Reservoir Distribution and Architecture of the Monteith Formation (Nikanassin Group), NW Alberta: Insights into Deltaic Reservoir Complexity

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Introduction

Deposits of the late Jurassic–earliest Cretaceous Nikanassin Group represent the initial coarse-grained pulse of sedimentation into the developing foreland basin in northern Alberta (Miles et al., 2009). The lowermost formation within the Nikanassin Group, the Monteith Formation, was deposited by a series of prograding deltaic complexes. Increasing exploration and development activity targeting the tight gas sandstone reservoirs within the Monteith Formation makes an overview of the regional stratigraphic architecture and reservoir potential of each member of the Monteith Formation timely. Insights into the complex interplay between waves, tides, fluvial input and storms during deposition of the Monteith Formation deltaic complexes from a core and wireline log database provides valuable insight into the paleogeography, reservoir architecture, facies distribution, and reservoir parameters.

The Monteith Formation consists of three distinct coarsening upwards packages in the study area, separated by regionally correlatable flooding surfaces. These coarsening upwards packages are informally referred to as the Lower, Middle and Upper allomembers (Fig. 1). Each allomember within the Monteith Formation has a similar lithofacies association stacking pattern marking a shift from prodelta through delta front mouthbar and distributary channel, interdistributary bay, and fluvial channel deposits. The deltaic system of the Monteith Formation is characterized by a number of elements that suggest river flooding significantly influenced sedimentation, including: 1) sharp-based delta front packages, which is indicative of rapid progradation; 2) common massive and climbing rippled sandstone beds in delta front strata associated with rapid sedimentation of sand from suspension; 3) complex internal delta front architecture, and 4) ubiquitous presence of hyperpycnal flow deposits in the prodelta.

Complex internal stratigraphic architecture developed in the Monteith Formation is attributed to the interpreted dominance of floods during deposition. Fielding (2005) has demonstrated that the dominance of flooding in deltas can cause rapid progradation, incision and sandbody reworking. Despite resultant limitations with internal stratigraphic correlations, in some areas deltaic complexes can be further broken down into smaller deltaic lobes based on delineation of high order flooding surfaces that are semi-regionally correlatable (Fig. 2). This degree of high order mapping allows for development of a basic understanding of the internal heterogeneity and compartmentalization within Monteith Formation sandstone reservoirs.

The entire Monteith Formation thickens to the west and southwest, a trend also apparent within each of the mapped allomembers. Net sandstone distribution in each allomember is complex and mapped trends do not obviously correlate with trends in the overall thickness of the formation (Fig. 3). Analysis of net sandstone distribution reveals that there is limited sandstone in the Lower Monteith Allomember in the northwest portion of the study area; the northwest limit of sandstone is interpreted to represent the major depositional edge of the Lower

Monteith deltaic system (Fig. 2; Fig. 3). The depositional edge of sandstones in the Middle and Upper allomembers have not been recognized, as they are beyond the edges of the study area

References

Miles, B.D., Hubbard, S.M., Raines, K.M., Kukulski, R.B., Fisher, R.M., and Zonneveld, J.P., 2009. A Stratigraphic Framework for the Jurassic–Cretaceous Nikanassin Group, Northwestern Alberta, Canada: CSPG–CSEG–CWLS Annual Convention, Core Conference Extended Abstracts, p. 32-39.

Fielding, C.R., Trueman, J.D., and Alexander, J. 2005b. Sharp-based, flood-dominated mouth bar sands from the Burdekin River Delta of northeastern Australia: extending the spectrum of mouth bar facies, geometry, and stacking patterns. Journal of Sedimentary Research, v. 75, p. 55–66.

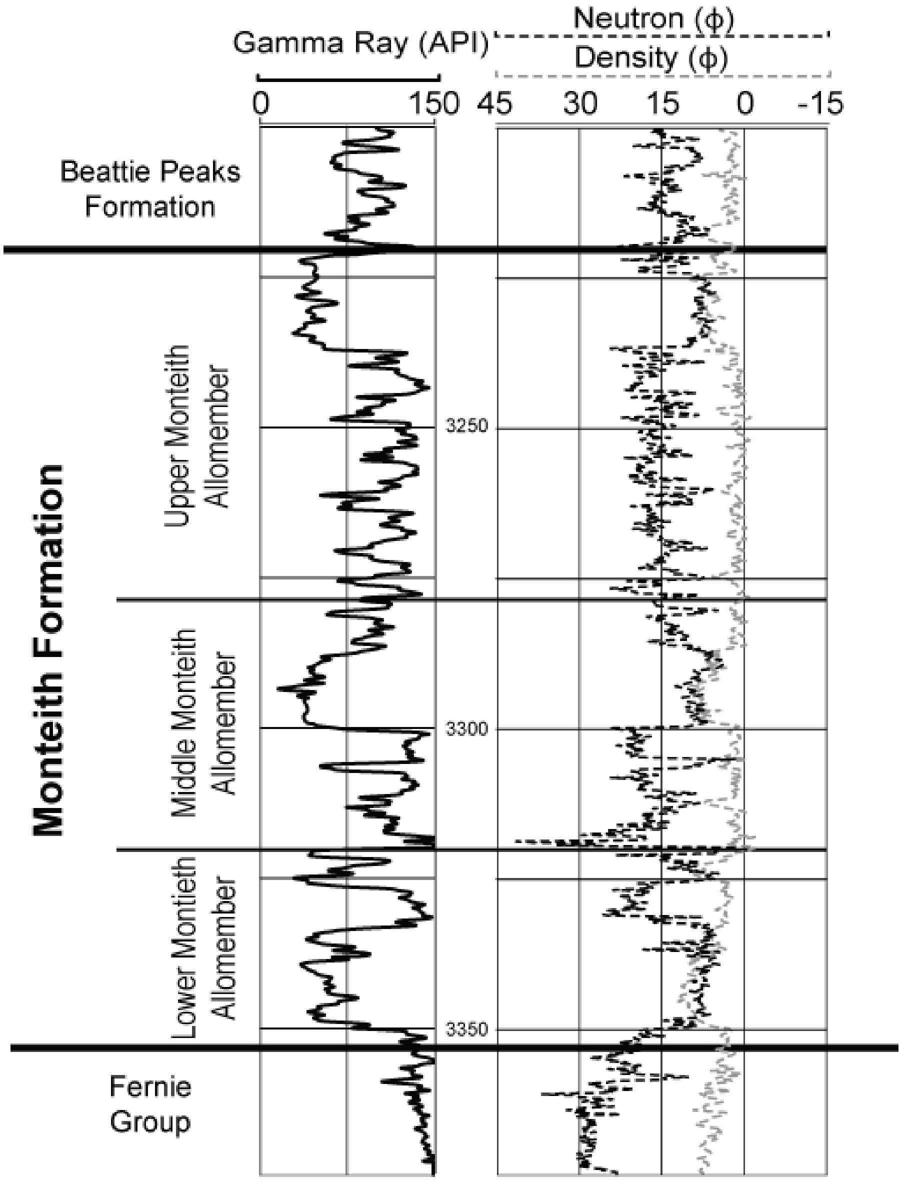

Figure 1: Type wireline log through the Monteith Formation. The top of the Middle Monteith Allomember corresponds to a marine flooding surface and is used as a regional scale datum.

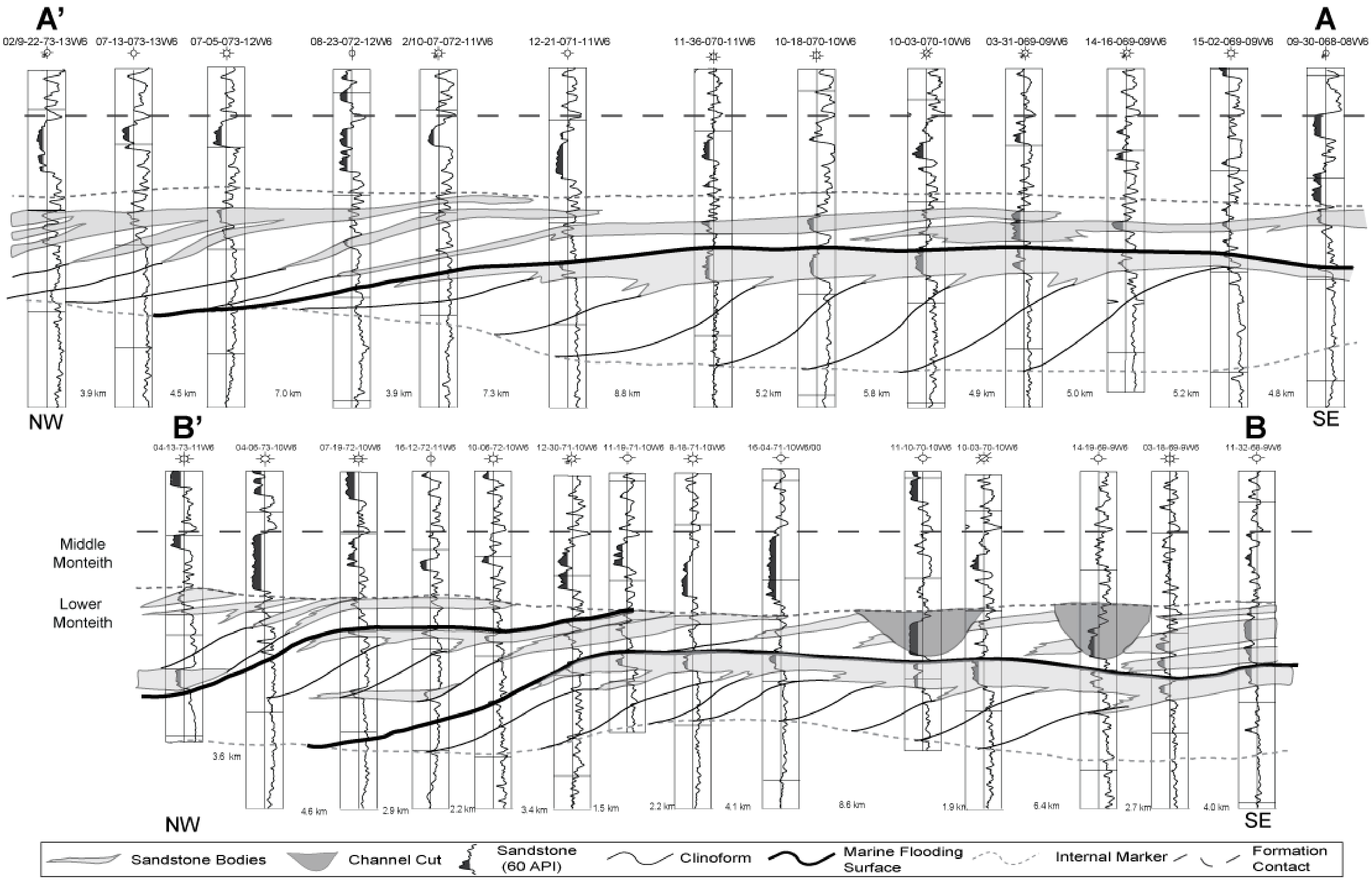

Figure 2: Genetically correlated cross-sections though the Lower Monteith Allomember. Sections are contained within a single (Red) deltaic complex as mapped in Fig 3. Internal high order flooding surfaces demarcate shingles within the complex. The SE-NW progradation is evident in this deltaic complex.

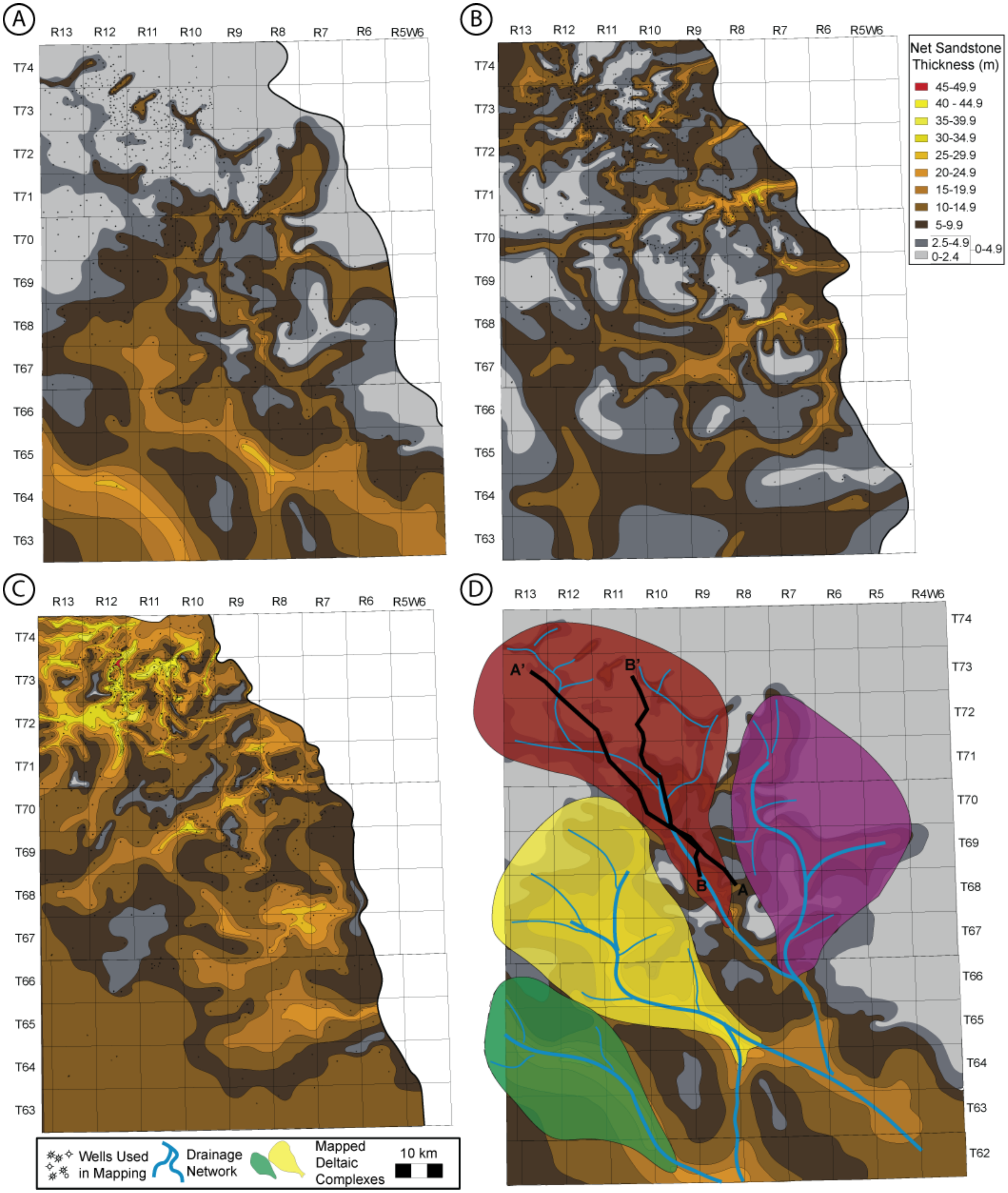

Figure 3: Net sandstone thickness maps for the (A) Lower Monteith Allomember, (B) Middle Monteith Allomember, (C) Upper Monteith Allomember, utilizing a 60 API gamma value cutoff. Contours are 5 m however, near the depositional edge of sandstone (between 0 - 5 m) it is 2.5 m. (D) Interpreted net sandstone thickness of the Lower Monteith Allomember. Each of the coloured lobes represents a major deltaic complex with the internal drainage pattern interpreted. Mapped pattern indicates a SE-NW axial progradation of the Lower Monteith Allomember (Fig. 2).