ADDING PROJECT VALUE THROUGH LOG-DERIVED VARIABLE WATER SATURATION EQUATION EXPONENTS' APPLICATION

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ABSTRACT:

From the formation evaluation perspective, hydrocarbon reserve optimization essentially focuses on the possibilities of improving fluid saturation computation procedures. In a clastic reservoir-setting, such an exercise intrinsically involves review of the relevance of all the parameters in the equations used for fluid saturation computation. These parameters are derived from either core or wireline log data.At the exploratory phase however, the parameters in question need to be derived from conventional logs given the lack and/or scanty availability of core data; moreover it is generally not possible to cut conventional cores through multi-stacked reservoirs.

In the founding equation for petrophysical interpretation formulated by Archie (1942), the aforementioned parameters includes the cementation exponent m, the saturation exponent n and the empirical constant a. Direct water saturation laboratory measurements from core by Retort or Dean-Stark method are carried out after drilling and recovering the core. The saturations in the core change in the process of coring and core recovery and hence corrections are required to convert ambient condition measurements to reservoir in-situ stress conditions which involve use of rock compaction and elastic property data. Conventional wireline resistivity logs, on the other hand, respond to water saturation and porosity under reservoir conditions and are usually calibrated with core data that are often not measured under the appropriate reservoir wettability and pressure conditions.

Given the above inherent uncertainties in the core-derived Archie parameters emanating from laboratory measurement techniques and possible data manipulation coupled with challenges in the interpretation of resistivity logs, the matching and reconciliation of core and log data becomes imperative in gauging the reliability of both data sets. This, on the other hand, optimizes hydrocarbon reserve estimates and hence adds project value.

In this exploratory endeavor, core-derived Archie parameters from wells in the Muglad basin, Sudan, has been matched with log-derived ones and their reasonable match was taken as the QC basis that justified use of variable log-derived parameters for each interval. Application of the derived parameters in deterministic petrophysical fluid saturation computation model led to significant increase in hydrocarbon saturation values relative to earlier computation using averaged uniform parameters for all zones.