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Slimhole Nuclear Magnetic Resonance Logging While Drilling - A New Service for the Oil Industry

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A 6.75 inch tool size was previously thought to be the smallest size in which a Nuclear Magnetic Resonance (NMR) measurement could be made in Logging While Drilling (LWD) applications. Requests from the industry, especially in more complex and deeper environments, presented a need for NMR technology in a 4.75 inch tool size. To meet that need we have made changes in both the electronics and the mechanical design. Recent measurements show that the data quality from the smaller tool is comparable to that from the well established 6.75 in tool. The capability to cover a wide hole size range with NMR is an important step to establish this technology as a standard formation evaluation measurement.

The sensitive volume is a 0.7 liter toroid encircling the centralized 4.75 in tool having a nominal diameter of 9.5 inch. The vertical resolution is similar for both tool sizes and depending, amongst other things, on the rate of penetration and running average. The tool concept consequently avoids motion artifacts and enables the tool to measure T2 echo trains. This is especially important in while-drilling applications, where the drill string dynamics often causes tool motion relative to the formation. A low magnetic field gradient of 2.5 Gauss/cm, a short inter-echo time of 0.6 ms, and optimized drillstring stabilization are paramount for this concept.

Mud pulse telemetry has been considered to be a bottleneck for LWD NMR data for a long time. An additional feature introduced with the new slimhole NMR LWD is the transmission of whole echo-trains in compressed data format. The possibility of sending compressed NMR data uphole via mud pulse telemetry can provide complete petrophysical information in real-time. This supports quick decisions while drilling, and is important in reducing drilling costs.

Reliable answers for a variety of client objectives like tar detection, viscosity estimation, and porosity measurements have already been successfully provided. In case histories we show how slimhole NMR data can be used to add important petrophysical information if combined with conventional triple combo data. Detection of heavy hydrocarbon becomes feasible as well as straight forward light hydrocarbon saturation determination. In cases where the application of nuclear tools is not possible or desired slimhole NMR-LWD provides a reliable and accurate porosity measurement.