similar to many Jurassic oolite reservoirs of the Gulf Coast. Extensive coring of the shoal, lying north of Andros Island on the margin of Great Bahama Bank, has documented six subsurface facies: (1) skeletal grainstone; (2) ooid grainstone; (3) ooid packstone; (4) fine-peloid packstone; (5) pellet wackestone; and (6) lithoclast packstone. The relief of the shoal over the surrounding seafloor is the result of contributions by these different facies in differing amounts throughout the area, but in broadest terms the relief is a result of ooid sands in one facies or another. Basically, the facies anatomy consists of a fringe of ooid grainstone bordering a much wider shoal composed of two opposing sand wedges—an upper bankward-thinning wedge of ooid packstone overlying a muddier seaward-thinning wedge of fine-peloid packstone.

During sea-level rise in the last 5,000 years, topography of the underlying Pleistocene limestone has affected shoal growth by initially localizing ooid formation and structuring the shoal's bankward-curving trend. Growth of the shoal occurred in three stages: (1) bank flooding, from 4,000 to 5,000 years B.P., when fine-peloid and pellet muddy sands were deposited in platform interior; (2) shoal formation, from 3,000 to 4,000 years B.P., the beginning of ooid accumulation along the platform margin; and (3) shoal development, during the last 3,000 years, when growth of a marine sand belt established size and physiography of the shoal and changed platform sediments from muddy sands to ooid sands. This change was a result of increased agitation produced by a combination of topographic buildup and rising sea level.

The anatomy and growth history of the Joulters ooid shoal suggest that present patterns in surface sediments are a product of changing subenvironments throughout the late Holocene. The development of the shoal provides one possible scenario for the evolution of a common facies package—a narrow belt of ooid grainstone bordering a much wider belt of ooid packstone that becomes increasingly muddy with depth.

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Key Largo—Subsurface Core Study

The islands of the Florida Keys are often viewed as an exploration model of stratigraphic traps which may form, during very high stands of sea level, several kilometers landward of shelf margins. A detailed study of one of these islands—Key Largo—has been undertaken utilizing cores from 10 boreholes drilled to depths of 7 to 21 m. The stratigraphic section cored is of late Pleistocene age and represents a linear accumulation of reefs enclosed by extensive, generally burrowed deposits of skeletal sand. Reef facies contain approximately 20 to 30% of the relatively large corals, predominantly *Montastrea annularis, Diploria* sp., *Porites astreoides,* and *Porites porites.* Skeletal-sand facies (packstones to grainstones) vary in detail but are characterized by pellets, *Halimeda* sp., mollusk, coralline algae, and foram debris, and are associated with both the reef facies and with finer grained, mollusk-bearing wackestones. Mudstones per se are scarce.

The stratigraphic succession is interrupted in the upper 10 m by two major discontinuities formed as the result of subaerial diagenesis during low stands of sea level. Evidence includes caliche crusts, angular substrate fragments, root casts, and pockets of reddish soil. The shallowest and commonly more subtle of these two breaks is generally developed within 2 to 3 m of the modern surface, whereas the deeper and more conspicuous discontinuity lies at a minimum depth of 7 to 8 m. This latter break represents a prolonged period of exposure and is overlain by a burrowed to locally cross-bedded zone of quartz sand containing varied amounts of coarse skeletal debris.

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Paleoecologic Interpretation of Environmental Stability—A Different Approach

Evolutionary patterns, taxonomic diversity, and genetic variability commonly have been used to interpret environmental stability in ancient communities. Paleoecologists have lamented the imprecision of these interpretations. Much of the imprecision was due to inadequately defined species distribution within units. The problem here is that adult organisms, particularly marine benthos, occur in isolated patches. By contrast, larval and juvenile forms, commonly ignored in paleoecologic studies, are more widely distributed and much greater in number. They also are more sensitive to subtle environmental fluctuations. This greater distribution and larger population size of younger organisms is well exemplified by the fossils recovered from acid residues of limestone units from the 240-ft (72 m) thick Kope Formation (Cincinnatian Series). In each of the five sections studied, at least half of the individual layers contained large populations of larval and juvenile organisms. Adults of the same species of these varied taxa are comparatively rare, however. Taxa represented include gastropods, pelecypods, and brachiopods. Any paleoecologic interpretations based on adult forms only would be drawn from much more restricted information than one drawn from all stages of the life cycle represented in these samples. It is suggested that much more precise interpretations of environmental factors such as stability and diversity can be drawn from analyzing remains of the entire life cycle, rather than just adult forms.

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Drainage Anomalies in Gulf Coast Tertiary Sandstones

Unanticipated drainage patterns or drainage anomalies are common phenomena in Gulf Coast Tertiary sandstones. Drainage anomalies can occur in reservoirs that were deposited in a single depositional environment or in several environments. They can be recognized by an analysis of the production data, from pulsed neutron logs, or from logs in new wells drilled later in the life of the field. One of the best ways to locate drainage anomalies is by undertaking comprehensive subsurface engineering reviews which incorporate all geologic, petrophysical, production, and reservoir engineering data from the field—the synergistic approach. Recognition of these drainage anomalies often leads to the drilling of new wells or the recompletion of existing wells, thereby increasing the ultimate recovery from a reservoir.

Five examples of drainage anomalies in three offshore Louisiana fields include two from South Pass Block 27 field; one from South Pass Block 24 field; and two from Eugene Island Block 18 field. Three are from reservoirs which were deposited in several depositional environments and two are from single environment reservoirs. Four are oil reservoirs and one is a gas reservoir.

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Regional Stratigraphy of Limestone Marker Beds in Bridge Creek Member, Greenhorn Limestone (Upper Cretaceous), Western Interior United States

Time-parallel limestone beds of the well-known Kansas section have been traced westward in an attempt to determine their total geographic extent, their origin, and their utility in precise regional correlation. The entire sequence of marker beds extends from Canon City, Colorado, to Springer, New Mexico. Certain groups of these markers are traceable southward to White Oaks, New Mexico, northward to the Black Hills, and westward to the northern San Juan basin. The most widespread limestone beds were deposited across areas no smaller than 388,000 sq km (150,000 sq mi). Individual beds are identified positively by position in sequence, relation to adjacent bentonite seams, lithology, and fossils. Each bed is thoroughly bioturbated, and the thickness, fossil content, and field characteristics are remarkably uniform for great distances. Dominant mineralogy is calcite; quartz and pyrite are the only consistent accessory minerals. The limestones are micritic to microsparitic wackestones and, uncommonly, packstones. Principal allochems are planktonic forams, inoceramid bivalve fragments and prisms, calcispheres, and oyster fragments. Fecal pellets are scarce west of the Rocky Mountain front but common in Great Plains sections. Limestone bed contacts are mostly gradational with adjacent shaly strata, and evidence for hardgrounds is lacking.

Limestone beds of the Bridge Creek Member reflect offshore shelf deposition during the late Cenomanian–early Turonian transgressional maximum of the Western Interior sea. Relative proportions of pelagic versus benthonic allochems confirm that limestone beds represent slow deposition caused by reduced detrital influx. Deposition occurred on a nearly planar surface, with local highs marked by areas of condensed sequences.

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Impact of Deep Sea Drilling Project on Paleo-oceanography

The Deep Sea Drilling Project has been largely responsible for the development of a new field of earth sciences—paleo-oceanography. Documentation of the sedimentary and fossil record from the ocean basins during the past decade has vastly increased knowledge of the factual basis for oceanic sedimentology and paleobiogeography. The wealth of new data provides the basis for much innovative research to define and describe the processes important in paleo-oceanography. It has become evident that the ocean system is not in a steady state, but that supply of materials to the ocean and output as sediment are affected by processes both exterior to and interior to the ocean system, operating on a variety of time scales. Furthermore, it has become apparent that processes in the interior of the earth (the driving forces for plate tectonics), affect erosion processes operating to denude the continents, both directly through mountain building and indirectly by causing sea-level and climatic changes. Sea-level changes affect the distribution of materials between the continental shelves and the deep sea; climatic changes operate through feedback mechanisms with the ocean to affect the interior processes and outputs of sediment to the seafloor. Understanding these complex interrelations is the goal of the new field of paleo-oceanography.

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Spectrum of Depositional Models for Clastic Strandline Systems

Studies of charts, maps, and remote-sensing imagery of the world's shorelines, plus field studies of the shorelines of Chile, Europe, the Middle East, and most of North America, indicate that terrigenous clastic, coastal-plain shorelines vary systematically in response to changing hydrographic regime. Hydrographic regime is primarily a function of the interaction of wave-energy conditions (controlled by wave height) and tidal range. On coastal-plain shorelines that are wave dominated, deltas tend toward arcuate or cuspate shapes, with an abundance of beach ridges; whereas barrier islands are long and continuous, with abundant washover effects. On tide-dominated coastal-plain shorelines, deltas are multilobate, and barrier islands are supplanted by offshore, linear sand ridges that trend obliquely or perpendicular to the strandline. Coastal-plain shorelines of mixed energy have complex delta systems and stunted barrier islands cut by numerous tidal inlets which are accompanied by large tidal deltas.

On modern coastal-plain shorelines, coastal environments at the entrance to shoreline embayments, or arcs, contain mostly wave-dominated features. The heads of the embayments, however, are usually tide dominated. As the balance between wave and tidal energy changes along the shoreline arc, delicate readjustments are made among such features as sediment-distribution patterns, relative abundance of washovers, nature and relative abundance of tidal deltas, and barrier-island morphology and stratigraphy.

These observations permit the construction of a spectrum of depositional models, ranging from purely wave-dominated to purely tide-dominated types, that may be applied to ancient depositional basins. Details of sandbody geometry, relative facies abundance, paleocurrent patterns, and other relevant stratigraphic conditions differ significantly among the different models.