A new extra-deep azimuthal resistivity measurement: Verification of responses

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ABSTRACT

Since 2004 extra-deep resistivity has been used successfully in Norway for reservoir navigation relative to distant bed boundaries. Due to more complex and heterogeneous reservoir structures, a new extra-deep azimuthal resistivity (EDAR) tool has been developed in order to improve reservoir understanding and geosteering decisions. During drilling, the inversion results of deep azimuthal resistivity measurements can image the reservoir architecture tens of meters away from the borehole, thereby bridging the gap between traditional logging-while-drilling (LWD) measurements and surface seismic data. The new tool allows to delineate multiple geologic layers with contrasting resistivities away from the borehole without probing the layers directly. The non-unique nature of inversions leads to questions about the reliability and accuracy of the inversion results.

In order to verify the inversion results and interpretation methodology, an airhang test was performed. During this test the tool was suspended at specified distances to a water surface and the corresponding responses were compared to theoretical values. The measured response from this high-resistivity-contrast scenario matched the expectations very well. In a next step, a field test at a drilling site was conducted to check the performance in a realistic downhole setting. The well was landed horizontally in the target zone using the new EDAR system. The verification step determined the ‘true’ top boundary, which was accomplished by sidetracking from the original well path and penetrating the target top at a point previously interpreted from the resistivity data. The verification tests will be discussed in detail, in addition to a general overview of the hardware and interpretation comprising the measurement.

Keywords: Geosteering, Reservoir Navigation, EDAR, Deep Resistivity, Inversion