

Case Study: Geosteering in high angle carbonate wells

Geosteering utilizing Gas-While-Drilling data for high angle well & completion placement



Client

Kuwait Oil Company
Onshore Development, Kuwait

Challenge

The Marrat carbonate reservoir comprises a variety of sub-layers. The carbonate displays very little variation in response to resistivity and gamma ray tools, rendering the various sub-layers difficult to identify during drilling horizontal sections, especially when slim and or short radius wells are required.

Solution

GEOLOG proposed a real-time fluid characterization solution delivered through the analysis and interpretation of mud gas, integrated with LWD and conventional surface logging techniques.

Results

The Gas-While-Drilling (GWD) methodology utilized in the interpretation provided clear identification of the sub-layers that was not available from the LWD. The real-time gas analysis was integrated with the LWD data and used to geosteer the well through the optimum target zone and identify the zones with optimum hydrocarbon content. The analysis identified the fluid phase as being a light oil. The completion strategy was modified to include only the zones displaying the favourable hydrocarbon content.

Value

The advanced gas analysis provided a cost-effective method to identify the formation sub-layers and fluid phases present. Through the timely delivery of the information the completion strategy was able to be changed to allow optimal production with zero water cut.

Services used



G8 Advance gas analysis (C1-C8)

The Marrat formation comprises a series of sublayers which have demonstrated variations in productivity. Conventional downhole tools used while drilling, such as LWD gamma ray and resistivity do not display sufficient character to identify the sub-layers effectively, and hence make geosteering a far more costly and complex operation requiring a greater range of downhole tools.

The application of advanced gas analysis in conjunction with the conventional LWD tools successfully identified sub-layers of the Marrat carbonate reservoir during the drilling of a horizontal well. The methodology involved real-time quality control and gas interpretation from both conventional and advanced gas ratio analysis. The advanced gas analysis when combined with conventional surface logging techniques was successfully used to identify formation tops, lithological changes and the reservoir zones within the target formation sub-layers.

The results are typically displayed as a slice or curtain along the well path, with predicted pre-drill formation tops and log properties as a backdrop upon which new information is displayed as it is received during the drilling operation. If sufficient changes in log character are identified to determine that the well is approaching a given formation or hydrocarbon zone, this can be used to geosteer the well so as to maintain the trajectory within the target reservoir zone.

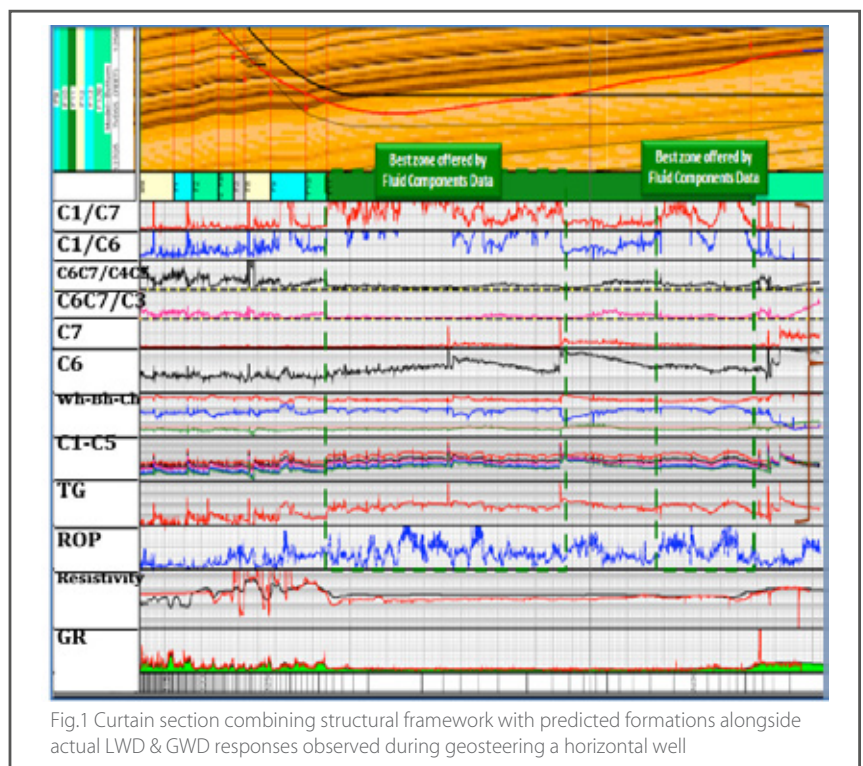


Fig.1 Curtain section combining structural framework with predicted formations alongside actual LWD & GWD responses observed during geosteering a horizontal well

Technical Paper References



Innovative In-house Geosteering Utilizes Gas-While-Drilling Data for Deep Jurassic High Angle Well Placement. SPE-163368-MS