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Unraveling the Complexities of Deltaic Strata in the Lowermost Nikanassin Group, NW Alberta: Insights into Reservoir Architecture and Palaeogeography

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Deposits of the Jurassic–early Cretaceous Nikanassin Group represent the initial coarse-grained pulse of sedimentation into the evolving Mesozic foreland basin in northwest Alberta (Miles et al. 2009). The lowermost formation in the Nikanassin Group, the Monteith, consists of three distinct coarsening upwards packages separated by regionally correlatable flooding surfaces, herein referred to as the lower, middle and upper allomember. Each of the allomembers in the Monteith Formation was deposited by a series of prograding deltaic complexes flanking the foreland trough; facies associations indicate that fluvial and storm processes were significant influences on deposition, with tidal influence also notable locally. Deducing the complex interplay between waves, tides, fluvial input and storms during deposition of the delta from an extensive core and wireline log database provides valuable insight into reservoir architecture and the palaeogeography of this interval.

Coarsening upwards deltaic complexes of the Monteith Formation are capped by regionally correlatable flooding surfaces. A facies association attributed to deposition in a prodelta setting characterizes the basal fine portion of each succession. This prodelta association consists of thin normally graded sandy to muddy beds representative of hyperpycnal flow deposits interbedded with hummocky cross stratified sandstones (up to 75 cm thick) interpreted to represent tempestites. Salinity stresses associated with the influx of fresh water via hyperpycnal plumes are interpreted, based on the presence of impoverished trace fossil assemblages dominated by opportunistic forms and abundant syneresis cracks. A delta front/mouth bar facies association sharply overlies the prodelta assemblage with minimal evidence for incision. The sharp contact is interpreted to be autocyclic in origin associated with rapid progradation of the delta during storm events and/or lobe switching. The delta front facies association is characterized by current rippled and cross stratified sandstone attributed to channel mouthbar sedimentation; however, a number of intervals contain massive sandstones with fluid escape structures. Bank collapse in deltaic distributary channels triggered by storm events is speculated to play a role in the origin of these massive units. Overlying the delta front/mouthbar facies association are facies with a more terrestrial signature including deposits of fluvial channels, tidal channels, brackish embayments, and delta plain lakes.

Understanding the architecture of complex deltaic systems has been a focus of recent deltaic studies (see papers in Giosan and Bhattacharya, 2005). An analogue for deposits of the Monteith Formation is the Dunvegan Formation of the Western Canada Sedimentary Basin. Facies successions in the Dunvegan Formation have a number of similarities, including thickness of allomembers, facies present and the facies stacking patterns (Bhattacharya and Walker, 1992; Bhattacharya and MacEachern, in press). Storm influence was significant during deposition of both the Monteith and Dunvegan formations, suggested by the presence of hyperpycnal flow deposits and hummocky cross-stratified units in prodelta successions from each formation, as well as massive sandstone in the delta front. Notably, the allomembers in the Dunvegan Formation show greater variability in depositional processes (river and wave dominated) compared to the dominantly storm-influenced, river-dominated deltaic succession of the Monteith Formation. Insights from the well-constrained deltaic succession of the Dunvegan Formation help to refine our understanding of the complex facies and reservoir architecture in the poorly defined Monteith Formation of the Nikanassin Group.

References

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