analysis of 250 electric logs in the Sand Wash basin. Lithofacies geometry and relations combined with the interpretation of inferred processes from sedimentary structures were used to develop depositional models.

The Mesaverde Group can be subdivided into wave-dominated deltaic deposits and their flanking sand-rich strandplain, interdeltaic deposits. Deltaic headlands were approximately 20 km wide, while the strand plains extended downdrift for at least 60 km. Near deltaic depositional axes, multiple straight and meandering distributaries replace the upper part of the shoreface sequence. Fluvial plain deposits cap this sequence with point-bar sandstones, splays, overbank mudstones, and coals. In interdeltaic areas, progradational shoreface sandstones were deposited and are overlain by coastal plain brackish and freshwater deposits and coals. Marine flooding of the coastal plain was probably due to a combination of subsidence and formation of flanking lows adjacent to depositional axes due to loading.

The progradational shoreface is a coarsening-upward sequence 30 to 120 m thick. The sequence includes a basal bioturbated mudstone which becomes interbedded vertically with hummocky cross-stratified sandstones that are capped by an 18 to 60 m thick sandstone. The base of the thick sandstone contains hummocky cross-bedding that grades vertically into troughs that are capped with very low angle cross-bed sets.

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Mid-Cretaceous Black Shales: A Result of Excessive Fertility or Global Anoxia?

In Holocene marine environments, organic carbon accumulation rates are high in areas of high productivity, rapid deposition, and in anoxic basins. Heavy metal accumulation rates are high in areas of high bulk sedimentation (resulting from the large detrital component), in areas of high fertility (heavy metal enrichment in organic tissue), and in areas of hydrothermal activity. The various environments can be characterized by the relations between their bulk sedimentation rates, amounts and types of organic carbon in the sediment, organic carbon accumulation rates, primary productivity, preservation factors (fraction of organic carbon fixed in the photic zone that becomes buried in the sediment), and accumulation rates of heavy metals (such as Cu, Ni, Zn). Differences in these relations exist, in particular, between areas where sapropel deposition is due to high supply (i.e., high fertility in localized upwelling areas) and where it is due to anoxic deep waters (such as in the Black Sea).

Application of an improved calcareous nannofossil biochronology to compute accumulation rates in various DSDP sections show that the mid-Cretaceous black shales are characterized by substantially higher accumulation rates of heavy metals relative to organic carbon than is observed in Holocene upwelling settings. The implied widespread deep-water anoxia suggests high organic carbon preservation factors and correspondingly low primary productivity for large parts of the mid-Cretaceous oceans.

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Genetic Stratigraphy and Hydrocarbon Potential of a Combination Progradational-Retreating Barrier Island System

Depositional models and consequent stratigraphic "standards" are among the most valuable tools in scientific hydrocarbon exploration. Such models have been established for barrier-island systems based on extensive study of modern coastal areas. However, concepts of genetic stratigraphy have been developed only for the end members of the barrier-island spectrum, i.e., transgressive barriers (U.S. east coast type) and progradational barriers (Texas Gulf Coast type). Stratigraphic models for these pure types may be inadequate when exploration deals with ancient systems that fall towards the middle of the spectrum. Therefore, a different model must be developed for these intermediate types.

One such intermediate type of barrier-island system along the peninsular Florida west coast has been recognized and modeled by the author. Caladesi and Honeymoon Islands (just north of Clearwater Beach, Florida) formed at the end of the rapid Holocene sea-level rise by upward aggradation of an offshore bar. Subsequent development of the system has been episodic and complex in response to fluctuations in relative rates of sea-level rise and sedimentation. The resulting stratigraphy reflects alternating shoreline progradation (slow sea-level rise) and recession (fast sea-level rise). Laterally adjacent mud and sand environments are repeatedly superimposed on each other, producing an attractive sequence of source and reservoir lithology different from that of previously studied systems.

This stratigraphic framework can be recognized in subsurface cores and electric logs. This model can be used to identify position in a subsurface barrier-island system and to lead to hydrocarbon discovery.

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Geochemical and Mineralogical Analyses, Pennsylvanian Kendrick Fauna, Eastern Kentucky

The Kendrick brachiopods of Pennsylvanian age secreted low-Mg calcite shells with average Sr^{2+} content of 1,140 ppm. The crinoids and rugose corals secreted intermediate-Mg calcite skeletons with average Sr^{2+} contents of 2,140 ppm and 1,770 ppm, respectively. Conversely, the Kendrick mollusks secreted aragonite shells which contain less than 1,000 ppm Mg^{2+}. However, the average Sr^{2+} content (4,040 ppm for the cephalopods, 5,210 ppm for the gastropods, and 4,840 ppm for the pelecypods) is higher by a factor of about 2 over the average Sr^{2+} content of their Holocene counterparts.

The brachiopods, gastropods, and pelecypods precipitated calcium carbonate in oxygen (average -4.5 ppt, $\delta^{18}O$, PDB) and carbon (average $+1.7$ ppt, $\delta^{13}C$, PDB) isotopic equilibrium with ambient Pennsylvanian seawater. The crinoids and rugose corals are light in both $\delta^{13}C$ and $\delta^{18}O$ by about 5 ppt, relative to isotopic equilibrium values. This isotopic depletion, as in the crinoids' modern counterparts, probably relates to the incorporation of isotopically light metabolic oxygen and carbon at the site of calcification. In contrast, the Kendrick cephalopods apparently precipitated shell aragonite in oxygen isotopic (-4.5 ppt) equilibrium with ambient seawater, whereas their carbon isotopic composition ($+0.5$ to -5.4 ppt) is controlled possibly by kinetic effects.

The Fe^{2+} and Mn^{2+} contents of the fossil allochems and shale suggest that Kendrick seawater was slightly euxinic. In addition, the Na^{2+} content and oxygen isotopic composition indicate a slightly higher water temperature and hyposalinity for Kendrick seawater. Diagenetic alteration is limited to occlusion of pore spaces in the fossils and to compaction and cementation of the shale. This process probably occurred in the marine and/or submarine environment.

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