Simulation and Verification of Poststack Seismic Data of Fluid- and Solid-filled Reservoirs; Case Study: Southern North Sea

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Recent literature on extensions of the Gassmann equation investigates the substitution of fluids and solids in the pore space of reservoir rock. Conventional substitution fluids-only is described by the Gassmann equation, whereas extensions of this theory are needed to account for solid material (such as salt) in the pore-space. This modified rock physics framework was used to make predictions for Amplitude Versus Offset behaviour in the Lower Volpriehausen sandstone reservoir in this study. This was achieved through the simulation of Poststack seismic data based on a geologic model. A total of 13 wells were analyzed through multicomponent geophysical well logs integration. Detailed cross plots analyses revealed that the Lower Volpriehausen reservoir interval is characterized with heterogeneous medium and wave parameters which are similar at some particular depth, indicating similarity in lithology. Facies changes due to cementation and compaction is also indicated by the lateral variations in parameters values. Evidence gathered showed that depth-dependent effect does not exist in this Formation. Hence, synthetic seismic could be generated and compared in different domains using the rock physics tool .The synthetic seismic appearances of various geologic scenarios, based on the regional well data, were modelled and verified against real seismic data, in the Poststack domain. Seven wells within the 3D seismic survey areas were modelled. Two wells with salt-plugged zones within the reservoir interval made solid-fluid substitutions and inverse-solid substitution possible. Based on the substituted wells, predictive 2D forward models were generated, which were compared with their respective original fluid and solid-filled wells. This enabled the assessment of the impact of solids in the pore-space on amplitude versus offset. This also lead to further improvement of the understanding of the rock physical behaviour of gas bearing and salt plugged reservoirs in the Southern North Sea, particularly in the presence of possible geologic facies changes and depth variations. This synthetic-to-seismic calibration with the new Gassmann's formulation is a powerful tool for finding gas fields and reducing the interpretation risks of drilling into poor-quality, solid-filled reservoirs.