

Reading Between the Lines: A NEBC Shale Gas Quantitative Interpretation Case Study

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Summary

This presentation will describe an unconventional case study in the context of a modern integrated interpretation workflow. The objective of the case study was to predict the geomechanical properties of a shale reservoir interval and map the prime zones for optimum gas development. The workflow illustrates the successful integration of geological information and seismic attributes to provide deterministic ranges for potential stimulated rock volumes which allow for cost-effective production planning.

Introduction

The Horn River shales contain about 70% of Canada’s total estimated shale gas resource and the largest accumulation of gas in North America (Figure 1). Nexen Energy ULC holds multiple leases in the area but this case study focusses on a specific project where a multi-component 3D survey was acquired in 2012. The resource objectives in this area are the organic shales of the Devonian Muskwa Formation and the Otter Park and Evie members of the Horn River Formation (Figure 2). Nexen has been proactive in acquiring the 3D early in the development process, so thorough analysis can focus the drilling program and reduce risk.

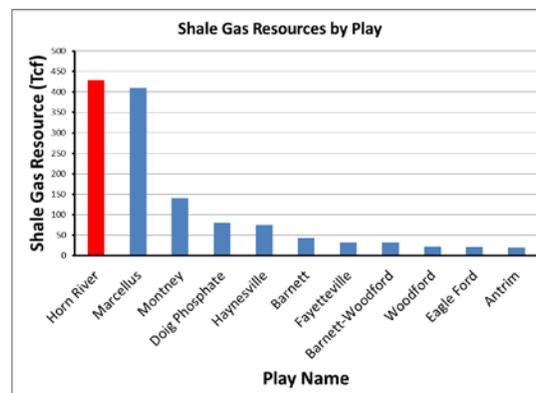


Figure 1: Relative shale gas resource size by play (after EIA, 2011).

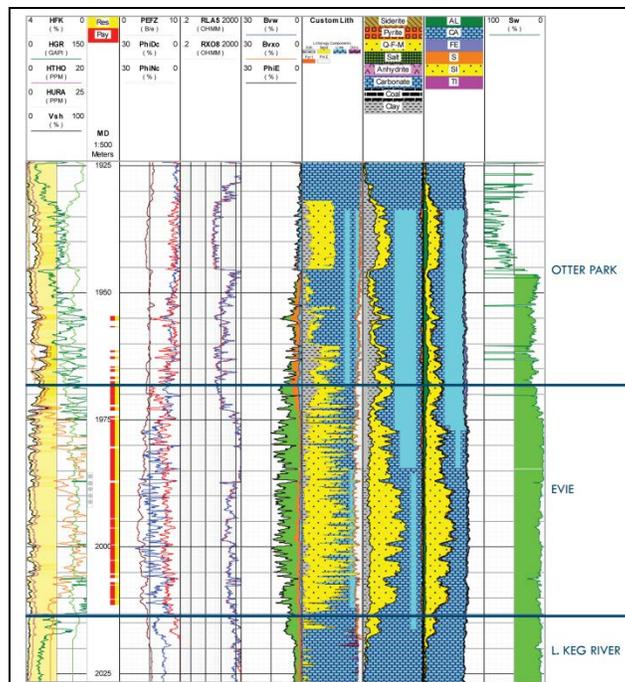
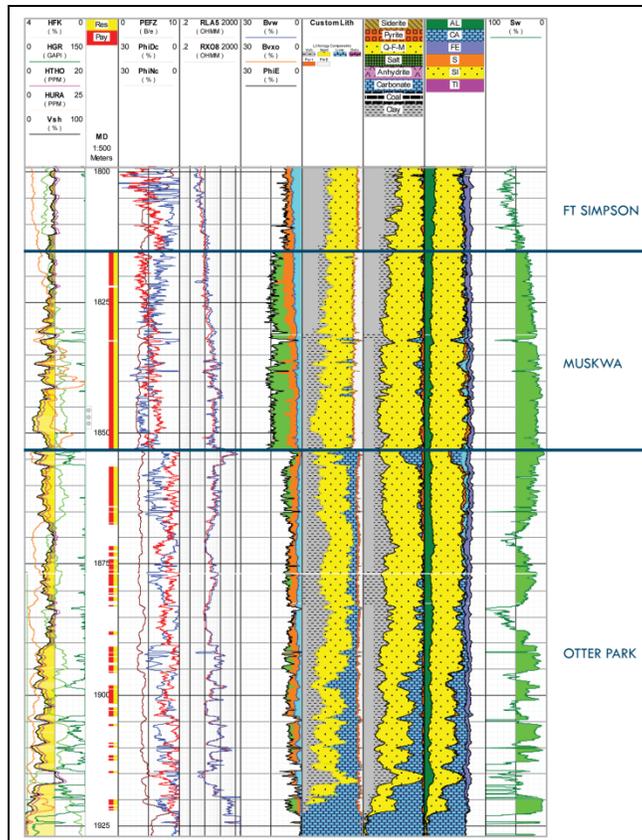


Figure 2: Petrophysical analysis of Muskwa and Horn River Formations. Modified from Charest, 2013

Method

Quantitative Interpretation (QI) is the process of relating seismic amplitude measurements directly to rock or fluid properties, and using these derived relationships to convert seismic data to geological predictions. Thorough understanding and calibration of well data for this purpose is a key step in this process, and is demonstrated through crossplots of elastic properties derived from logs identified by the preferred rock properties. Figure 3 shows Young's modulus plotted against Poisson's ratio with the points coloured by zone. This crossplot indicates that Muskwa and Evie have distinctly separate properties that can be interpreted in terms of relative brittleness.

From this and other crossplots, a series of deterministic templates have been defined, and used to classify the seismic volume based on equivalent elastic properties derived from the seismic data. Figure 4 shows the equivalent seismically-derived attributes coloured by cluster density and overlain on the well data crossplot from Figure 3. Figure 5 shows the fully-classified seismic profile using an optimum combination of all attributes, compared with the conventional seismic profile.

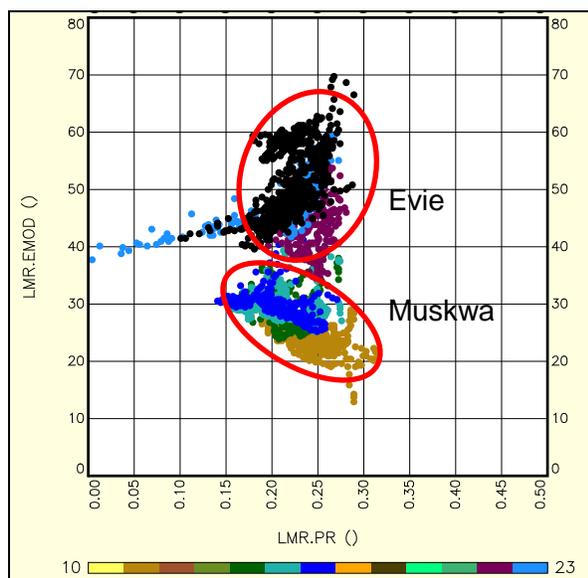


Figure 3: Well data crossplot of computed Young's Modulus vs. Poisson's Ratio curves from six wells. Points are coloured by geological unit within the Muskwa and Evie zones.

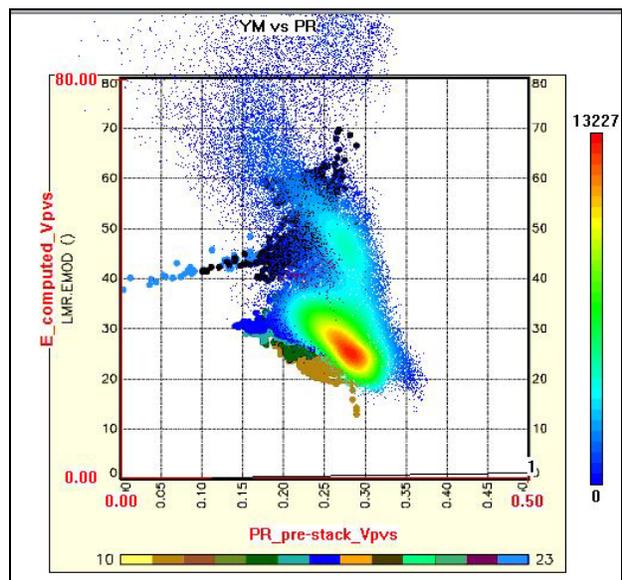


Figure 4: Seismic attributes representing Young's Modulus and Poisson's Ratio overlain on the well data crossplot from Figure 3. Seismic points are coloured by cluster density.

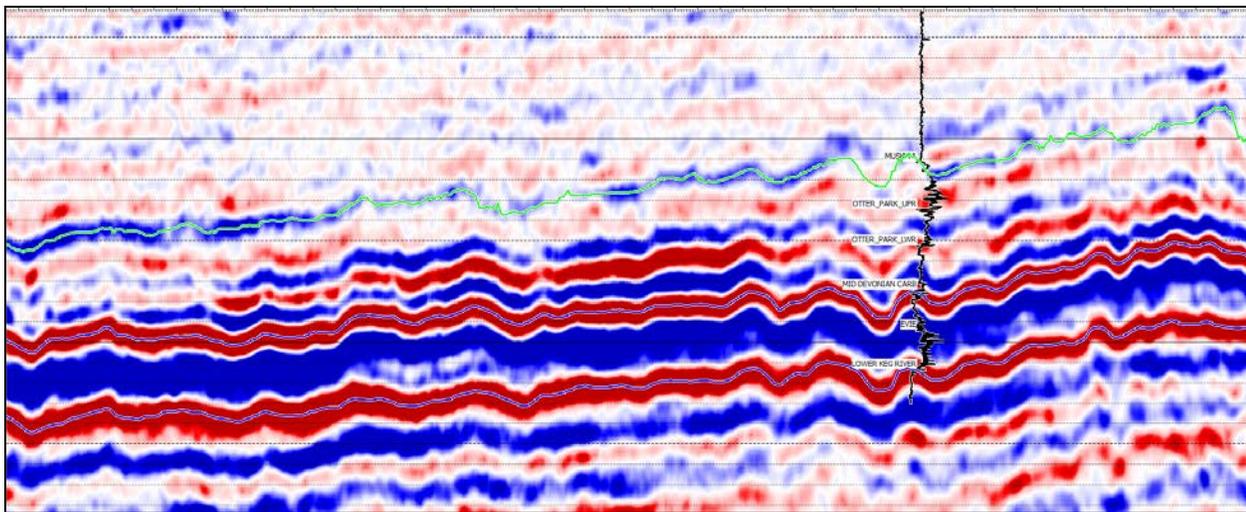
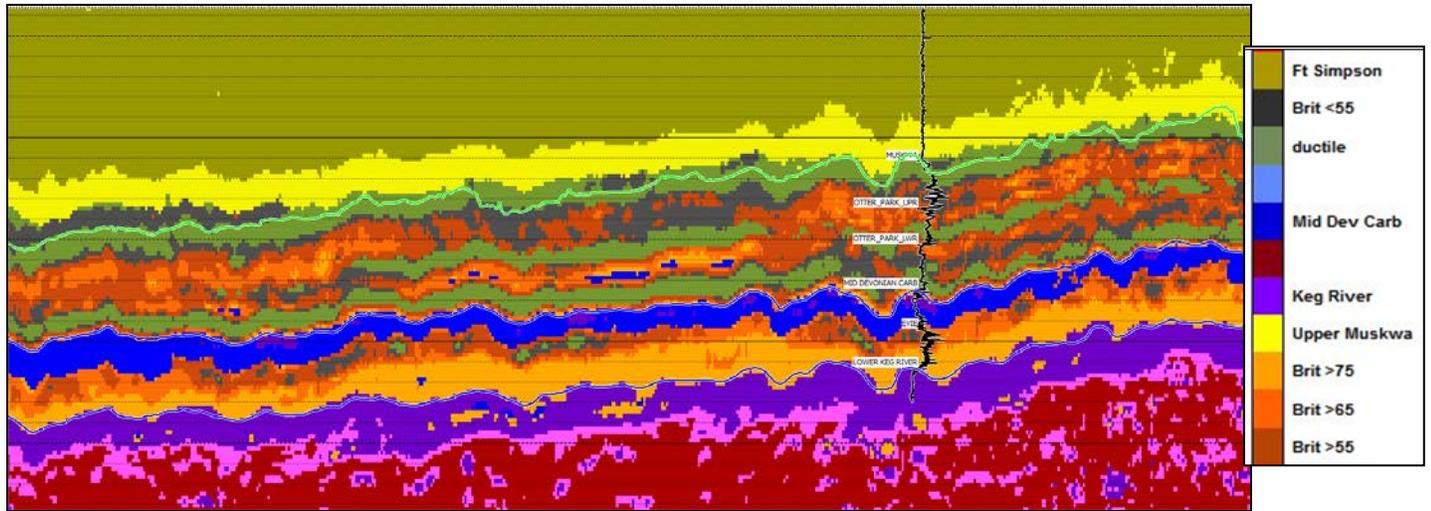


Figure 5: Classified seismic profile (top) compared with original conventional seismic section. Class colours represent either geological unit or relative brittleness index as shown in the legend.

The presentation will show some of the 3D quantitative analysis, the derivation of rock property templates from the well data, and will describe the progressive interpretation techniques employed to make the best use of each of the elements in the process.

Acknowledgements

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References

- Charest, M., 2013, Liard / Horn River / Cordova Shale Gas Update, Canadian Discovery Digest, Vol. 3, 2013, p.17-64.
 EIA (Energy Information Administration), 2011. World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States.