Combination of Production Log, Water Flow Log and Comprehensive Temperature Analysis for Accurate Water Source Determination in Exploratory Wells

Afrah S. Al-Ajmi[1], Abdullah Al-Ibrahim[1], Badruzzaman Khan[1], Sunil Kumar Singh[1], Hazim Ayyad[2], Sarah Jamal[2], and Majid Mehraj[2]

[1]Kuwait Oil Company, Ahmadi, Kuwait.
[2]Schlumberger, Ahmadi, Kuwait.

ABSTRACT

Understanding the water source during testing in exploration wells is critical on the field development strategy. Because if the produced water is confirmed to be coming from the perforated reservoir, and not leaking behind casing through the bad cement from a different reservoir, then it means the petrophysical evaluation has to be re-visited. In this paper, case studies will be presented detailing how the water source was identified and confirmed in two exploration wells with unexpected high water cut during the testing phase. This paper demonstrates the capability of an integrated workflow that includes production logging tools, advanced temperature analysis and water flow log measurements along with real time decisions to detect the water source in heterogeneous, deep and complex exploration wells. Production logging tool configured with reservoir saturation tool – for fluid saturation and water flow log measurements – and detailed temperature analysis were utilized to track the movement and source of water. The production logging tool identified the inflow zones and phase contributions within the perforation interval, water flow log tool configured in 'normal' and 'inverted' modes detected and differentiated between upward and downward water movement behind casing and temperature comparison between geothermal and dynamic conditions also provided an understanding of the source and movement of fluid. A total of three formations, all in the lower cretaceous were tested. Case study 1 and Case Study 2 lay across the same well (with Case study 1 being the deeper of the two) and Case Study 3 lay across a different well. For Case Study 1, water flow log was run in an inverted mode to detect downward water movement. The water source was identified to be above the perforation interval, flowing down into the perforation through bad cement. In Case Study 2, the production logging tool identified the water entry intervals within the perforation and with the help of detailed temperature analysis, the water was tracked to be coming from a deeper source below. For Case Study 3, water flow log was run in normal and inverted modes and with the help of temperature understanding under flowing and shut in conditions, the source of water and its movement behind casing was confidently detected.