AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

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Experimental Evidence for Basin Subsidence Enhancing the Landward Incursion of Flooding Surfaces and its Implication to Parasequence Generation

A striking characteristic of shallow-marine parasequences is the asymmetry in thickness of deposits associated with progradation versus retrogradation of shorelines. In any vertical section, deposition appears almost entirely tied to conditions of shoreline advance, with very little to no sedimentation being associated with shoreline retreat and flooding-surface development. Why the strong asymmetry?

Experimental run XES 96-1 at the St. Anthony Falls Laboratory, University of Minnesota, investigated the response of shoreline position to changes in baselevel occurring at different frequencies. Other initial and boundary conditions where held constant and baselevel was controlled so that each falling stage began and rising stage ended at the same absolute elevation. Despite this constancy in highstand baselevel, the shoreline position at the start and end of baselevel excursions differed. Shorelines during rising baselevel overshot their expected landward equilibrium positions. Data suggests that a contributor to these overshoots was persistent subsidence of the nonmarine surface during intervals of falling and low absolute baselevel. Associated reductions in nonmarine sedimentation rates, but not subsidence rates, dropped the absolute elevation of the nonmarine surface, allowing the rising-stage shoreline to advance farther landward then asymptotically return to its equilibrium highstand shoreline position. Overshooting trapped coarser-grained sediment further landward in the system then might be expected, providing a possible explanation for the lack of sedimentation, associated shoreline retreat and flooding surfaces seen in parasequences. Analysis of relevant time and length scales indicates that similar shoreline overshoots are expected in natural systems.