# Overcoming Unconformities and Laterally Variable Lithology for Optimal Well Placement.

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## Abstract

Deep Azimuthal Electromagnetic (EM) tools mapping boundaries away from the well bore are commonly deployed to optimize well placement. Resistivity of the surrounding formation and contrast with the nearby layers are two major factors governing the imaging quality. Thin reservoirs truncated by unconformities with lateral resistivity changes are a great challenge, which can hide the nature of complex reservoirs especially in new development areas. This paper presents a Complex case study from Oman resolved by a new generation deep EM tool capable of visualization of the target zone, where sudden exits were avoided and lateral changes of resistivity were mapped despite low contrast intervals.

Pre-well modelling based on only one offset well indicated good contrast between both upper and lower boundaries. In addition, density image, and neutron tools were deployed to provide a detailed picture of the reservoir and refine the geological interpretation. Resistivity variation across the formation boundaries was approximately 1 to 8 Ohm M, the total thickness of the target zone based on offset data indicated 1.9m, however there was expectation of possible thinning interpreted from previous well exits in this formation. In the only nearby well, well placement was optimized based on conventional deep azimuthal EM resistivity without imaging capabilities, in this well sudden exits occur without any reasonable anticipation, this led to moving well azimuth far to the East side to increase reservoir exposure. The expectation was that the reservoir was thinning or truncated towards the West side.

In the planning stage of the target well, the asset team decided to locate a new well plan towards the West side of the previous well to eliminate any doubt regarding thinning or erosion of the reservoir and inspect a new tools capabilities. The resistivity imaging allowed boundaries to be clearly identified and mapped the true thickness of the target zone, allowing optimization of the well placement position in the best zone of reservoir. The detection of boundaries continued with good resistivity contrasts until the well trajectory approached the exit point from the previous well where resistivity imaging revealed the reason for the exit. The resistivity at that interval sharply deteriorated to ~1 Ohm, with a very low resistivity contrast, although this limited EM propagation boundaries were still resolved, and an exit avoided. The low resistivity continued over ~200m, then reservoir characteristics improved, and it was possible to drill beyond the planned TD with confidence.

The mapping results provide detailed information regarding the Complex reservoir and its continuity towards the west opening a new scope in such a challenging environment. The enhanced sensitivity of the new generation of EM tools proves to be capable of boundary tracking, enabling high confidence in well placement operations, allow accurate geosteering and improved reservoir understanding.