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Integrated Workflow for Reservoir Characterization for Exploration & Exploitation of Hydrocarbon

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SUMMARY

Fullwaveform elastic inversion technology in conjunction with rock physics provides an useful output:
Lithology and fluid identification with pore pressure

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Rock physics analysis can provide the relation between the parameters (or seismic attributes) that govern seismic wave propagation (e.g., V_p , V_s , and density in isotropic media) and the reservoir property of interest such as rock / fluid type, porosity, pressure and saturation. In this process, we need to account for the quality of the seismic data and derive the appropriate uncertainties associated with the seismic data, such as noise, resolution, and inversion artifacts into the reservoir property estimation. In this presentation, we show how to quantitatively propagate seismic data quality issues such as resolution, noise, and inversion accuracy into the lithology estimation in a clastic basin. The method consists of several steps: seismic inversion to obtain elastic parameters, petrophysical well log analysis to define a classification scheme based on Bayes' theory and probability density functions; upscaling the PDF's to seismic scale using Backus' theory and finally, applying the final scheme on seismic attributes (V_p , V_s and density) derived from the first step. The use of full waveform inversion and Bayesian classification techniques provides a mathematical framework that enables us to model and directly relate data quality input into the uncertainty associated with reservoir properties prediction. The final output of this process is a map in 2D and a cube in 3D, of rock / fluid types with *confidence levels associated with each property at each CMP and time sample*. We illustrate the procedure with examples from several basins from the world. This methodology can be easily applied to data from carbonates areas as well where inversion techniques are known to yield porosity, pay and fracture properties.