Gas Identification in Thin Beds Using LWD Measurements – West Africa Offshore Example

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ABSTRACT

Gas identification and determination of Gas-Oil Contact (GOC) in reservoirs containing gas and oil can be a major challenge in laminated sand-shale sequences, where the presence of shales drastically affects the response of gamma ray, resistivity, density and neutron logs. Due to the resolution of these measurements, it becomes increasingly difficult to identify and quantify the gas reservoirs. In a West Africa Offshore well in a Cretaceous formation, using a Pentacombo Bore Hole Assembly (BHA) with basic Formation Evaluation (FE) measurments, the use of additional services such as Nuclear Magnetic Resonance (NMR) and Formation Pressure Tester Logging While Drilling (LWD) services, significantly improved the confidence in interpretation of the reservoir fluids. In the example well, though the size of the density-neutron crossover showed a reduction in the oil zone as compared to the gas zone to a certain degree, the actual position of the Gas/Oil contact and the reservoir fluid saturation were not certain. Using the traditional NMR porosity undercall in gas zones as well as the dual wait time (DTW) tranverse relaxation time (T2) distribution analysis, the gas zone was confirmed and the saturation of each of the fluids in the reservoir was accurately determined. The NMR tool was programmed to acquire data in dual wait time (DTW) mode. The Magnetic Resonance Dual Wait Time (DTW) approach takes advantage of Longitudinal Relaxation Time (T₁) contrast to solve for hydrocarbon saturation. “In light hydrocarbons, in a water-wetting reservoir, the hydrogen atoms in the hydrocarbon fluid relax slower than the nonmovable and movable water. By using two polarization or wait times (T_w), it is possible to calculate hydrocarbon saturation using magnetic resonance tools” (Thorsen et al., 2008, January 1). Due to the low hydrogen index of gas, the short wait time will only polarize a fraction of the porosity in the gas zone while achieving a near full polarization in the liquid (oil or water) zone. The same hydrogen index effect was evident in the total porosity computation from NMR measurement. Significantly lower porosity was observed in the gas zone as compared to the oil zone. This was the first indication of Gas Oil contact (GOC). Further analysis of the dual wait time T2 distribution gave a proper estimate of the saturation of the fluids in the reservoir.