RP30

Beyond Rock Physics Templates – And the way ahead

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SUMMARY

The need for efficient and robust techniques for quantitative assessment of reservoir properties from seismic data will be crucial in improved exploration for stratigraphic traps of hydrocarbons. Integrating rock physics with seismic data inverted for Amplitude Versus Offset parameters or acoustic and elastic impedances, or P-to-S wave velocity (V_p/V_s) ratios, is a key element in this process.

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The most common way to perform this integration is by using rock physics templates. Here acoustic impedances and V_p/V_s ratios, derived from the seismic data, are plotted into a 2D space where correlations of V_p/V_s vs acoustic impedance as functions of, for example, porosity, mineral composition and pore fluid content are pre-defined using some rock physics model. The particular rock physics model to be used differs with type of lithology, burial depth and pressure conditions. In essence, this process implies to estimate a suite of reservoir properties, usually three or more parameters, from two data parameters. In nature this invokes a substantial non-uniqueness scenario. In practice, however, the solutions are partly constrained by the rock physics models chosen to guide this process. Here is where the geological interpretation is embedded. Rock physics models for unconsolidated sands or granular media models, may show a very different effect on the seismic properties when perturbing reservoir parameters than a rock physics model made for consolidated sands. Hence, the reservoir properties interpreted strongly depend on the templates used.

To partly overcome this problem and to give a better diagnostic of the problem at hand, a more extended workflow - called inverse rock physics modelling – is reviewed, with particular emphasis on data applications. Inverse rock physics modelling is a process where all possible solutions of reservoir models associated with a set of seismic data parameters, e.g. acoustic impedance and V_p/V_s , are established for a given rock physics model. By exploring a suite of various rock physics models believed to be possible candidates to describe the reservoir, the robustness and uncertainties in the estimation problem are recovered. Examples from using the method successfully for calibration of rock physics models to well log data is demonstrated, and, further, how to extrapolate reservoir properties away from the well position from inverted seismic data is shown. Finally, examples of the effect of embedding errors in the data parameters are discussed.