

Tight Gas Sandstones of the Uppermost Nikanassin Group*

L. Zambrano¹, P. K. Pedersen¹, and R. Aguilera²

Search and Discovery Article #50943 (2014)

Posted March 30, 2014

*Adapted from extended abstract prepared in conjunction with presentation at CSPG/CSEG/CWLS GeoConvention 2012, (Vision) Calgary TELUS Convention Centre & ERCB Core Research Centre, Calgary, AB, Canada, 14-18 May 2012, AAPG/CSPG©2014

¹Geoscience Department, University of Calgary, Alberta, Canada (ljfzambr@ucalgary.ca)

²Schulich School of Engineering, University of Calgary, Alberta, Canada

Abstract

This study analyzes rocks from the Nikanassin Group, well-known gas-bearing strata in the Deep Basin of Alberta. The Upper Jurassic – Lower Cretaceous Nikanassin Group is unconformably overlain by the Cadomin Formation and conformably overlies the Fernie Formation. It contains the Monteith, Beattie Peaks, and Monach formations, from oldest to youngest (Kukulski, 2009). Original gas in-place from the Nikanassin Group has been estimated recently to range from 10 to 100 billion cubic feet per section (Machula, 2010). The wide range of production rates is likely a function of the abundance of natural fracture networks and the complexity of the reservoir facies along the Deep Basin and the Alberta Foothills (Solano et al., 2010).

The study area is located approximately 400 km northwest of Edmonton, Alberta and partly covers the north and southeast portion of the Wapiti gas field and the northwest portion of the Red Rock gas field. It encompasses 2000 km² and is bound in the NW by Township 67 Range 11W6 and in the SE by Township 64 Range 7W6 ([Figure 1](#)).

Specifically, the stratigraphic interval investigated in this study is the **Monach Formation**, which corresponds to the uppermost portion of the Nikanassin Group in the Deep Basin of Alberta. It is the youngest stratigraphic unit; it is unconformably overlain by the conglomeratic Cadomin Formation; and it overlies the interbedded sandstone, siltstone, and coal of the Beattie Peaks Formation (Miles, 2010) ([Figure 2](#)). Reservoirs of the Monach Formation within study area are mainly amalgamated sandstone which reach up to 150m of gross thickness in the undeformed strata in the northwest, to zero at the subcrop edge in the east. The sandstone is predominantly composed of medium to very coarse, moderately to well sorted, subangular sand grains, with silica cement. The dominant pore geometry is represented by microporosity from dissolution mainly of chert fragments. The presence of microfractures and slot-like pores significantly contributed to increasing permeability and production rates from Monach Formation adjacent to the deformed belt. Porosity from routine core analysis ranges from 1.5% to 8 %, and permeability values are between 0.05 and 1 millidarcy (mD).

This study focuses on: 1) the definition of the sedimentary facies across the study area through detailed core descriptions and well-log

interpretations; 2) interpretation of depositional environment; and 3) investigation of the relationship between petrophysical properties and sedimentary features. Different sources of reservoir data have been examined in order to provide an integrated geological analysis of this tight gas reservoir. Drill cores offer the most complete sampling of rocks encountered in the subsurface. Based on detailed core observations of physical sedimentary structures, grain size, and lithology, a total of six facies are identified along a SE-NW transect ([Figure 3](#)). The interpreted vertical facies sequence combined with well logs allows the data to be extrapolated laterally.

The sedimentologic interpretation, based on examination of these cores, with the observation of fining-upward packages, suggest fluvial depositional environment. Further correlation of these sedimentary features with petrophysical properties measured in core samples provides a link to mappable and predictable geological patterns/processes, such as sedimentary facies, mineralogy, and diagenesis.

Preliminary results suggest some degree of correlation between typical well logs with measured properties and some of the features logged from cores ([Figure 3](#)). For example, higher permeability values are likely present in with medium grain size sand, rather than coarser grain. In order to validate the previous assumption regarding which factors directly affect permeability, further analysis will be performed, utilizing standard petrographic methods on selected samples, which at present suggest severe diagenetic controls on porosity and permeability.

The understanding of the most important controls, including grain-size distribution, sorting, pore geometry, and mineralogical composition, will help us minimize the uncertainty inherent in permeability prediction.

Acknowledgements

Special acknowledgement is to the second and third co-authors of this article. This work is being supported by the GREE Project conducted by Dr. Roberto Aguilera, ConocoPhillips-NSERC-AERI Chair in Tight Gas Engineering in the Chemical and Petroleum Engineering Department at the University of Calgary. Also, Thank to Dr. Per Kent Pedersen for his help and support on this project.

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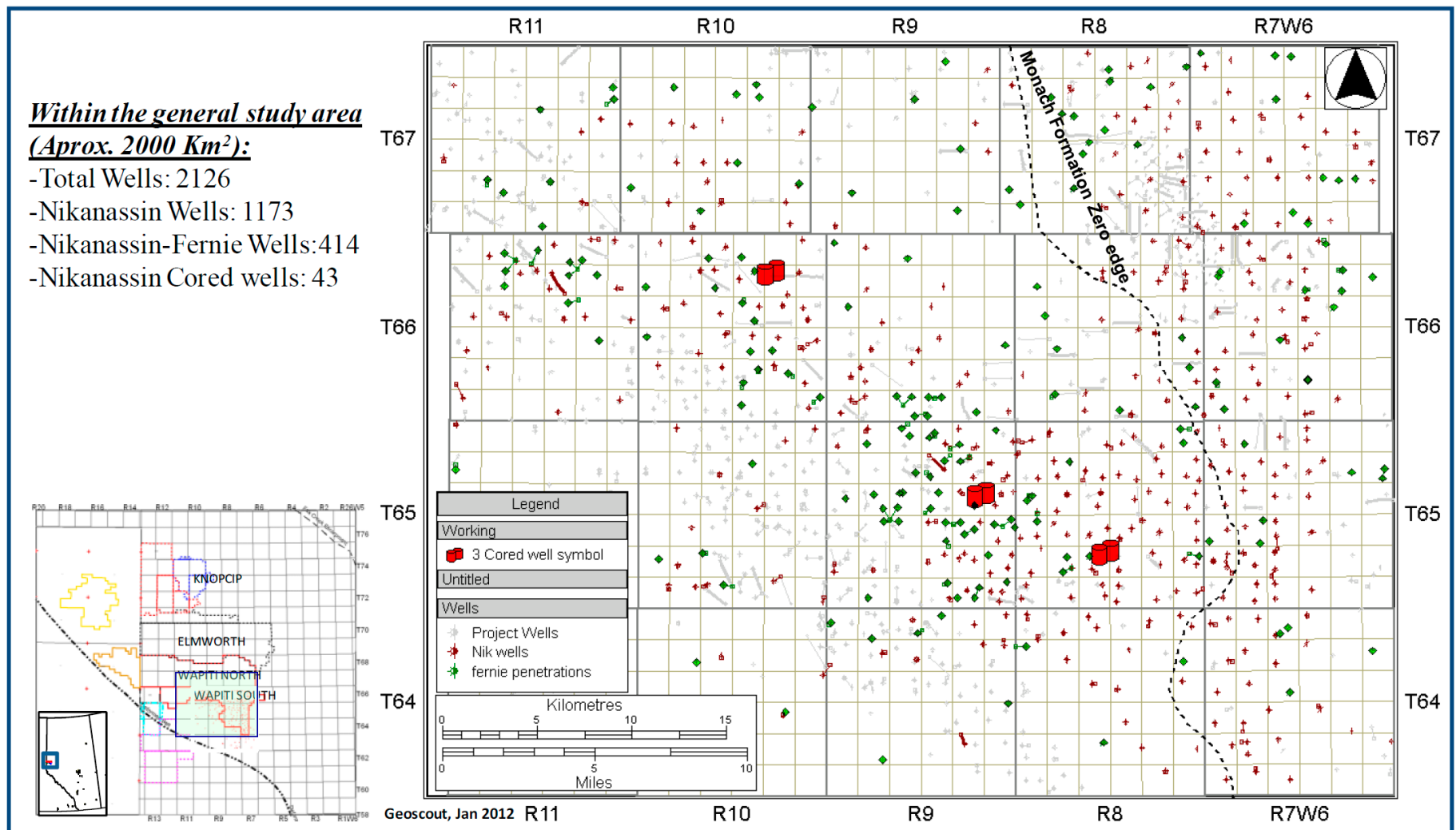


Figure 1. Location of the study area in west-central Alberta, Canada, with a detailed view of the study area, showing Nikanassin wells, and the adjacent oil and gas fields.

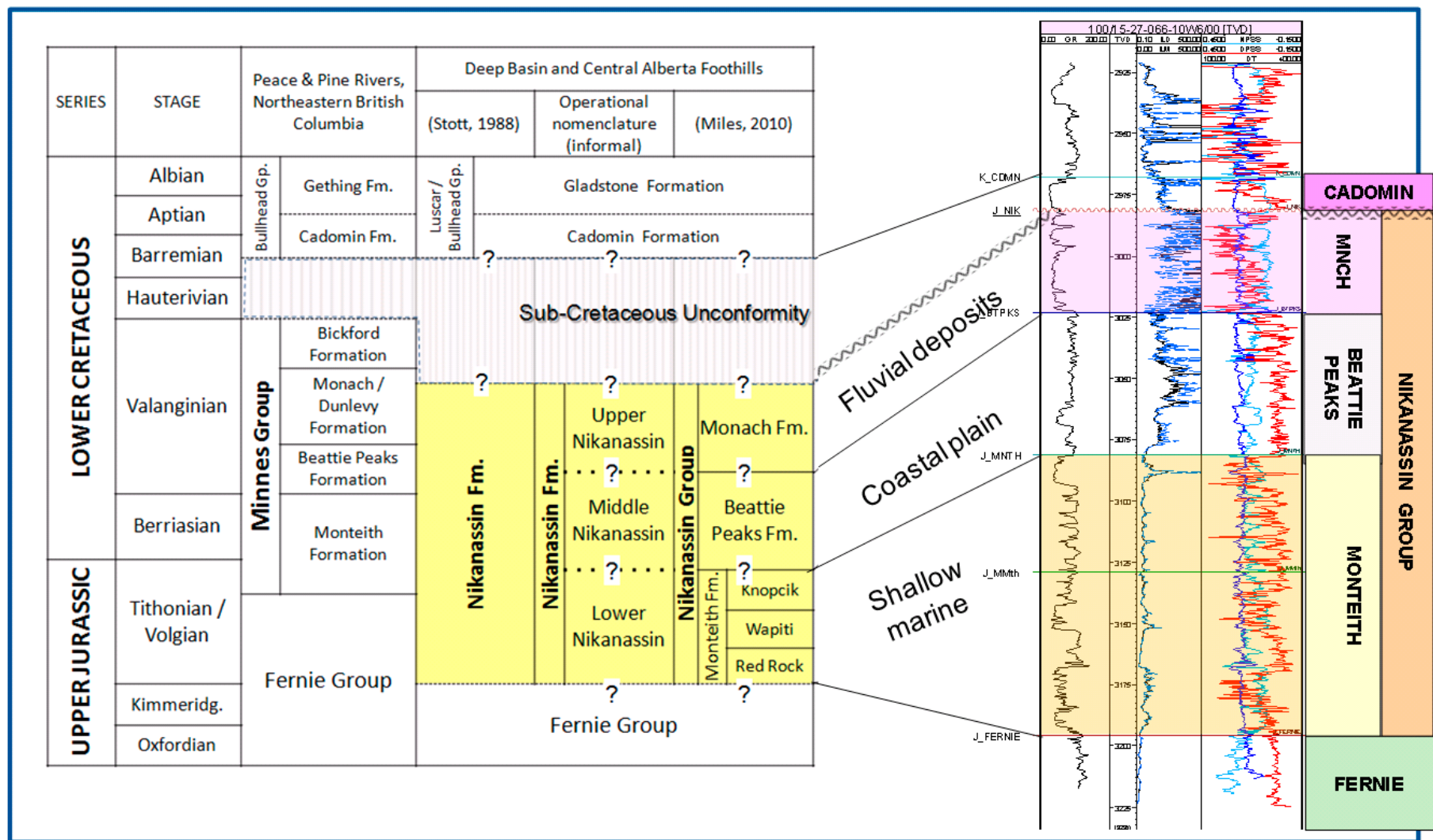


Figure 2. Lithostratigraphic chart of Nikanassin Group in the vicinity of T66-10W6 (adapted from Stott, 1998; Miles, 2010; Solano et al., 2010).

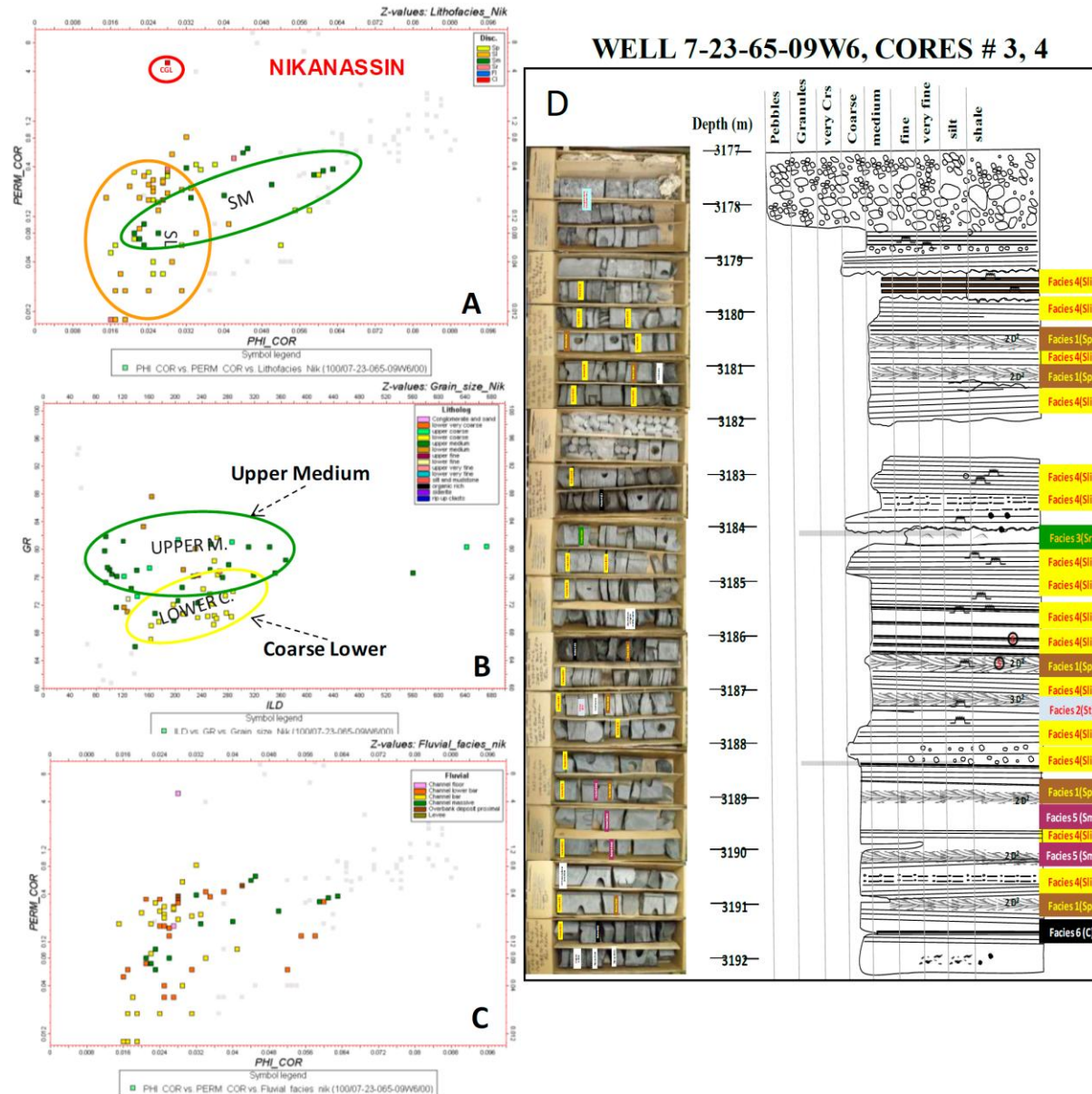


Figure 3. A. Porosity vs. permeability distribution grouped by the interpreted grain size (core logging). B. Gamma-ray values plotted against resistivity, and constrained by the interpreted grain size (core logging). C. Porosity vs. permeability distributions grouped by the interpreted fluvial facies. D Core log description and interpreted facies of whole core interval.