CYCLIC SEDIMENTATION IN THE MISSISSIPPI RIVER DELTAIC PLAIN

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ABSTRACT

A major characteristic of modern Mississippi River sediments is the orderly repetition of depositional events. This cyclic repetition consists of alternations of detrital and non-detrital deposition. Each major deltaic lobe is comprised of a detrital lens or complex of lenses bounded on all sides by non-detrital sediments indigenous to the basin of deposition. The lens is characterized by a high percentage of relatively coarse clastics, abrupt facies changes and rapid accumulation and burial rates. The bounding sediments are richer in organic constituents and other chemical precipitates, have slower deposition rates, and tend to be tabular accumulations with considerable lateral continuity.

Recognizable cycles occur on many scales. These range in magnitude from large overlapping deltaic lenses, with thicknesses of 50 to 250 feet and an aerial extent of 2,500 square miles, to small crevasses which fill restricted overflow ponds.

Examples of major cycles are provided by the modern and pre-modern lobate deltas. Cores reveal the following environmentally determined facies within a major cycle: marine shelf, prodelta, delta front, crevasse, interdistributary bay, lacustrine, swamp and marsh. Each facies contains a characteristic assemblage of sedimentary structures, fauna and flora.

The modern birdfoot is the present locus of active deposition of detritus. Its associated lens consists of a thick accumulation of prodelta clays deposited under marine shelf conditions grading upwards into relatively coarser sands, silts and clays related to the active delta front, crevasse and environments marginal to the delta front. The bulk of coarse deposition takes place within the immediate vicinity of distributary mouths (channel, bar and natural levee environments).

A shift in the point source of sediment supply is responsible for the abandonment of an active delta and initiation of a second cycle related to the new point source. The abandoned or moribund delta, deprived of nourishment, undergoes coastal retreat and inundation due to continuing subsidence. During this process, reworked and in situ deposits accumulate over the detrital lens forming the bounding surface of the cycle. The pre-modern deltas, varying in time of abandonment, afford a natural laboratory for the study of these capping accumulations. The Lafourche delta is an area of thick marsh accumulation and a rapidly retreating shoreline, with a resulting concentration of quartz-rich beaches composed of relatively coarse material winnowed from retreating distributaries. The St. Bernard complex, an older sequence, has undergone a longer period of subsidence and hence shallow marine conditions have invaded previous marsh surfaces. Still older recognizable complexes to the west have subsided below sea level and are covered by shell reef accumulations. Normal deterioration of the abandoned mass, which results from subsidence and coastal retreat, produces a sequence above the detrital lens consisting of organic clays and peats, concentrations of sand and shell, erosional surfaces marked by intensive burrowing, and accumulations of reefal material.

Within each major episode several smaller cyclic units may be apparent. These are commonly referred to as subdeltas or crevasse complexes. Within a crevasse complex an assemblage of environments similar to the major cycle is developed, but on a smaller scale. Forming the flesh on the skeletal framework of major distributaries of the birdfoot delta is a series of lenticular sedimentary masses deposited in the region of the active delta. These crevasse deposits form in shallow bays between or adjacent to major distributaries and extend themselves seaward through a system of radial, bifurcating channels similar in plan to the veins of a leaf. Thus, a crevasse is a scaled down version of the major deltaic cycle and can be used as a model.

Each crevasse system goes through a series of developmental events forming an episode in the history of the expanding delta. That is, each crevasse system forms initially as a break in the major distributary natural levee during flood stage, gradually increases in flow through successive floods, reaches a peak of maximum discharge and deposition, wanes and becomes inactive. As a result of subsidence, the dead crevasse system is inundated, reverting to a bay environment and completing the sedimentary cycle. Rapid subsidence and compaction provides the mechanism for the preservation of this cycle in complete form.

The mass of sediment resulting from crevasse deposition is relatively thin (10 to 40 feet maximum thickness), lenticular in cross-section and characterized by abrupt lithologic changes. Facies within this unit indicate the following environments: shallow marine prodelta and bay, delta front (composed of natural levee, channel and bar), marsh, swamp, pond, beach, reef and interdistributary bay.

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Vertical and lateral distribution of environmentally controlled facies within a deltaic mass are the result of the cyclic nature of sedimentation and delta growth. In the Mississippi River Deltaic Plain, cycles are determined primarily by the shifting point source of sediment supply and continuing active subsidence. The resulting complex arrangement of facies can be better understood by comparison, the natural model provided by a crevasse system.