Evaluation of Sand Proportion Using Statistics of the Seismic Signature: An Application to Onshore Mozambique Reservoirs

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ABSTRACT

Estimation of static properties using seismic data remains one of the main challenges in the subject of quantitative interpretation for Earth Modeling. This is partly because data integration requires theoretical models or heuristic approaches which can find difficult to manage differences in measurement scales and sensitivities to a physical attribute. Additionally, limitations in the available information (e.g. 2D vs. 3D seismic surveys, number and distribution of wells, quality and noise) can further baffle the link between seismic and reservoir properties; thus impacting on the overall effectiveness of the predictions. In particular, for 2D seismic data, acquisition and processing approximations can make correlations between geology and amplitude-phase-frequency attributes dubious. Seismic data conditioning is often a recommended tactic to improve robustness of quantitative predictions. When applied in a comprehensive fashion, seismic inversions together with rock physics templates can provide insights on reservoir properties. Yet application of these techniques is time-consuming and outcomes might still be uncertain. To partly accommodate for the limitations described, a fast turn-around nested statistical workflow is presented. Focusing on a stratigraphic window for which sand presence and distribution need to be evaluated, the proportion of seismic loops is calculated. As encouraged by 1D/2D data-driven models, the number of reflection coefficients in a sand-shale framework leads, bandwidth permitting, to a number of seismic impulses which in turn can be linked to sand proportion. Synthetic tests show a simple linear function can be designed as a first-degree approximation. In a field study, this relation can be inverted provided adequate calibration is made. Confidence intervals in the achieved well-to-seismic correlation are then used to feed a stochastic simulation process helping to account for uncertainties in the goodness of the fit and spatial data distribution. This helps defining probabilistic scenarios; ultimately describing uncertainty envelopes associated with the sand extension. In our case, this workflow is applied to 2D seismic surveys from Onshore Mozambique. Results highlight sand rich fairways and potential discontinuities. Observations made help support the subsurface characterization activities in the area.