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Facies Identification and Fluid Prediction using Rock Physics analysis.

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ABSTRACT

Rock physics is an invaluable tool in that it allows explorationists to effectively utilize high resolution well data in various elastic domains and, in doing so, to greatly reduce the drilling risk. One of the main challenges faced by explorationists is the mapping of porous sand with economic quantities of hydrocarbons (condensate), in a deep, tight reservoir. A rock physics guided inversion was carried out to aid in the optimum placement of wells in a field in Saudi Arabia. Different modeling methods were used with this inversion to isolate hydrocarbon-filled sands of reasonable porosity (i.e., pay sands) within a clastic reservoir which exhibited tight, clean sands of Permian age. Additionally, different facies recognized from core descriptions were also used to locate good facies sand. A Rock Physics Template (RPT) was constructed based on nine wells located within the Eastern Province of Saudi Arabia and this template was subsequently used to guide the pre-stack inversion for mapping pay distribution within the field.

The workflow was comprised of three stages: (1) petrophysical analysis to calculate the lithological composition, fluid composition and porosity in the wells; (2) Biot-Gassmann fluid substitution to simulate different scenarios; and finally (3) construction and application of the RPT to describe the porosity and clay content in these wells.

The wireline data was conditioned prior to the Gassmann fluid substitution and construction of a Rock Physics Template. Biot-Gassmann fluid substitution was then performed to calculate elastic properties for the tight reservoir after being filled with 100% brine and 90% condensate. A data projection was applied to the inverted seismic cubes to separate pay zones (i.e., condensate-rich zones) from non-pay zones (i.e., zones containing either brine sand or brine sand with a large percentage of shale). A second Rock Physics Template was then applied to this pay volume, allowing for the modelling of spatial variation in porosity and clay content within the reservoir. Moreover, facies
analysis was performed for confirmation. Geologically plausible geo-bodies were extracted to guide the subsequent drilling of new wells within the field.