Optimizing Well Placement in Heterogenous Carbonate Reservoir Utilizing a New Generation of High Definition Mapping Tool

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Abstract

Objectives/Scope
Field development plans and oil recovery can be significantly enhanced by the full understanding of the geological structure, petrophysical properties and reservoir behavior. Detailed subsurface understanding can depict strategies for reservoir and field development. Building a detailed picture of the reservoir requires a combination of measurements and data acquisition processes usually starting with seismic data to build a geological model which is refined during drilling operations with a combination of logging while drilling (LWD) and reservoir mapping sensors.

Methods, Procedures, Process
Conventional LWD sensors usually measure formation properties around the well trajectory, Deep azimuthal electromagnetic (EM) tools are often used to map boundaries further away from the wellbore to improve well placement. The resistivity of the surrounding formation and resistivity contrast with the adjacent layers are two critical factors that influence the depth of detection and ability to map multiple layers. As the resistivity contrast decreases, it becomes more difficult to identify boundaries at a distance. A Deep Azimuthal EM tool with enhanced sensitivity to resistivity variations was deployed along with a mapping inversion algorithm in the case study. In addition to utilizing density and neutron tools, to provide a detailed picture of the reservoir and refine the geological interpretation near well-bore.

Results, Observations, Conclusions
A case study from the North of Oman where a carbonate reservoir with anticipated thickness variation and variable reservoir quality, overlain by shale identified from offset data was selected for the deployment of a high- definition multi-layer inversion mapping tool. The varying thickness of the carbonate target and the small contrast in resistivity laterally towards the toe with the shale above imposed additional challenges for conventional deep resistivity tools due to their limited depth of detection and, were anticipated as being a challenge to the well placement operation, limiting the depth of investigation and the ability to detect the critical boundary and ensure there was no exit in areas of thinning.

The Realtime inversion output showed the Resistivity degradation across the lateral section ranging from 12 ohm-m to 2.5 ohm-m, the thickness of the reservoir showed substantial variation varying from 32ft at heel to 8ft at toe. The continuous detection of bed boundaries along

with lateral deterioration of resistivity provided a detailed view of the reservoir thickness and dip variation to optimize well placement decisions.

Novelty/Significance/Additive Information

A novel approach for utilizing a new generation of high-definition multi-layer inversion mapping tool, the successful mapping of the boundaries in low resistivity contrasts expands the environments in which the technology can be confidently deployed and ensure optimum well placement with increased reservoir understanding.