Combined Electrical and Acoustic Imaging for Fracture and Fault Characterization: Cases Studies from Cambro- Ordovician Tight Sands of Algeria

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Fractures play a major role in the hydrocarbon production of the tight sandstone reservoirs of Cambro-Ordovician age in Algeria. These unconventional reservoirs, with matrix permeabilities usually less than 10md and porosities between 3-10PU, do not produce commercially without the presence of fractures. As a consequence the main objective for drilling wells in these reservoirs is to maximize the number of open fractures intersected by the wellbore, whether these are natural fractures or fractures created with stimulation techniques. However, the fact that a fracture will flow or not depends on numerous factors, the main ones being the fracture aperture, its lateral and vertical extension, its orientation with respect to the maximum in-situ horizontal stress and connectivity with another other sets of fractures. Another challenge in these formations is the risk of water breakthrough from open faults or fractures reaching the underlying water table.

Acoustic borehole imaging has become part of the standard logging suite in these reservoirs drilled with oil based mud since the early 90's mostly because of their application to fracture characterization. Recent changes of drilling practices in the Hassi Messaoud field, from vertical wells to slim short radius horizontal wells often drilled under balance, have highlighted some of the difficulties of acquiring good quality data with the UBI imaging tool.

The combination of UBI acoustic images with electrical images from the OBMI* Oil-Base MicroImager addresses most of the inherent limitations of acoustic imaging and provides complementary geological information in these wells. Examples shown in this paper highlight the benefits of OBMIUBI image combination for the characterization of the fracture and fault network in these reservoirs:

- differentiation of open from closed fractures and determination of the direction of the in-situ horizontal stress with the UBI data
- improved detection of faults and their type (sealing vs non sealing), identification of fractures and structural dip in poor quality borehole sections and permeability indication from the OBMI data.

When combined with dynamic measurements and production data the fractures identified from the UBI and OBMI data provide critical input for the characterization of the best productive intervals and the zones of possible water entry in these challenging reservoirs.

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