
Early Detection of Biodegraded Oil Using NMR Downhole Logs and Hydrocarbon GC-MS Analysis on Sidewall Cores

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Detection of biodegraded oil at an early stage in exploration wells is quite important due to their poor characteristics with respect to good quality, less viscous oils. Traditional logs, such as resistivity, porosity and gamma ray logs, show the position of the reservoir and its hydrocarbon content but are unable to provide information regarding the hydrocarbon quality, it being sometimes difficult even to differentiate between liquid and gas accumulations. During an acquisition of wireline logs in an offshore exploration well, an NMR log was run, aimed at integrating the traditional set of logs to better define porosity, permeability and Swi. Because of the lithological complexity of the reservoir, sidewall cores were cut and petrophysical values such as porosity and permeability were measured. The presence of high viscosity biodegraded oil accumulations was suspected early on due to the "peculiar" signature of the NMR log in the hydrocarbon bearing rocks. Very low mean T2 values, which using the traditional partitioning of the NMR T2 distribution indicate high volumes of clay- and capillary-bound fluids, were measured in oil-bearing layers within the reservoir. A detailed molecular study was performed on the residual oil extracted from the sidewall cores and showed different levels of biodegradation in various sections of the reservoir depending on both depth and proximity to the OWC. The good relationship between the mean T2 value from the NMR log and the biodegradation level found through GC-MS analysis gave us confidence in NMR logs for early detection of these kinds of oils in reservoirs where cores are not available.
