

"Unveiling Fluid Dynamics: Petrophysical Insights and Fluid Replacement Models in the Middle Indus Basin"

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Summary

Demarcation of reservoir zone is one of the major challenges for the exploration scientists, especially in the area where the neutron density cross over is not clearly defining the zone of interest. To cope with this challenge the new technique was introduced named as fluid replacement modelling. It is a sophisticated technique used by hydrocarbon exploration industry for the prediction of the fluid type present within the reservoir. Five fluid replacement modelling scenarios with variable fluid saturations are tested and compared with the actual density log results. The scenario best matching the actual density log results give the estimate of the fluid saturations present within the reservoir. Fluid replacement modelling was applied on Sawan gas wells data and results indicated that Lower Goru Formation encountered in Sawan Gas field wells consists of reservoir consists of 60% gas, 40% water. AVO analysis coupled with fluid replacement modelling gives the information about the reservoir fluid beyond the well points.

Theory / Method / Workflow

Interpreted log curves are utilized to execute the fluid replacement modelling. This technique allows to study the effect of different fluids on the logs. So, the assumptions are made by incorporating different fluid replacement modelling scenarios based on variable fluid saturations in the reservoir by keeping in mind the reservoir in situ conditions. The curves are obtained at various water and hydrocarbon saturations i.e., 100% water, 30% water and 70% gas and 30% water, 50% oil and 20% gas. The curves than obtained are compared by the density logging data to give the relatively accurate estimation of the fluid distribution present within the reservoir.

Results, Observations, Conclusions

The present study was conducted by using the data of the Sawan gas field wells. Study area lies within Sukkur rift zone along the south eastern margin of Jacobabad Khairpur high. Lower Goru Formation of Cretaceous is acting as prolific hydrocarbon reservoir in this region.

Sembar formation is acting as proven source rock while Upper Goru Formation is the seal rock. Petrophysical interpretation results are utilized for the execution of fluid replacement modelling workflow. Five fluid replacement modelling scenarios were created that were Scenario 1: Gas 100%, Scenario 2: Oil 100%, Scenario 3: 100% water, Scenario 4: 60% oil and 40% water, Scenario 5: showing presence of 60% gas, 40% water. These results are in the form of P and S wave along with predicted density. The density curve of each scenario was compared with the actual logging curve, hence giving an idea about the fluid typing of the reservoir. Figure 1 is illustrating curves of scenario 1 while figure 2 is showing scenario 3. P and S wave curves for scenario 5 is shown in figure 3. The identification of reservoir fluid greatly aids in analyzing the reservoir characterization and better understanding of field economics. Synthetics were also prepared for each scenario for confirmation of the fluid type in the reservoir based on comparison with the fluid replacement modelling scenarios. Synthetics of in-situ logs and FRM resulted in 5th scenario shows good match thus conforming that reservoir consists of 60% gas, 40% water.

Novel/Additive Information

The fluid replacement modelling will reduce the risks associated with the reservoir fluid prediction. Because it gives an accurate idea about the fluids present in the reservoir. This will result in better understanding and monitoring of the reservoir before and during production. AVO Analysis will be helpful for finding the fluid type and fluid saturation beyond the well position when integrated with FRM results thus characterizing the fluid type for entire reservoir.

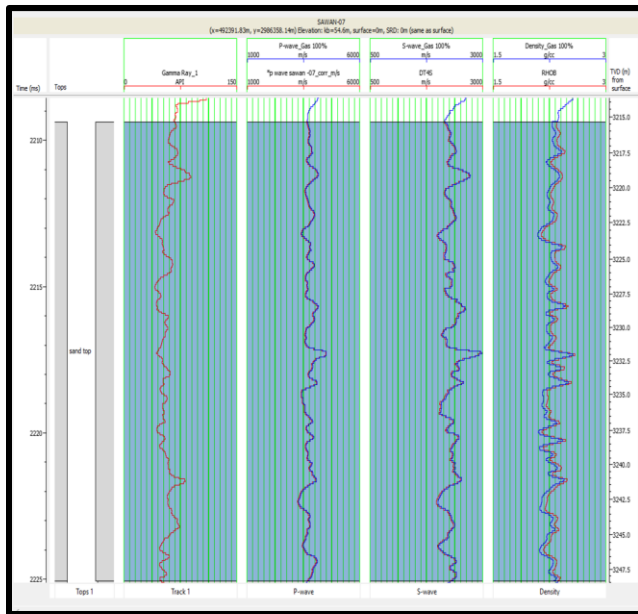


Figure 1 Scenario 1: Gas 100%.

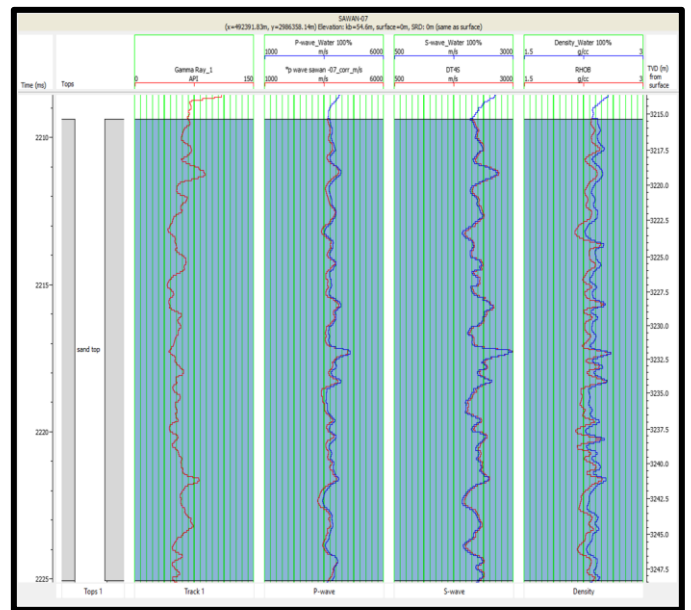


Figure 2 Scenario 3: 100% water

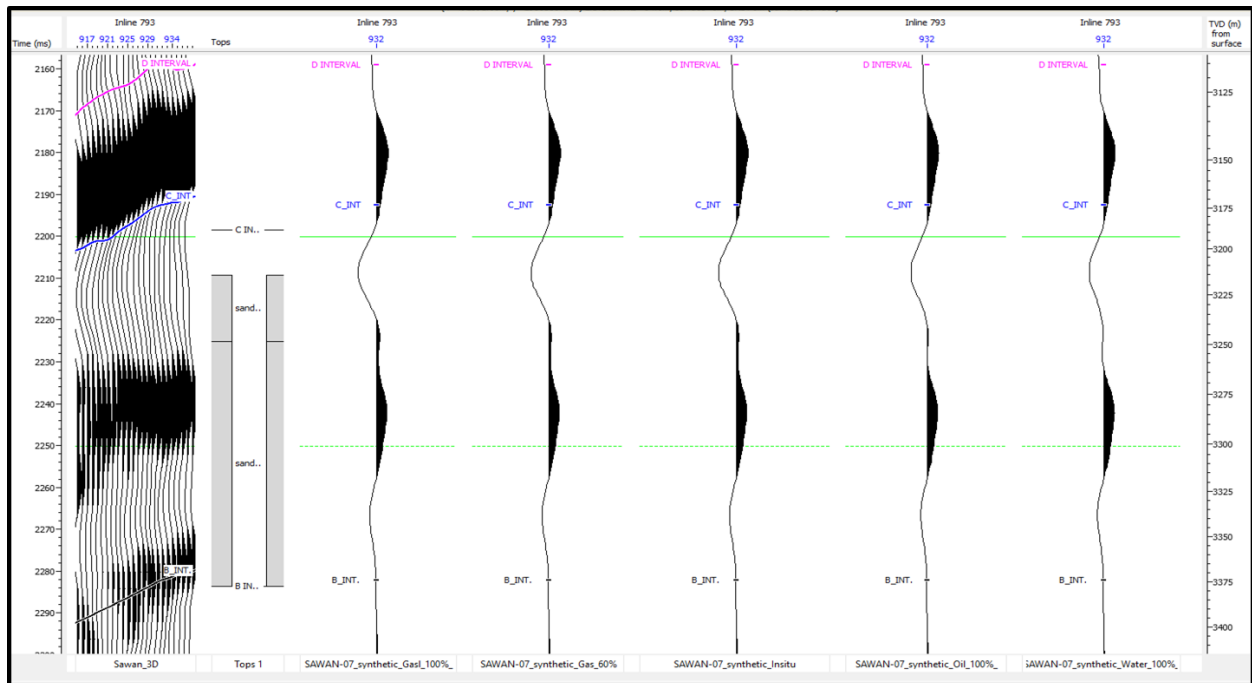


Figure 11: Synthetics of different scenarios at Well Sawan-07

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