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Sedimentological aspects toward precise formation evaluation and testing

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Sedimentary structures and orientation of reservoir rocks are of prime importance in defining the different origin and depositional sites of such rocks. It has been evidenced that the thickness, dip magnitude and orientation of such sedimentary structures can cause lateral permeability anisotropy and exert a great effect on the various types of open-hole logging tools. Such an effect can result in suppressing the resistivity values and generate unrealistic conventional formation evaluation results regarding fluid saturations within reservoir rocks.

The various kind of diagenesis that occur within depositional environments and during burial express a great effect on open-hole logs, especially resistivity tools. It has been found, for example, that bioturbation can suppress the resistivity measurements of sandstone reservoirs and generate unreliable results regarding hydrocarbon saturation within such reservoirs.

Testing fluvial sands, for instance, has to be carried out with care, especially with RFT tools. This is due to the fact that when fluvial channels migrate, they create lag deposits which may act as a vertical permeability barrier when cemented. Sedimentary features like slumps or over-turned bedding, load cast, and local scours that present within a certain direction of the borehole wall can upset our RFT measurement and result in unqualifying potential reservoir rocks.

Thin laminated sequences and turbidite sediments can act as a high potential reservoir. However, and due to the low resolution of standard open-hole logs, such reservoirs normally tend to be missed, or will come with a very pessimistic potential on formation evaluation modules. Testing such sedimentary sequences using RFT tools is extremely difficult since we are dealing with 30–50 cm thick layers.

In conclusion, it seems that higher resolution and oriented open-hole logs are extremely needed for better evaluating reservoir rocks in terms of hydrocarbon saturation. In addition, it is very important to integrate the geological data that is extracted from borehole electrical images to formation evaluation modules. This can be achieved by defining the various types of heterogeneities and correcting open-hole logs responses by taking dip magnitude and azimuth of sedimentary features in consideration.

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