

Interaction of Tidal and Fluvial Processes From Delta Front to Coastal Plain: Subsurface Implications

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Abstract

Deltas show a range of different morphologies, architectures, facies and grain size distributions. Although the interplay of external factors may contribute to this variety, a significant role is played by the interaction of fluvial and marine processes. Constraining the relative importance of fluvial, tidal and wave effects in an ancient deltaic system, is crucial to improve prediction of 3D depositional architecture and reservoir connectivity. This study provides an example from the Lajas Formation, which consists of middle Jurassic deltaic deposits that accumulated in the back-arc phase of the Neuquén Basin, Argentina. Sedimentological logging, correlation panel construction, architectural element and facies analysis were combined with statistical analysis of rhythmicity in stratal thicknesses, to evaluate the degree of tidal influence during deposition. Lower parts of 5-12 m thickening/coarsening upward packages (medial/distal mouth bars) show ripple-scale bimodal palaeocurrents associated with marine/brackish trace fossils. Upper parts of these packages (proximal mouth bars) show unidirectional river-dominated paleocurrents and rhythmically distributed carbonaceous drapes to cross-beds, indicating modulation by tidal process. Fining-up sandstone packages 3-5 m thick lack trace and body fossils, bimodal paleocurrents and rhythmically distributed carbonaceous drapes, and are interpreted as river-dominated distributary channel fills. Minor (0.5-2 m) thickening/coarsening upward packages are interpreted as interdistributary, marine-influenced bays filled by river-flood derived crevasse subdeltas. Mud drapes, rhythmical bundling and rare bimodal palaeocurrents indicate tidal reworking during interflood periods. The Lajas example shows a clear dissipation of tidal effects in the mouth bars, with little or no evidence of tidal influence in the channels, but minor influence in interdistributary areas. Moreover, the position of tidal bidirectional and modulated facies appear to be shifted seaward compared to modern and ancient examples of tide-dominated deltas. The Lajas Fm. is interpreted as a tidally-influenced rather than a tidally-dominated delta, which has implications for (1) geometry of mouth bars, which might be less elongate and more interconnected than if tidally reworked; and (2) grain size distribution in distributary channels, which will contain fewer fluid muds and drapes, and can thus be considered as important additional reservoirs.

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