
In-situ Water Salinity and Saturation Determination from Simultaneous Logs

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With secondary and tertiary recovery becoming increasingly common, the problem of assessing formation saturation becomes more complex as injected fluids mix with the original waters resulting in variations in the water salinity (and hence water resistivity, R_w) across a field. By deriving two independent water saturations from measurements with differing sensitivities to formation water salinity we demonstrate how the water salinity and saturation can be determined simultaneously.

The recent introduction of a Logging-While-Drilling (LWD) Thermal Capture Cross-Section (Sigma) measurement acquired very close to the resistivity measure point on the LWD tool has opened the possibility of comparing the open-hole pre-invasion Sigma-derived saturation with that from a traditional open-hole Archie-derived saturation. As both are acquired at close to the same depth at the same time, the saturations should match if the assigned water salinity (and hence water resistivity and water sigma value) is correct. As the Sigma and resistivity measurements differ in their response to changing water salinity, any discrepancy between the two saturations can be used to determine simultaneously both the in-situ water salinity and the actual formation water saturation by varying the water salinity until a water saturation match is achieved.

We review field examples showing the application of this technique to Middle East carbonate reservoirs.
