Abstract

One of the most important objectives of fluid sampling using wireline formation testers (WFT) is to ensure that representative samples of the different fluids encountered in the formation are obtained. Usually the wireline or LWD petrophysical logs will guide the sample acquisition program. This typically means that resistivity and nuclear logs are used to infer basic fluid types, caliper log is used to verify that the borehole is suitable for sampling, and NMR logs are used to gauge if permeability is sufficient for a sample to be taken. However these logs are not able to capture variations in the hydrocarbon column to allow the operator to ensure that all representative fluids are sampled. The most important information, a continuous fluids type and property log, is still not widely used in the industry.

Modern NMR logging tools can deliver – in addition to conventional porosity and permeability information – a continuous fluid log of oil, gas, water and OBM filtrate (OBMF) at multiple depths of investigation. The radial fluid profiling allows discrimination of OBMF versus native oil. Additionally, within the hydrocarbon column the NMR measurements can be used to provide continuous logs of oil viscosity and gas-oil ratio (GOR). With this information acquired before the sampling operation, it is easier to ensure that a full suite of representative samples are acquired and that we do not indulge in needless over sampling. When NMR data is acquired after the sampling operation, the continuous logs of viscosity and GOR can be calibrated with WFT data to provide fluid information in places where WFT did not sample.
Figure 1. Signatures of oil and OBM filtrate in Diffusion-Relaxation maps for 1) an oil that is more viscous than OBMF – the oil has shorter T2 and lower D than OBMF (left), 2) an oil that is as viscous as OBMF – both have the same T2 and D (center), and 3) an oil that is less viscous than OBMF – the oil has longer T2 and higher D than OBMF (right).
Figure 2. Comparison of MDT and NMR derived viscosity measurements.
Figure 3. Fluid identification with MDT gradients and NMR fluid typing.
Figure 4. Comparison of MDT and NMR viscosities in very heavy oil.
Selected References


