

The Power of 3D Seismic Beyond Structure

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Summary

Using 3D seismic elastic parameters for cross-plotting in LMR and I_p V_p/V_s space shows the complexity of the lithology in the Montney formation. The cross-plots help to map out various lithologies and mitigate geohazards such as stratigraphic tight zones. In addition, predicting zones of brittleness and ductile are important when designing fracturing and drilling programs.

Introduction

3D seismic has come a long way in the past 20 years, advancements in acquisition and processing have greatly improved the quality of the data. 3D seismic is used in exploration and development projects all over the world. In today's workflow the use of elastic parameters has become more and more common to help with reservoir characteristics, lithology mapping and mitigating geohazards. This talk is a general overview of using 3D seismic to map out various lithological facies and identify potential geological drilling and completions risks. The Montney formation was used to examine derived attributes to characterize the reservoir and show potential drilling geohazards.

Workflow

The workflow used to generate the seismic maps and cross-sections was started by well log curve interpretation and generating elastic parameters. These were then used to create LMR cross-plots (Goodway 2009) and tied back to the log curves (Gamma) for lithology identification and validation (Figure 1).

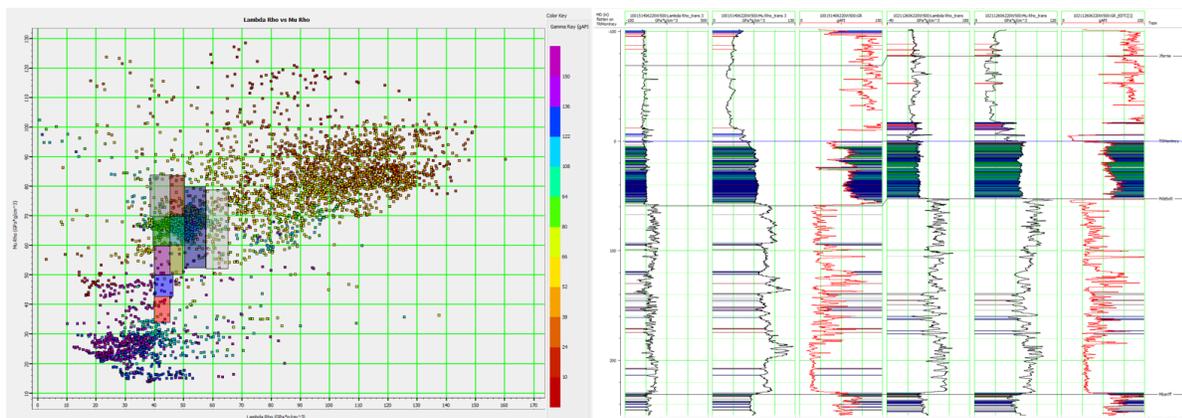


Figure 1. Cross-plot Lambda Rho vs Mu Rho, corresponding logs with Gamma for 15-14 and 11-26

A RPT model was created using the main mineral components (from lithology logs) in the Montney

formation within the study area (Figure 2(a)). RPT lines for Quartz to Dolomite (10% increments), Quartz to Shale (25% increments), and Quartz to Clay (25% increments) were created at constant pressures. These RPT lines were then used on the LMR cross-plot using 3D seismic attributes to map out various facies and lithologies (Figure 2(b)).

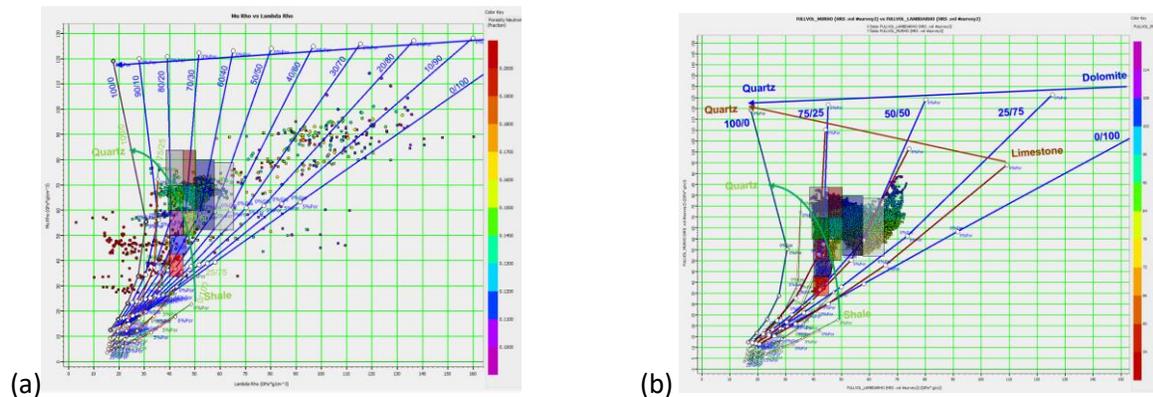


Figure 2: (a) RPT on LMR cross-plot of log attributes, (b): RPT on LMR cross-plot of 3D seismic attributes

In addition to LMR cross-plot, a second set of cross-plots was generated using seismic attributes I_p and V_p/V_s . These showed very similar results for the various facies and lithology maps as well as the cross-section.

Using the derived elastic properties, Young's Modulus and Poisson's Ratio, additional seismic cross-plots were created. These in turn were used to show brittleness and ductile zones (Cho, Perez 2014) within the Montney formation (Figure 3)

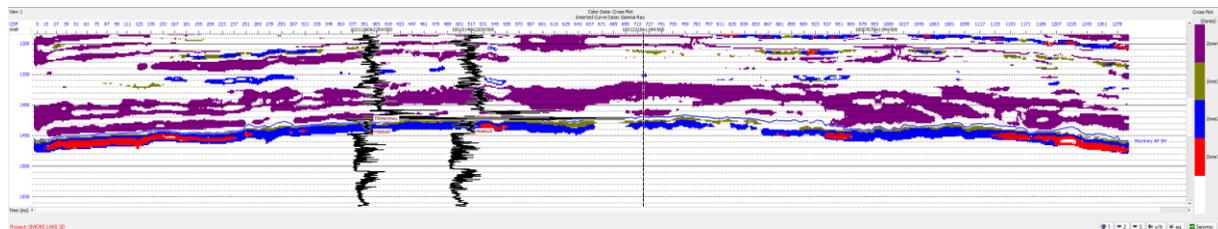


Figure 3. Seismic section from Poisson's Ratio vs Youngs Modulus, showing Brittleness and Ductile zones

Conclusions

3D seismic inversion data provided valuable reservoir attributes for improved lithology mapping and reservoir characterization. It was also shown that the 3D seismic inversion data provided valuable information to mitigate geohazards and lithological boundaries, and help design fracturing programs and pick better drilling locations. In addition, it provides structural information for improved horizontal drilling and staying in the zone of interest.

About the Author

Mantu Sihota (P.Geol) has over 27 years of experience in geoscience in the Western Canadian Sedimentary Basin, most recently as Chief Geophysicist for a large E&P company. He has a proven track record of success in technical, leadership and business development roles. He currently holds the position of Director, Geoscience at Pulse Seismic.

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References

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Goodway, Bill, EnCana Corporation, 2009, The Magic of Lame, CSEG