

Rock Physics Inversion: A Montney Case Study

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Abstract

In this case study, we applied a novel workflow for generating petrophysical property volumes in a Montney tight gas play. In the past, this method has been applied in high porosity, offshore oil exploration environments with great success (Westang et al, 2009). The workflow used involves the following steps:

- a) Seismic data re-processing and conditioning
- b) Log calibration and wavelet estimation
- c) Low frequency model generation
- d) Simultaneous pre-stack AVO inversion for elastic rock properties
- e) Rock physics inversion for petrophysical properties

The AVO inversion algorithm is based on the Aki and Richards linear approximation to the Zoepritz equations (Aki and Richards, 1980). The inversion is carried out simultaneously on multiple angle stacks in order to accurately derive elastic rock property volumes such as acoustic impedance, V_p/V_s ratio, and density.

The rock physics inversion is a new technique in characterizing tight gas plays. Initially, a rock physics model was developed relating the elastic rock properties to porosity, water saturation, volume of clay, volume of sand, and volume of carbonates using well logs and other available information. The model is consistent with the Reuss and Voigt bounds (Reuss, 1929), as well as Gassmann fluid substitution (Gassmann, 1951). The rock physics model is then used to define an inversion framework which is used to derive volumes of the above mentioned rock properties. The outputs of the rock physics inversion provide an intuitive laterally extensive characterization of reservoir quality, which may be of use in planning well placement and completions.

The quality of the results was evaluated by comparing the inversion results to the well log interpretations used to define the rock physics models, and also to other wells present in the study area that were not included in the analysis. The good match between the inversion and the well logs suggests the inversion results are reliable. Based on these results, the target zone of a Montney horizontal was altered. Once obtained the well logs confirmed this change in strategy.