A New Model to Identify the Pore Types for Oil Based Mud Profile in Complex Carbonate Reservoirs: Jurassic Formation, Bellota Field, Mexico

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Abstract

The cementation factor, m, in the Archie Equation to calculate water saturation, Sw, is variable, not constant in fracture/vugs/matrix carbonate systems. If we use m equal to 2 for vuggy or fracture porosities, the water saturation values are typically either too low or too high, leading to incorrect engineering decisions. That is why one of the first difficult tasks in development a confident petrophysical in this complex reservoirs is to identify the pore types in order to use the appropriate cementation factor, mvariable,

In the past, many wells were drilled using a Water Base Mud (WBM) and petrophyscists and geoscientists, based on that profile of invasion, developed methodologies using cross plots from conventional well logs to identify the pore types1. One of the crossplots used is the Archie water saturation, Swa, vs. ratio resistivity water saturation, Swr. In this method, Swa is calculated assuming that the reservoir is water wet, with intergranular or intercrystalline porosity and the cementation factor, m, equals 2. To calculate Swr in this case, we require mud filtrate resistivity, Rmf; water resistivity, Rw; resistivity of formation in the invation zone, Rxo; and true resistivity, Rt

Today, many wells have been drilling using an Oil Based Mud (OBM) to reduce the formation damage but the models developed in the pore type identification for profile of invasion with WBM does not apply for OBM. We have developed new models to extend the methodology to identify the pore types for Oil Based Mud (OBM) filtrate invasion. In this case, for example, to calculate Swr depends on Rxo, Rt, and Swir. Also, we have improved the cross-plotting technique for identifying the multipore system present in complex carbonate reservoirs by using fuzzy logic that significantly reduces uncertainty in pore-type identification and characterization. Our models predict with high certainty the pore types and they were validated with image logs and the production results in each well agree with water saturation calculated from these models. We have successfully applied our methodology to identify the complex pore types for a complex carbonate reservoir in the Jurassic formation in Mexico.