

Seismic Lithology Prediction

A Montney Shale Gas Case Study

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Summary

Recent petrophysical work (Nieto 2009) has shown that the Montney formation needs careful petrophysical work to characterize the reservoir before drilling and completion. Upper and Lower Montney are deposited in cycles on a scale of tens of meters in thickness, each cycle containing fine scale laminated silts with varying degrees of TOC.

These variations in lithology allow the creation of rule based lithologs, the first and key step in any petrophysical evaluation. In this study, 5 main lithoclasses or ‘petrofacies’ were created: Phosphatic Montney, high TOC, Silty zone, Low TOC-good porosity, Low TOC-best porosity. These petrofacies were determined from rules using 4 commonly found logs: GR, Resistivity, Delta (Neutron-porosity – Density porosity) and Density porosity.

A pre-stack seismic inversion was performed over this case study area in order to evaluate lateral continuity of the reservoir quality. The good match between the wells and the inverted seismic results indicated that the interpretation could be further enhanced by creating Lithocubes with the above classification.

The technique used here was based on Bayes Theorem and combined the initial proportion of the different facies with the probability density function based on Cross-plots of the elastic parameters (see pictures below). The predictions were compared to the original lithologs for quality control and a probability volume of each facies was generated as well as a most probable facies cube. Finally, these volumes were used to pinpoint zones with the highest reliability of facies prediction and thereby increase confidence in the interpretation.

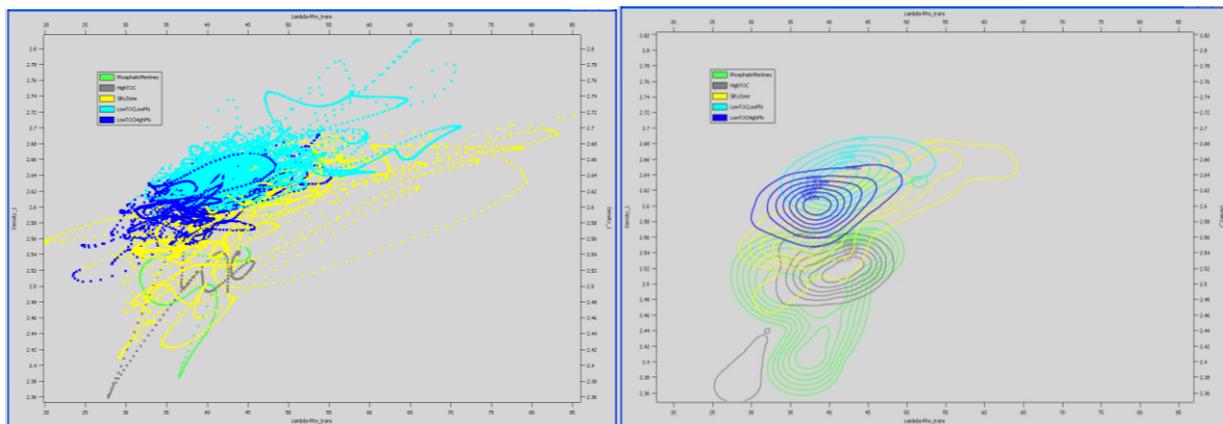


Figure1: Left, Xplot of LambdaRho versus density well logs colored by petrofacies. Right, probability density functions for each petrofacies used for the classification.