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# Characteristics of the Triassic Upper Montney Formation (Unit C), West-Central Area, Alberta

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## Abstract

Unconventional hydrocarbon resources include those subsurface oil and gas accumulations that are challenging to recover and estimate relative to conventional resources, either due to poor reservoir quality or unique fluid storage and transport mechanisms. A representative project to illustrate this difficulty is focused on the Lower Triassic of the Montney Formation for unit C (informal name) within the Pouce Coupe South Pool (gas plays within distal fan siltstone-shale intervals), west-central Alberta. Four wells were used in this study N1, N2, N3 and N4 **(Fig. 1)**.

The objective of this project is to incorporate core data with petrophysical measurements using various well logging tools to delineate the different petrofacies in the studied wells. Non-routine-methods are applied to understand the porosity, probe permeability, and pulse decay permeability that were conducted on ultra-low matrix permeability rock (at variable confining pressure) to establish controls of lithology on stress-dependence of permeability and to improve the fine scale heterogeneity of the reservoir **(Fig. 2)**.

Integration of possible geological information and petrophysical properties from the reference well N1 is implemented to recognize the different rock types for the studied unit. The results of qualitative and quantitative analysis from the reference well are taken to arrive at different well log picks and petrofacies. The NeoStrat® (Automated well log correlation) software is used to correlate and to improve sedimentary petrofacies evaluation and rock type identification for non-cored intervals at other adjacent matching wells N2, N3 and N4.

The NeoStrat® software is a computer program developed to perform all computations (weighted correlation) without querying the user with questions that the program can resolve by itself **(Figs. 3A & 3B)**. The program has been designed to extract all possible information from wireline logs and tested successfully in the current project. The eventual results with the software have relieved the tedium of correlating logs, and this consistently outperforms human log interpreters in determining rock types and petrofacies relationships **(Fig. 4)**.

## Results:

The results are summarized in **(Figures 4 and 5)**. The key points are:

- The Montney Formation (unit C) is consisted of inter-bedded siltstone and shale deposited in a low energy depositional environment. The study unit is characterized by a non-uniform spatial distribution of the reservoir properties.
- Routine core analysis is not useful for characterizing such reservoir due to heterogeneity and the measurements are not performed under reservoir conditions (in-situ).
- Combination of geological and petrophysical data yielded valuable results in defining the different rock types and petrofacies.
- In addition to delineating the top of the unit, three rock types with different reservoir qualities were recognized based on the petrophysical properties. Reservoir attributes for very fine-grained sandstones, siltstones (petrofacies 3) at Unit C include a 15-20 m thick interval with 0.4-0.5 net to gross ratio, 5-6% average porosity, 0.001-0.003 mD average permeability, and Sw of 20-30% **(Fig. 5)**. **Table 1** summarizes the petrofacies and cut-off values for the studied unit.
- Well N1 has the lowest reservoir quality compared to the other correlated wells. Based on the information from geoSCOUT geoLOGIC System, the Wells N2 and N3 have produced up to 24,000 $e^3m^3$ gas from the Montney over a period of 5 years (2006-2011). Well N3 was perforated and fractured at depth 2216 – 2220 m within Montney Formation (unit C). Although, N4 has comparable lithology and petrophysical properties, N4 has produced from the Triassic Doig Formation. N4 was vertically drilled (1994), however, drilling in Montney requires advanced methods such as horizontal drilling and hydraulic fracturing which was not therefore exploited.
- NeoStrat® can prepare sophisticated cross sections displaying the lithology and different petrofacies of the subsurface. The program offers multiple options to annotate the cross section for better understanding of the interpretations.

## Conclusion:

Reservoir characterization and results of the Montney Formation (unit C) are integrated with the geological and petrophysical data and will be directed for accurate assessment of reservoir properties and their distributions, and to explore the feasibility of developing these resources with new technology such as horizontal wells and hydraulic fracturing.

## Acknowledgements

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**References**

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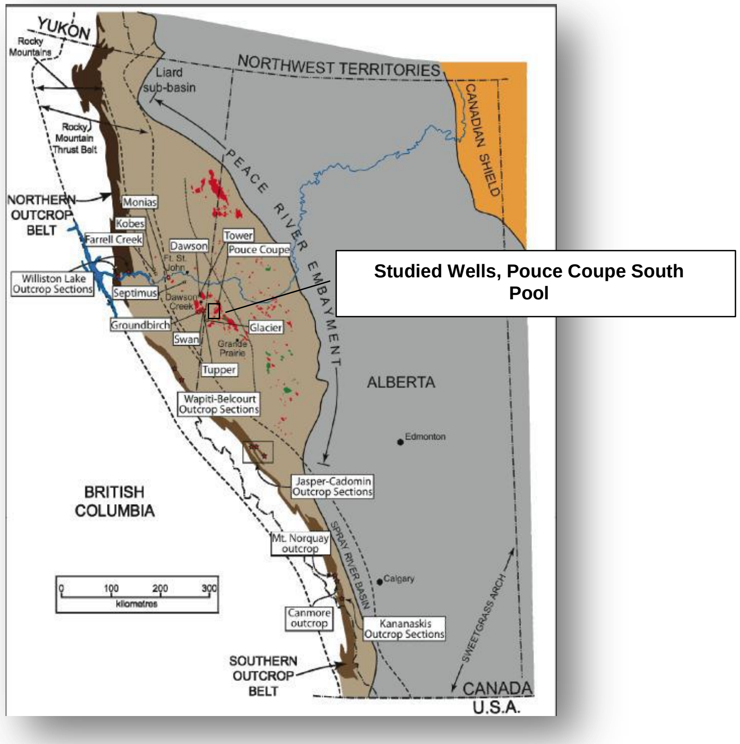



**Figure 1:** Location of the study area

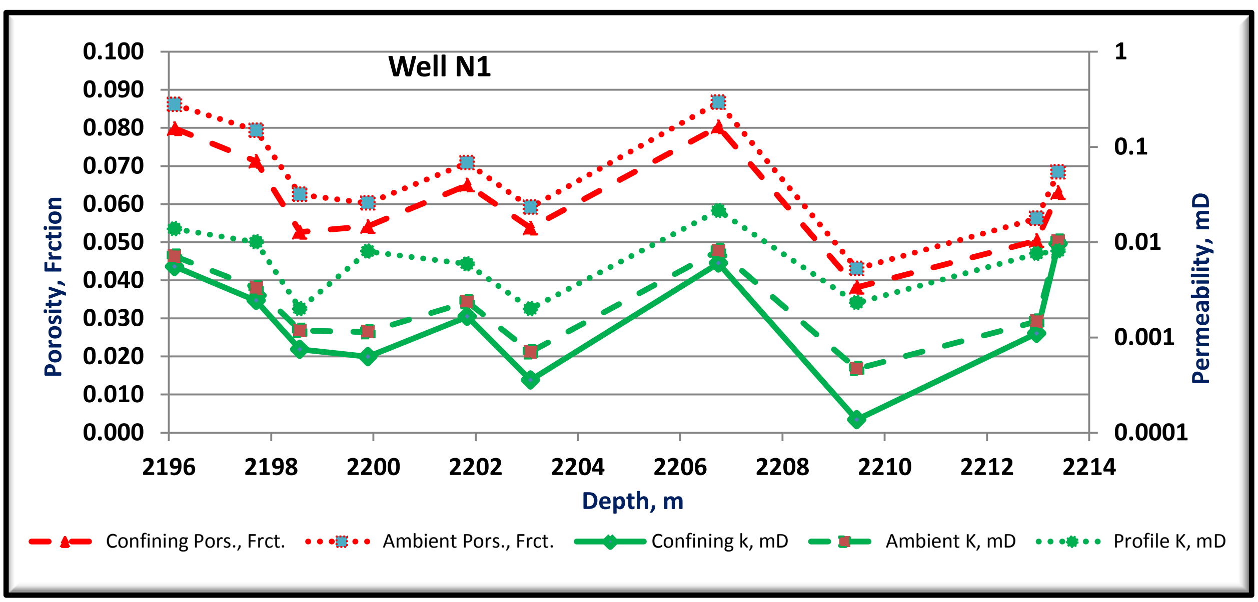
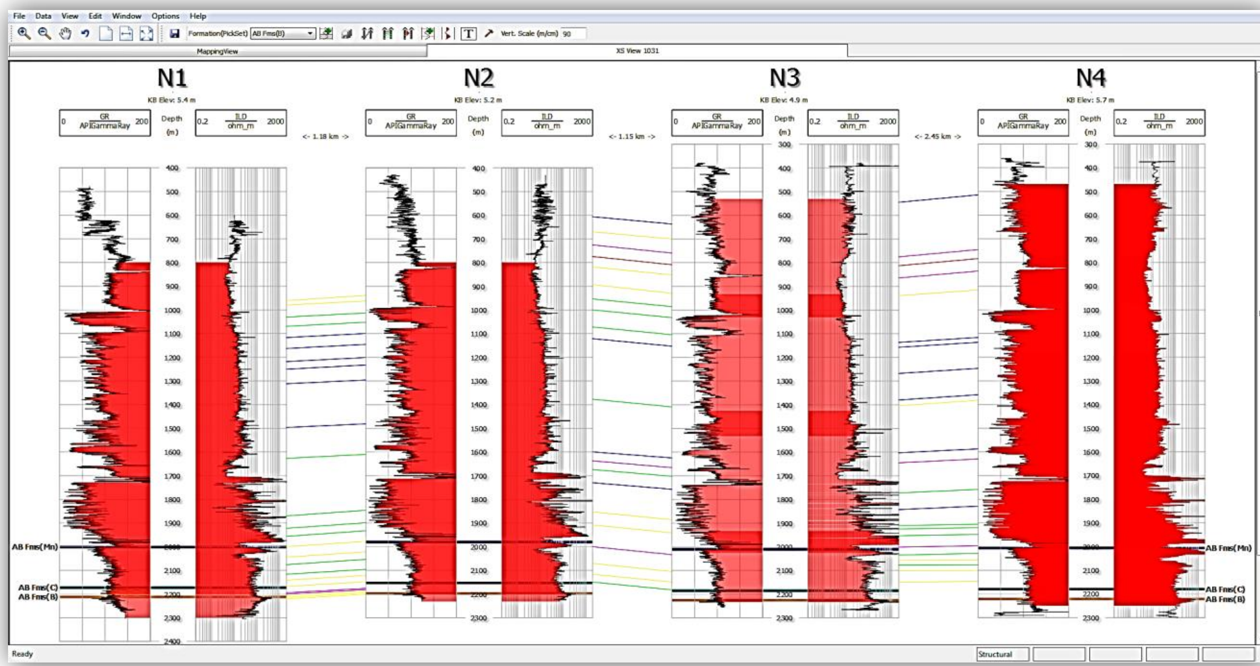
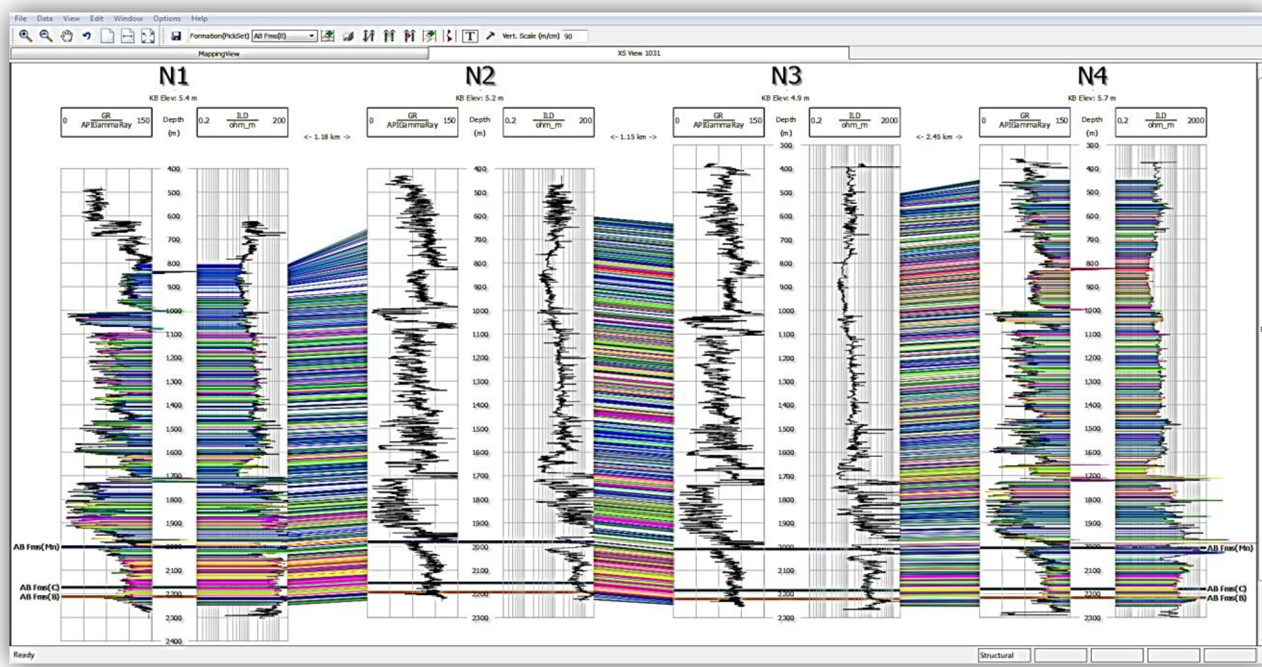



**Figure 2:** Porosity and permeability core plugs at ambient and various confining pressure. The porosity and permeability decrease with an increase in net confining pressure




A




B

**Figure 3:** Automatic tracing of formation and unit tops for the study wells (A). Weighted cross-correlations obtained using automatic calculation of search intervals (B)

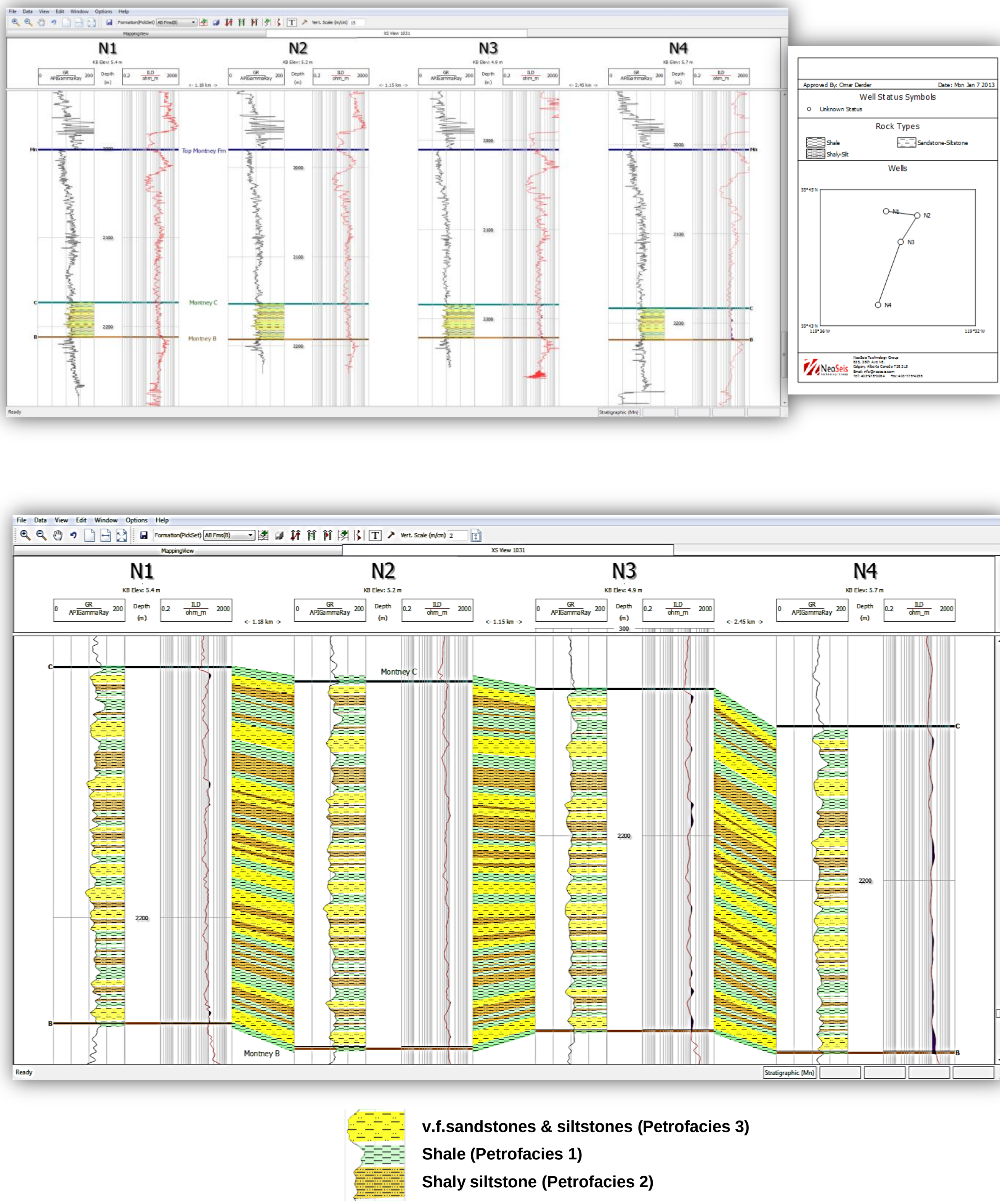



**Figure 4:** Cross section through Pouce Coupe South, west-cental area, Alberta with datum set at top Montney Formation; logs are gamma (black) and resistivity (red)

**Table 1:** Log threshold petrophysical values assigned to recognize petrofacies for MnC interval of the studied Wells

| Petrofacies | GR (API) | Ø (%) | Resistivity (Ohmm) | RHOB ($Kg/m^3$) | K (mD) |
|---|---|---|---|---|---|
| **1, shale** | 115-130 | 2-7 | 50-85 | 2552-2629 | 0.0003-0.001 |
| **2, shaly siltstone** | 110-120 | 3-8 | 60-130 | 2555-2600 | 0.001-0.0018 |
| **3, v.f.sandstone-siltstone** | 100-110 | 4-10 | 70-140 | 2545-2595 | 0.0018-0.006 |

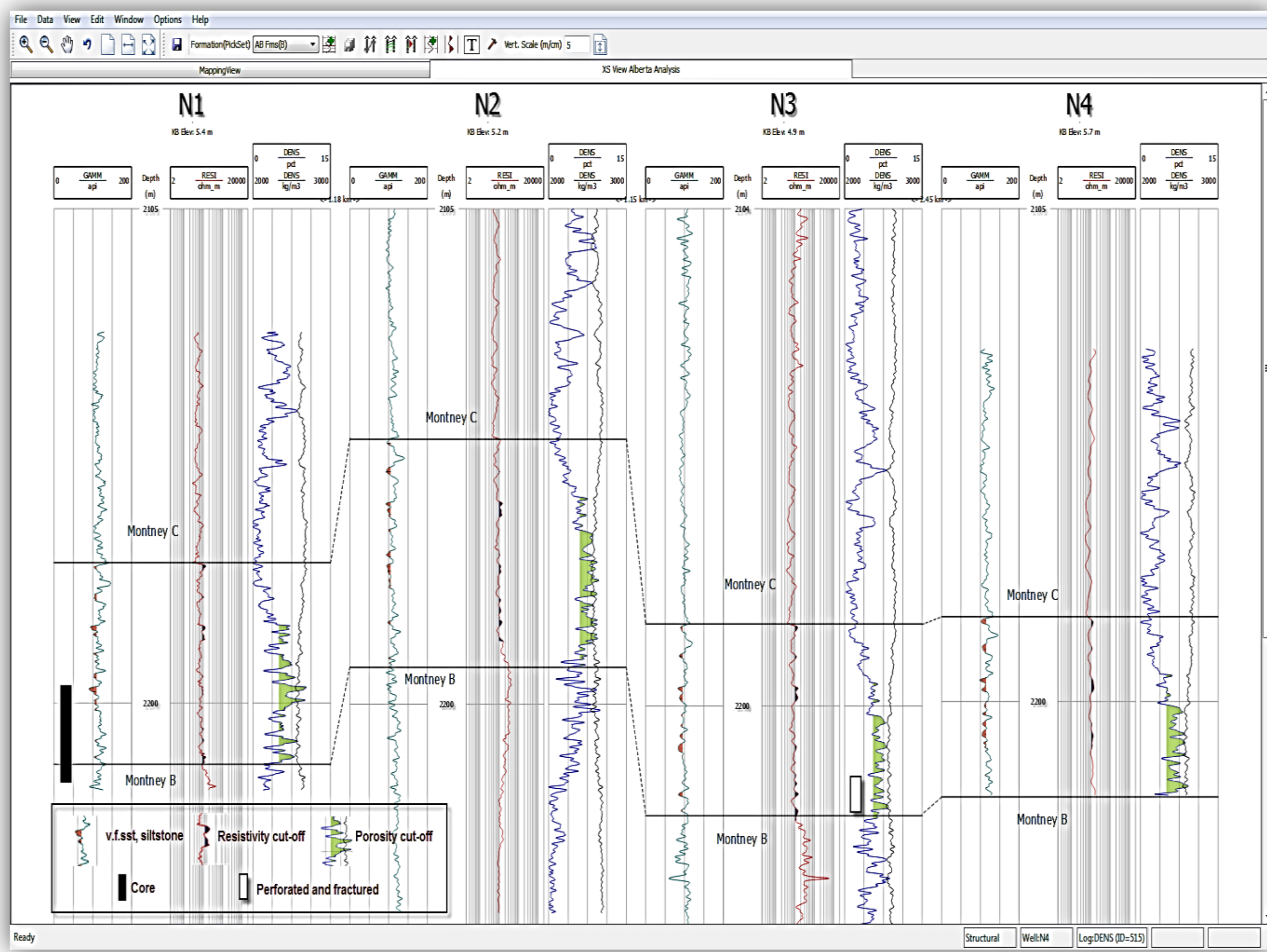



**Figure 5:** Log responses over the Montney Formation (unit of MnC) interval for wells N1, N2, N3 and N4. Petrofacies 3 represent better reservoir properties; logs shown are gamma (green), resistivity (red), density porosity (blue) and density (black)