LWD Imaging Identifies Cause of Drilling Mud Losses in Heavily Fractured Reservoir

MicroScope HD service enables completion design optimization to isolate troublesome fracture zones, select perforation zones away from formation fractures.

Mitigate drilling mud loss in horizontal wells of Oman

Petroleum Development Oman (PDO) was drilling horizontal wells to develop a large gas field containing heterogeneous vuggy limestone affected by a fracture network distributed throughout the area. Drilling highly deviated wells in the heavily fractured and complex heterogeneous carbonate formations was a challenging process, and PDO had experienced severe drilling mud losses in previous wells because of the major fractures. The fracture network can act as an avenue for early water breakthrough, shortening the life of the well.

Use high-definition LWD imaging to identify troublesome fracture zones

Schlumberger provided MicroScope HD* high-definition imaging-while-drilling service to acquire resistivity images to characterize the fracture network. Based on these resistivity images, mitigation measures were taken to address mud loss as well as early water breakthrough.

After drilling, recorded data were processed to be used for geological interpretation. The interpretation included full structural feature identification and detailed fracture characterization to identify types of fractures (conductive or resistive) as well as morphology and geometry of each fracture (continuous or discontinuous), the fracture density, and fracture distribution along the logged interval. Minor subseismic faults were also identified from the images.

Geological interpretation of the high-definition resistivity images revealed the presence of a few major conductive fractures that were likely enhanced during drilling, and a large number of partial discontinuous conductive and resistive fractures.
**CASE STUDY:** MicroScope HD service enables completion design optimization to isolate troublesome fracture zones

Optimize completion design to isolate fractures, position perforations

The real-time images from MicroScope HD service provided initial identification of faults and fractures, and the high-resolution recorded images successfully identified the fractured zones that contributed to drilling mud losses. Completion design was developed to isolate those fractured zones, as well as to select proper perforation zones away from the fractures. This enabled a proactive completion design helping to optimize well production.

The high-resolution images used in conjunction with other LWD logs enabled well placement decisions and real-time updates of the reservoir geological model. With vertical resolution of 0.4 in, MicroScope HD service enabled identification of subseismic faulting, conductive and resistive faults, fractures, and formation dips, as well as characterization of invasion profiles in horizontal wells and in reservoirs with anticipated structural heterogeneities.

Images from MicroScope HD service were used for sedimentology analysis, providing heterogeneity distribution, porosity distribution histogram, total porosity distribution, and heterogeneity type porosity.