

Precise Reservoir Characterization, Formation Evaluation and completion design using LWD High-Resolution Ultrasonic Imaging in North Kuwait Cretaceous Carbonate: Case Study

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Summary

This paper provides insight into the successful application of innovative field development strategies to optimize production from Sabriyah Mauddud reservoir. It also highlights the advantage of acquiring high-resolution image in different mud system for identifying the zones of demonstrating production and reservoir characterization and Formation Evaluation.

Theory / Method / Workflow

Mauddud reservoir in Sabriyah field is a giant heterogeneous carbonate reservoir discovered in 1950s. The field is on production since 1957 with natural depletion since it has no surrounding aquifer. After years of continuous oil production there has been a severe reservoir pressure decline which affected the field productivity. Simultaneously water injection started to support reservoir pressure and to increase sweep efficiency. Different well profiles were drilled in the field to challenges the sustainability of oil production and early water cut, which had been observed in many horizontal and deviated wells. However, to minimize the water breakthrough and enhance oil production in horizontal wells KOC identified some attributes in Ultrasonic image very instrumental among latest technologies in the industry.

To address these issues, Kuwait Oil Company has started an initiative of deploying in-flow control devices (ICD) in horizontal wells to control the water production in Mauddud reservoir and optimize the life of oil production. Mauddud is heterogeneous formation in nature and has massive lateral and vertical variation in petrophysical properties like porosity, permeability and facies/clast.

The critical factors for successful ICD completion design depend upon accuracy of identifying the permeable zones high fractures intervals where the dominated production is coming from. Evaluation for such performance is hard with conventional measurements. Logging While Drilling (LWD) High-resolution Ultrasonic imaging has been deployed for the first time in North Kuwait to help qualitatively identifying the sweet permeable zones, fractures clusters and faults along with other formation petrophysical characteristics and formation pressure data for optimization of ICD completion design.

The need for acquiring accurate reservoir characterization data was recognized and subsequently answered by advance LWD ultrasonic imaging tool. Ultrasonic imaging tool is Logging While Drilling (LWD) tool developed to provide High-resolution image and 360 deg borehole size in

different mud system Water or Oil base mud and has no limitation for the formation/Mud resistivity contrast.

Results, Observations, Conclusions

Permeability in the heterogenous reservoir is complicated because of the presence of different types of secondary porosities resulted from vugs and fractures. The connected vugs or fractures could improve the permeability of reservoir rock significantly and become dominated factors for production; however, with time it could also provide an accessible path for water cut. The high-resolution ultrasonic amplitude and travel time images combined for precision reservoir characterizations and fractures interpretation. Secondary porosity interpretation from the high-resolution imaging allowed identification of high permeable zones with different rock textures including vugs and composite fractures. This enabled more efficient completion strategy.