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Using Nmr T2 to Predict the Drainage Capillary Curves (Pc- Sw) in Carbonates Reservoirs

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Summary

This research work predicts capillary pressure curves at primary drainage from the transverse T2 relaxation times of the NMR pore size distributions with ninety percent accuracy which could do the trick in reservoir applications. The capillary pressure-water saturation curves are important instructions to reservoir simulators for predicting the dynamic properties of the reservoir as well the fluid saturations at different depths. This study was originated from the challenges in forecasting the initial saturations from an NMR logged well. The procedure is a simple and non-damaging construction of capillary pressure curves from plug samples measurements.

Abstract

This research work predicts capillary pressure curves at primary drainage from the transverse T2 relaxation times of the NMR pore size distributions with ninety percent accuracy which could do the trick in reservoir applications. The capillary pressure-water saturation curves are important instructions to reservoir simulators for predicting the dynamic properties of the reservoir as well the fluid saturations at different depths. This study was originated from the challenges in forecasting the initial saturations from an NMR logged well. The procedure is a simple and non-damaging construction of capillary pressure curves from plug samples measurements.

Dynamic rock typing was used to assign the capillary pressure data to different layers in the reservoir. Laboratory Nuclear Magnetic Resonance (NMR) equipment has been proven to produce information on pore size distribution and varieties of methods was found in the literature to predict capillary pressure curves from borehole NMR logs. The proposed idea of integrating drainage capillary pressure from centrifuge to T2 distributions from NMR enables rapid synthesis of capillary pressure from plugs and interpretation of logs.

A scaling factor k, is adopted in the T2-Pc conversion. The optimum scaling factors for most research work is built upon the results. Water saturation at certain pressures, is often estimated from capillary pressure curves. It can therefore be argued that the perfect procedure of estimating the best scale factors is to recreate the saturations by the capillary pressure curves developed from NMR. In this research work, the range of pressures and T2 relaxation time was 0 -500 psi and 1 – 10000 ms respectively. Due to different geological facies usually described by the capillary pressure curves of different formations, the capillary pressure curves of the whole cored reservoir were reconstructed to get the average scaling constant, k of 4 psi.s with a low standard deviation of 0.02. The capillary pressure versus T2 curve tend to fit a power regression with a coefficient of determination of $R2 = 1$, signifying that the regression line analysis fits perfectly with the data for the 58 core samples.

With the T2-Pc conversion established, the capillary pressure data can be predicted continuously in the whole section of the reservoir. The procedure is more accurate compared to others since it takes cognizance of the pore structure from NMR distribution, and it is applicable to T2 distributions estimated at various water saturations. Previous methods are applicable to 100% brine saturated plugs which nullifies their predicted capillary pressure curves.