precipitation of the clays by meteoric water. The early precipitation of authigenic clay in marine sandstone by meteoric water has not been previously described. However, there are significant differences between the Cretaceous Western Interior basin and marginal basins such as the Gulf Coast basin which might help explain this occurrence. The highest rates of sedimentation and subsidence in the Cretaceous Western Interior basin were near the adjacent highlands, resulting in the stratigraphic rise of the marine sandstones toward the basin. Also, marine

shales constitute less than half of the thickest part of the basin fill. Thus, compactional fluids were possibly less significant diagenetically than in the Gulf Coast basin. These factors may have contributed to the development of a regional flow system in which large volumes of meteoric water moved basinward through the marine sandstones.

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Depositional Systems of Continental Margin of Eastern Gulf of Mexico West of Peninsular Florida: A Possible Modern Analog to Some Depositional Models for Permian Delaware Basin

Facies relations and the Jacka and Thompson (1979) interpretation of the response of the Permian Delaware basin margin to glacially induced sea-level fluctuations provide a scaled-down model which is useful in coming to understand their Pleistocene-Recent analogs on the massive west Florida continental margin. Both have a high sea-level stand system which consists of a nearshore band of clastics grading into a skeletal carbonate facies and a reefal barrier on the outer aspect of the shelf. Beyond the reef lies a band of reef talus, a carbonate slope, and base-of-slope deposits which include mass wasting debris and carbonate turbidites. The low sea-level model of the Delaware basin margin, along with reconnaissance seismic and surficial sediment data from the west Florida margin, provides a basis for a hypothesis for low sea-level stands of the latter in which drainage would be rejuvenated across the shelf. The clastic bank would be extended perhaps resulting in channelized delivery of clastics to the otherwise dominantly carbonate slope and base of slope deposits.

Parallels between the two systems are, of course, not exact and care must be taken not to go too far with the analogy. However, as we learn more about the sedimentology of the west Florida margin, we may be able to take the comparison further and perhaps to reverse the flow, providing some insight into the interpretive problems remaining to be solved in the Delaware basin margin.

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Macrofossil Assemblages of Moodys Branch Formation (Upper Eocene), Louisiana and Mississippi

The Moodys Branch Formation (upper Eocene, Jackson Group) is a thin, fossiliferous, glauconitic sand which represents the destructive shelf phase of a transgressive sea. Computer cluster analysis of fossils taken from closely spaced samples reveals six distinct macrofossil assemblages: (A) open bay, (B) nearshore, (C) inner shelf, (D) western inner middle shelf, (E) eastern inner middle shelf, and (F) outer middle shelf. Quantitative trends are similar to Holocene trends for dead shell assemblages in that species dominance and numbers of individuals increase nearshore and diversity, as measured by the Shannon-Weiner index, increases offshore and in bays. However, there are conspicuous differences in the environmental preferences of some Eocene species and their closest living analogs. This suggests that care should be taken when making ecologic analogies between modern organisms and fossil remains.

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Shale Mineralogy and Burial Diagenesis of Frio and Vicksburg Formations in Two Geopressured Wells, McAllen Ranch Area, Hidalgo County, TX

Thirty-six shale samples ranging in depth from 1,454 to 13,430 ft (443 to 4,093 m) from Shell Oil Co. No. 1 Dixie Mortgage Loan well and 33 shale samples ranging in depth from 2,183 to 13,632 ft (665 to 4,155 m) from Shell Oil/Delhi-Taylor Oil Corp. No. 3 A. A. McAllen well were examined by X-ray techniques to determine the mineralogic parameters of the geopressured zone in the Vicksburg Fairway. Both wells have the same weight-percent trends with depth for the mineralogy: quartz, calcite, total clay, and potassium feldspar are constant; plagioclase feldspar gradually increases; kaolinite increases; discrete illite decreases; total mixed-layer illite-smectite (I/S) decreases; illite in mixed-layer I/S increases; and smectite in mixed-layer I/S decreases. Chlorite is found only in the geopressured zone of each well.

Significant diagenetic changes begin at calculated equilibrium temperatures of 58 to 69°C. The most important change is the transformation of smectite to illite within the mixed-layer I/S phase which occurs according to the reaction suggested by Boles and Franks (1979) with $Al^{3+}$ acting as an immobile component. The source of $K^+$ for this reaction is discrete illite. The breakdown of discrete illite results in two other changes with depth: the formation of kaolinite; and the increase of plagioclase feldspar which is due to reaction with $Na^+$ and $Ca^{2+}$ provided by the smectite to illite transformation.

The Boles and Franks model is compatible with a steady supply of original mixed-layer I/S during the depositional history of the McAllen Ranch area. The constant content with depth of calcite, quartz, and potassium feldspar indicates that limited material, if any, is supplied by the shales to surrounding sands. The ions generated by changes within the clay minerals are involved in further clay mineral reactions as outlined above. In addition, magnesium and iron are involved in forming chlorite within the shales.

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Land Loss in Mississippi River Deltaic Plain

Systematic measurements and comparisons of maps, black-and-white aerial photographs, and color infrared imagery taken at five periods within the interval from 1890 to 1978 have been used to document land loss and habitat change within the Mississippi River deltaic plain. The studies show that the long-term trend of net progradation, which persisted through most of the past 5,000 years, was reversed during the late 19th century, and that during the 20th century land loss rates have accelerated geometrically. Within the 11,500 $mi^2$ (29,900 $km^2$) study area, land loss rates have progressed from approximately 6.7 $mi^2$/year in 1913 to a projected 39.4 $mi^2$/year in 1980. The greatest loss has occurred in the wetlands, but barrier islands and natural levee ridges are also disappearing at a very high rate.

The data can be used not only to document past change, but also to project future conditions. The findings have great significance to fish and wildlife resources, flood-protection planning, and land ownership.

Apparent causes of the high rates of land loss include the harnessing of the Mississippi River by levees and control structures which reduce tendencies toward natural diversion and funnel valuable sediments to deep, offshore waters. Additional factors include canal dredging and accelerated sub-