Asymmetrical, Dual-Clinoform, Wave-Influenced Delta Facies Model

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9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Two popular conceptual depositional models characterizing the influence of waves on preserved delta deposits are poorly linked: 1) Development of an asymmetrical distribution of facies along the coast, with sandier deposits updrift of the river mouth and more heterolithic deposits downdrift; and 2) The separation of an inner shoreface clinoform from an outer subaqueous-clinoform by a platform scoured to wave base. A physics-based, coupled hydrodynamic-morphodynamic model (CompStrat) is used to explore interactions between river and wave sediment transport across several evolving deltas fed by laterally-adjacent rivers. Wave currents suppress the formation of mouth bars and transport sediment away from active distributaries offshore and into inter-deltaic areas. Deltaic distributary channels are stable in position on the exposed delta top, but bifurcate and avulse frequently where they extend across the subaqueous wave-scoured platform. On wave-influenced deltas, submarine extensions of distributary channels temporarily link up with the edge of the outer subaqueous clinoform, preserving short-lived mouth bar deposits. For wave-dominated cases, most sediment is reworked down the shoreface on migrating sand waves, where it is preserved as a sharp-based sand above a wave-scoured erosion surface or passes through wave-current, return-flow, scour-channels offshore and into adjacent inter-deltaic areas. Gradual sea level fall initially enhances connections of distributary sediment supply to the outer subaqueous-clinoform edge, preserving more gradual upward-coarsening vertical successions. A prograding deltaic succession becomes progressively sharper-based, not directly because of sea level fall, but rather because local sediment supply rates decline relative to wave current reworking rates as the delta lobe area expands

toward its autoretreat limit. Inter-deltaic area fills are heterolithic mouth-bar-like deposits preserved where wave-driven return flow channels expand off the wave-scoured delta platform into deeper waters or through wave-built barrier islands. Prograding inter-deltaic deposits are typically gradually upward-coarsening successions, even when formed during falling sea level. Tides enlarge channels feeding inter-deltaic areas and preserve more mud-filled submarine channels. Transgression reduces sediment supply to inter-deltaic areas and preserves thin retrogradational delta top shoreface sands and abundant sandy channel fills along the axis of the drowned delta. The models suggest sharp-based shoreface deposits are not unique indicators of sea level fall and the largest preserved channel fills cutting into a wave-influenced delta tend to be diachronous to the prograding clinofom beds.