Integrated Ichnology and Sedimentology of Mixed River- and Wave-Influenced Delta Complexes, Upper Cretaceous Basal Belly River Fm, Central Alberta, Canada*

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Search and Discovery Article #50666 (2012)**
Posted July 31, 2012

*Adapted from poster presentation at AAPG Annual Convention and Exhibition, Long Beach, California, April 22-25, 2012
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Abstract

The Upper Cretaceous (early-mid Campanian) basal Belly River Formation of central Alberta comprises eight progradational, mixed river- and wave-influenced delta lobes (cycles A-H). Successive cycles intertongue with the underlying marine shales of the Lea Park Formation, and young to the east-northeast. A detailed subsurface analysis of cycles E-G was initiated within the Ferrier, Willesden Green, Gilby and Wilson Creek fields of central Alberta, to complement a previous study in the Ferrybank and eastern Pembina/Keystone fields. Expansion of the study area and study interval will serve to enhance our understanding of facies characteristics and depositional architectures within ancient, mixed river- and wave-influenced deltaic systems. Such refinements in the facies model will shed light on the degree of predictability in reservoir heterogeneities within such settings.

Fifty subsurface cores were selected, with the aim of optimizing spatial coverage and cycles intersected. Cored intervals were evaluated using ichnology and sedimentology in order to establish a high-resolution facies framework. Initial results reveal 12 discrete facies, which can be distilled into three distinct facies associations: (1) mixed river- wave- and storm-influenced deltas; (2) river-dominated, storm-influenced deltas; and (3) fluvio-estuarine distributary channels. Differentiation between FA1 and FA2 is based on the prevalence of river-generated features, such as soft-sediment deformation, syneresis cracks, current-generated structures, and drapes of fluid mud origin. FA3 is erosionally based, coarser-grained, and dominated by high-angle cross-stratification and current ripples. Although both FA1 and FA2 exhibit stressed ichnological suites consistent with a deltaic signal, FA2 is characterized by lower diversities and sporadically distributed traces dominated by facies-crossing elements. FA1 suites are more diverse, whereas FA3 units are mainly devoid of bioturbation.

Preliminary evaluations indicate that sandier deposits of FA1 are concentrated in updrift positions, whereas more heterolithic deposits of FA2 prevail in positions downdrift of the distributary channels. These distributions compare favorably with those predicted by the asymmetric delta model. Continued research will focus on along-strike variations in facies distributions for these Belly River lobes, in order to construct a paleogeographically accurate depositional model.
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Introduction

Net-Sand Thickness (60 API Cutoff)

Methods and Results

Thirty-two core successions were evaluated from across the areal extent of Cycle D for mudrock lithology, and wave and river influenced depositional facies (FA1-FA4). Successively, cycle stratigraphy was constructed with the evaluation of lateral pinchouts (Clay Banks and River Mouth) and vertically by evaluating deposits above and below the palaeophycus shell fragments and young to the east-northeast (Power and Walker, 1996). A detailed and wave-influenced delta lobe (cycles A-H). Successive cycles were analyzed for cycles D1a-D1c that are within the inner shelf (Shoestring Delta Complexes, Island of palaeophycus) for crossbedding, combined- and common flow, planar and wavy-parallel lamination; locally stratification; apparently structureless (massive) bedding

Study Area

FA1: Clays and siltstones. The upper claystones are tenacious, and chlorite rich and contain abundant plant fragments and cm-scale siderite banding; sandstone and silty sandstone

Deposits

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FA2: Clays and silts. Coarse sandy siltstone and silty sandstone with a single mudstone rip-up clast, and inversely graded bedset, as well as, carbonaceous detritus, which is common to Facies 3a. Carbonaceous detritus are moderately abundant to abundant, and are cemented intervals

FA4: Clays and silts. The siltstones are grey, fine- to medium-grained, containing abundant clast. Rip-up clasts, coal fragments, and organic detritus, as well as, Planolites, Thalassinoides, Teichichnus, Skolithos, Arenicolites, Cylindrichnus

References
