UNCERTAINTY QUANTIFICATION IN RESERVOIR FACIES CLASSIFICATION USING PROBABILISTIC ROCK-PHYSICS MODELING

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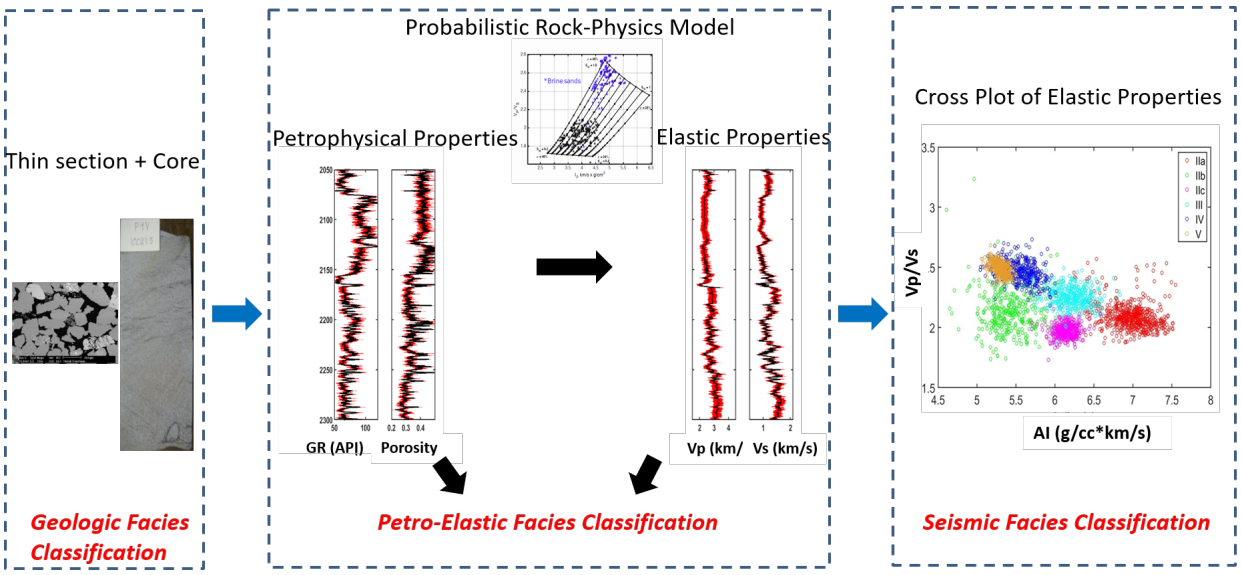
ABSTRACT

The goal in seismic reservoir characterization is to estimate petrophysical properties and facies profiles from measured seismic data. Facies classification, which directly determines the relationship among petrophysical properties, elastic properties and seismic attributes, plays an important role. Rock-physics modeling links the petrophysical properties and elastic properties, and it models probable scenarios away from well. Nevertheless, facies classification can be affected by several types of errors including input data error, rock-physics modeling error and data-model matching error. In this work, we will develop a workflow to systematically quantify the uncertainties in reservoir facies by integrating probabilistic rock-physics modeling, statistical sampling and validity index analysis. In addition, a semi-supervised classification algorithm that combines a priori information from expert knowledge will be developed. This technique aims to improve the unreliable estimation in conventional facies clustering and produces more consistent and geologically interpretable results. Finally, a complete reservoir facies characterization study including semi-supervised facies classification, uncertainty quantification and Bayesian linearized seismic AVO inversion will be performed. Conditioned to the seismic data, the final output from this study will be the optimal reservoir facies classes, the profiles of facies probabilities and the most probable facies.



Flow chart of the reservoir facies classification. From left to right are the geologic facies (thin section image from Oeren et al., 2003), petro-elastic facies and seismic facies classifications. For petro-elastic facies classification (middle), uncertainties from inconsistent numbers of geologic facies, measurement error of well log inputs, inaccuracy of rock-physics models and the mismatch between data and model will be addressed. For seismic facies classification (right), uncertainty related with facies overlap and resolution diminish of inverted seismic elastic properties will be estimated.