Integrated Reservoir Study using Well-Test Deconvolution Analysis and Well-Logging Data in a Gas Condensate Carbonate Reservoir

**INTRODUCTION** - Identifying the rock and flow properties of a hydrocarbon reservoir is needed to optimally manage the reservoir performance. Several tools and methods are used by engineers individually to study the reservoir, while this work suggests an integrated approach for more accurate reservoir study particularly in the complex cases of gas-condensate carbonate reservoirs. The main objective is to conduct an integrated reservoir study and characterization using a combination set of field data including drill stem test (DST) as a well test tool, wireline formation tester, production logging and petrophysical logging from a gas condensate carbonate reservoir.

**METHODOLOGY, RESULTS AND DISCUSSION** - The commercial softwares of Ecrin-Saphir; Emeraude and Geolog have been used for well test analysis, production logging and petrophysical logging interpretation, respectively. In this work, each single reservoir data from the subject well was individually analysed. Then, the integration of all the interpretation results performed in order to achieve more accurate findings. Well test analysis implemented using both pressure-derivative and variable-rate deconvolution methods. A series of data collected from the reservoir layer of an appraisal/vertical well in a gas condensate carbonate reservoir in Middle East, are analysed here. The reservoir interval is from depth 2909-3027 m (the reservoir thickness is 118 m), which was perforated uniformly from depth 2920-3015 m.

**INTEGRATED STUDY FINDINGS** - From petrophysical log interpretation, it can be inferred that the reservoir layer mostly consisted of dolomite, limestone with some portion of anhydrite, which divided the reservoir zone into three sub-zone (upper, middle and lower). In addition, the mobility contrast in wireline formation tester verified with the results of petrophysical logging and considered the middle zone as the highest mobility zone (Figure 1).

In Drill Stem Test (Figure 2) analysis, the final BU derivative showed two radial flow stabilization which indicated a multi-layered reservoir behaviour with different skin factor and kh, while the boundary dominated effects could not be seen. However, the deconvolved derivative enabled us to identify one IARF followed by 1/2 slope and then slightly rolls over at late time which is possibly an indication of limited/leaky faults (Figure 3).

The production logging interpretation results presented different reservoir behaviour in three distinct zones including the lower part of perforation below depth 2985 m, the middle zone around 2940-2985 (divided into three sub-zone with zonal contribution 11, 85 and 4 percent in production, respectively), and upper zone above 2940 m which suggests to have a multi-layered reservoir (Figure 4).

**CONCLUSION** - The results show that the integrated reservoir study using field data including petrophysical and production logging, wireline formation tester and well test analysis is extremely beneficial in achieving more certain reservoir findings and clarifying some uncertainties such as heterogeneous reservoir behaviour and boundary dominated flow effect.