

A Stratigraphic Framework for the Jurassic–Cretaceous Nikanassin Group, Northwestern Alberta, Canada

Brett D. Miles*, Stephen M. Hubbard, Keegan M. Raines, Ross B. Kukulski

Department of Geoscience, University of Calgary, Calgary, Alberta

bdmiles@ucalgary.ca

Robert M. Fisher

ConocoPhillips Canada, Calgary, Alberta

and

John-Paul Zonneveld

University of Alberta, Edmonton, Alberta

Summary

Upper Jurassic–basal Cretaceous units of northwestern Alberta are characterized by complicated stratigraphic architecture developed during a major phase of orogenic uplift. A paucity of publicly available sedimentologic and stratigraphic studies on deposits from the interval, limits the development of a general understanding of the depositional history for the tectonically and economically significant strata. Increasing interest in the tight gas potential of the early foreland strata makes an overview of the stratigraphy and basic depositional system timely. The relationship between depositional environments, facies and reservoir properties is crucial to understanding the gas potential of this interval in the deep basin.

A consistent, widely-used nomenclature for the Upper Jurassic–basal Cretaceous interval does not exist. In northeastern British Columbia the study interval consists of the Minnes Group, including the Monteith, Beattie Peaks, Monach and Bickford formations, from oldest to youngest (Stott, 1998). However, in the subsurface of Alberta the equivalent section, between the Fernie Group and Cadomin Formation, is referred to as the Nikanassin Formation. We will demonstrate that elements of the stratigraphic succession can be correlated across the provincial boundary.

The formations in the Minnes Group as defined by Stott (1998) are largely recognized in northwestern Alberta between T58-2W6 and T75-13W6, adjacent to the British Columbia border. In this work, we use the term Nikanassin Group for the entire stratigraphic interval due to the established usage of ‘Nikanassin’ in Alberta; the Monteith, Beattie Peaks, Monach, and Bickford formations are maintained to define mappable stratigraphic horizons, as defined by Stott (1998). The Monteith and Monach formations have the greatest reservoir potential within the interval and are the focus of this study.

The oldest stratigraphic layer is the Monteith Formation, which in most cases lies conformably on shales of the Fernie Group. The Monteith Formation can be divided into three distinct informally defined allomembers (designated the Lower, Middle, and Upper), each characterized by upwards coarsening cycles. Detailed sedimentological and ichnological observations support the interpretation of a storm-influenced, river-dominated deltaic succession. Each allomember consists of a prodelta facies association sharply overlain by deltaic mouthbar and distributary channel facies associations. Other less common facies associations include deposits of fluvial channels, brackish embayments, and coastal plain lakes. The complex stacking patterns present in delta plain deposits leads to heterogeneity within reservoir units and can have an impact on reservoir potential. Sandstones of the Monteith Formation are for the most part quartz arenites, with minor amounts of argillaceous grains and very limited chert; silica overgrowths are common.

Overlying the Monteith Formation is the Beattie Peaks Formation. The origin of this package is less clear as there is limited core available due to the lack of reservoir potential. The package consists mainly of shale and siltstone with sporadic thin sandstone units present to the northwest of the study area in British Columbia. Within the southern portion of the study area where cores are present, the Beattie Peaks Formation has a highly carbonaceous to coaly component. High organic matter combined with detailed facies analysis suggests that deposition occurred within a delta/coastal plain environment.

Sandstones of the Monach Formation are up to ~150 m thick in the subsurface of Alberta, with high sandstone/shale ratios (80-95%). The Monach Formation is thickest near the foothills and thins significantly to the east and northeast in the study area. This thinning may be due in part to depositional architecture, however differential erosion associated with the overlying sub-Cadomin Formation unconformity had a significant impact on preserved thickness of Monach Formation sandstones. Facies associations are attributed to deposition in an extensive fluvial system. Sandstone-dominated facies are interpreted to be associated with meandering channels and braidplains, with finer-grained overbank deposits preserved locally. The mineralogical composition is notably different than that of the underlying Monteith Formation, consisting of a more litharenite composition. Rock fragments and chert grains are a major constituent of sandstones highlighting the shift from the dominantly quartz composition of the underlying strata.

The Bickford Formation is a shale–siltstone dominated sedimentary package that overlies the Monach Formation. This lithostratigraphic unit is more prevalent to the west of the study area in British Columbia, largely absent in Alberta as a result of erosion associated with the sub-Cadomin Formation unconformity.

Establishment of a lithostratigraphic framework for upper Jurassic–basal Cretaceous strata will foster optimized mapping of reservoir and non-reservoir units in northwestern Alberta. This framework provides a means to organize depositional facies and gain an understanding of sedimentary processes in the evolving foreland basin setting. Initial sedimentological analysis of drill cores from the region show two major sedimentary systems account for deposition of reservoir sandstones, including a storm-influenced river-dominated deltaic system (Monteith Formation) and a fluvial system (Monach Formation).

References

Stott, D.F., 1998, Fernie Formation and Minnes Group (Jurassic and Lowermost Cretaceous), Northern Rocky Mountain Foothills, Alberta and British Columbia: Geological Survey of Canada Bulletin 516, p. 516.

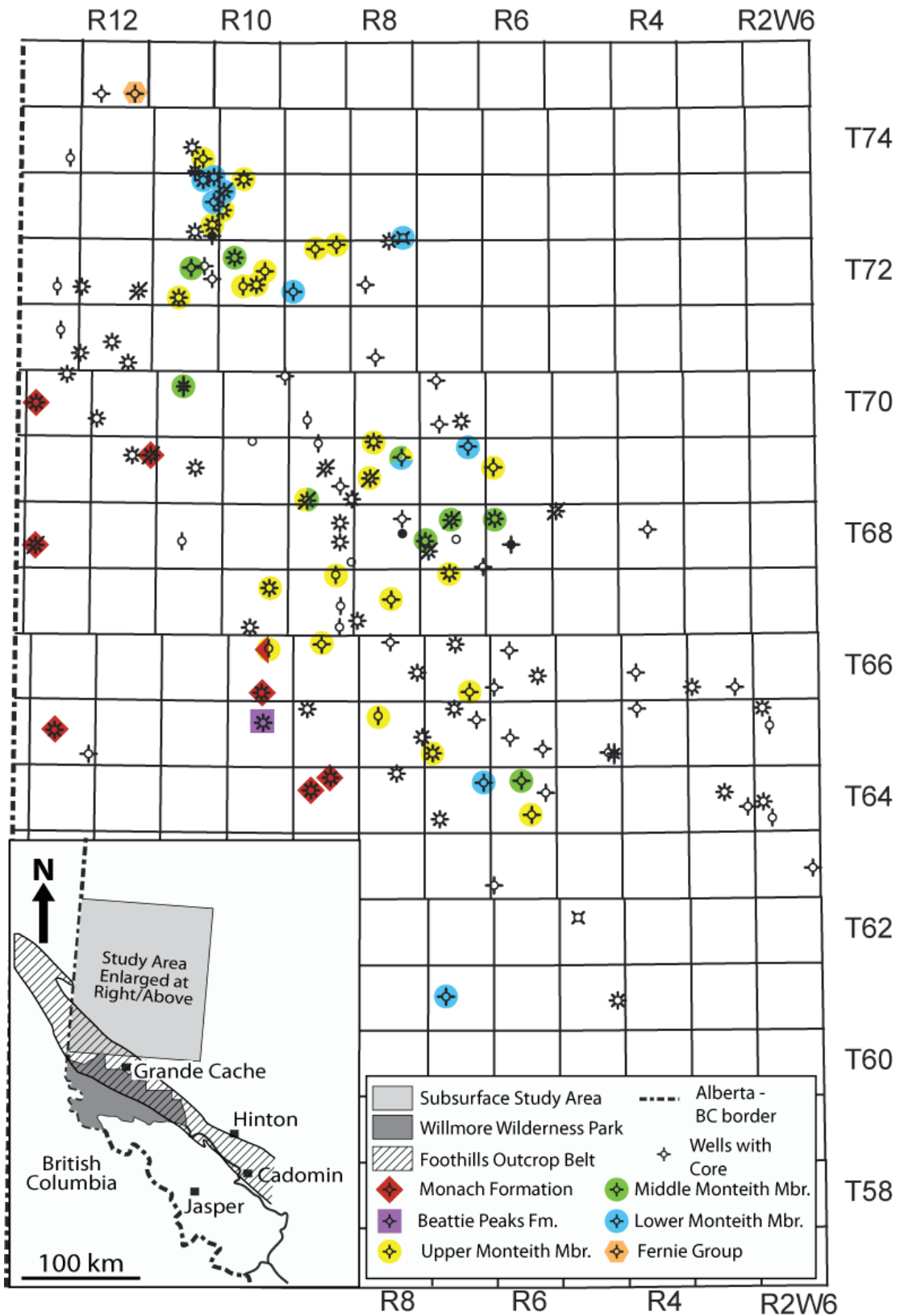


Figure 1. Northwestern Alberta study area, highlighting wells that have cores through the interval of interest. Detailed sedimentological logs have been generated from the wells with coloured symbols, indicating which interval the cores penetrate. The inset map shows the location of potential Nikanassin Group outcrops in the Foothills Belt.

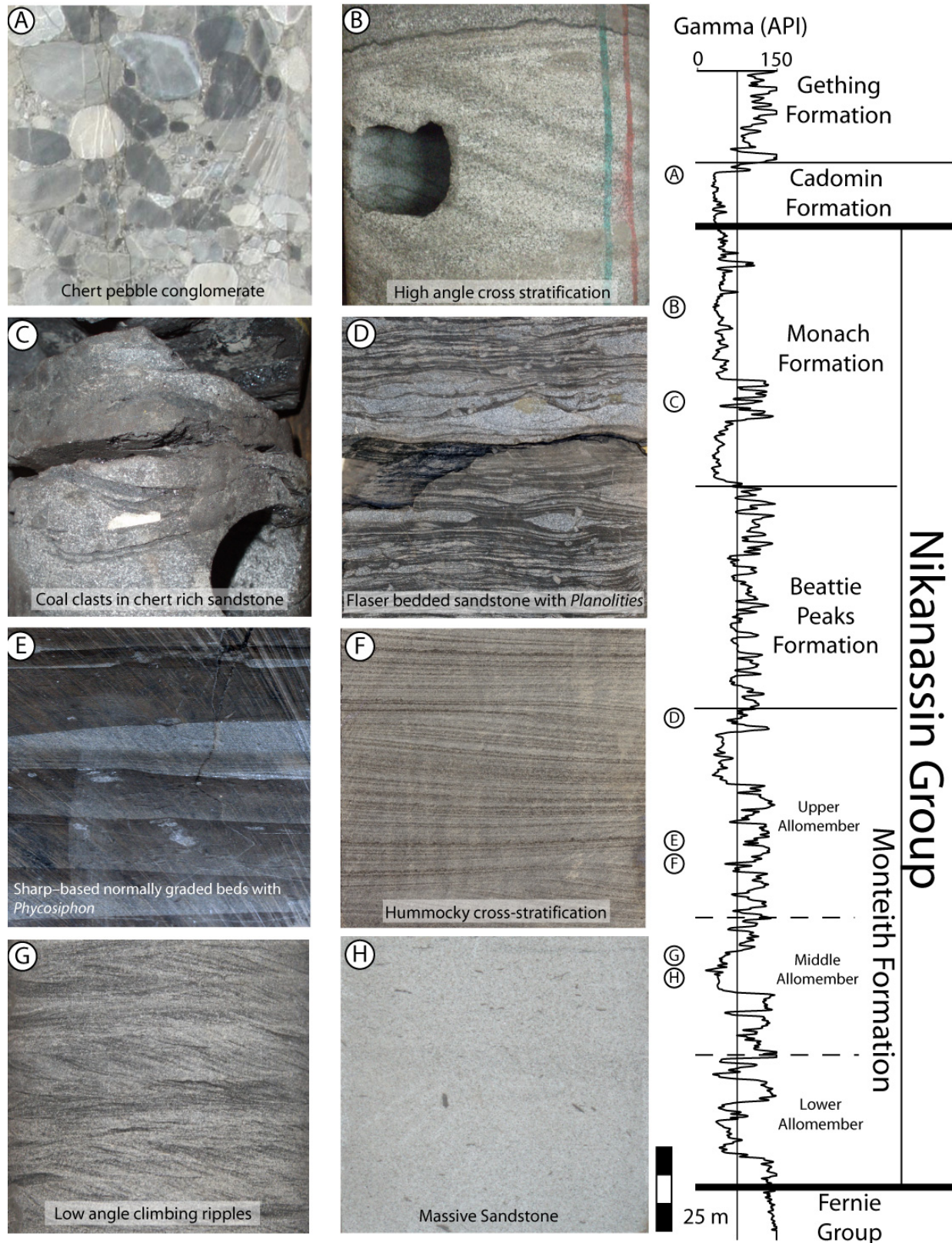


Figure 2. (Right) Idealized gamma ray profile through the Nikanassin Group, in the vicinity of T66-11W6. These stratigraphic horizons are regionally mappable across much of northwestern Alberta and into British Columbia where they have been less modified by erosion. Allomember picks within the Monteith Formation are based on flooding surfaces between members. (Left) Core photographs of various facies observed within different formations in the Nikanassin Group. Note that photos are from various core locations in the study area. The different facies represent the most common at each stratigraphic interval however a range of facies are present at each position in the column. Each core photo is 9.5 cm across.