MATURE FIELDS

CASE STUDY

Operator Validates Real-Time Magnetic Resonance Porosities in Carbonate Reservoir

4¾-IN. MRIL®-WD™ LOGGING-WHILE-DRILLING SENSOR DELIVERS T_1 DATA TO ENHANCE RESERVOIR UNDERSTANDING OF A MATURE FIELD

MIDDLE EAST

CHALLENGES

- Confirm mechanical integrity of NMR tool in challenging lateral well
- Compare NMR porosities with conventional porosity analysis
- Evaluate consistency between while-drilling and relog data sets

SOLUTION

Sperry Drilling collaborated and engineered a drilling solution, including:

- 4¾-in. MRIL®-WD™ magnetic resonance imaging logging-while-drilling (LWD) sensor to provide partial porosities for petrophysical analysis
- Density and neutron measurements from the following Sperry Drilling tools, configured within a Geo-Pilot® 5200 RSS bottom hole assembly:
  - ALD™ azimuthal lithodensity sensor
  - CTN™ compensated thermal neutron sensor
  - ADR™ azimuthal deep resistivity sensor

RESULTS

- No mechanical damage to tool despite significant vibration
- Excellent correlation between MRIL-WD porosity and conventional porosity analysis
- Consistency of parameters between while-drilling and relog sections validated no detrimental impact on data quality resulting from vibration

OVERVIEW

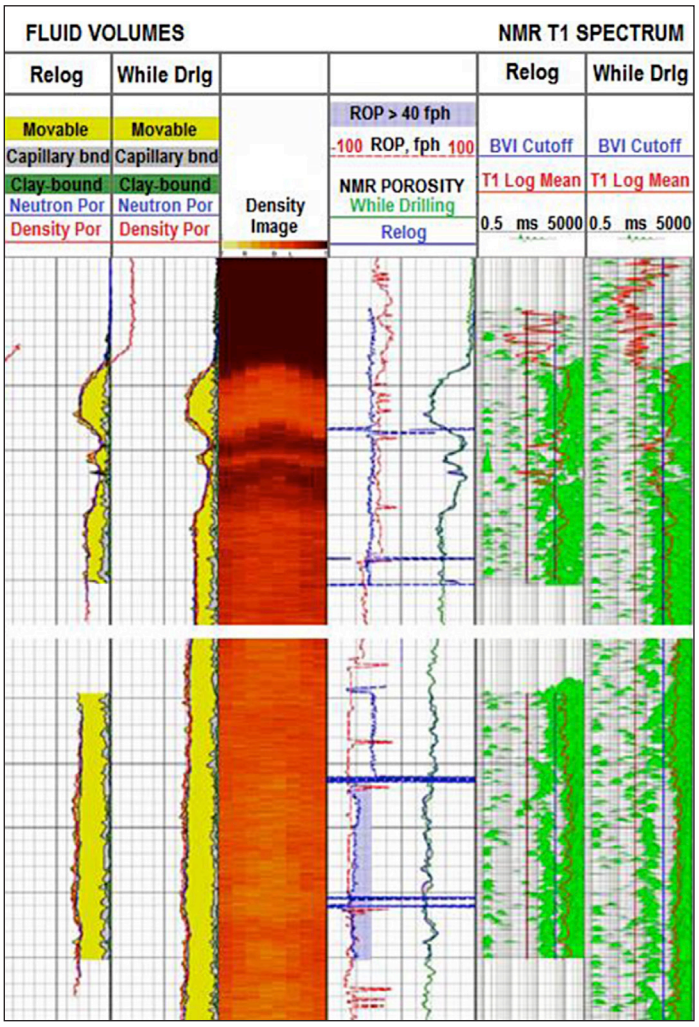
An operator in the Middle East wanted to perform an assessment of the mechanical integrity of the 4¾-in. MRIL®-WD™ magnetic resonance logging-while-drilling (LWD) tool while drilling a long lateral section with a 6⅛-in. hole diameter. The carbonate reservoir section featured a carbonate pore system comprised of mesopores and macropores. The well presented a good opportunity to compare the MRIL-WD log-based porosity with LWD density and neutron tool responses, as well as enabling evaluation of the consistency between data sets acquired while drilling and a non-rotating 'wipe' mode run. The Sperry Drilling team collaborated with the operator to carry out this comparative analysis of new technology tools versus conventional methods for evaluating rock porosity and related drilling conditions.

LWD T_1 DATA ENHANCES RESERVOIR UNDERSTANDING

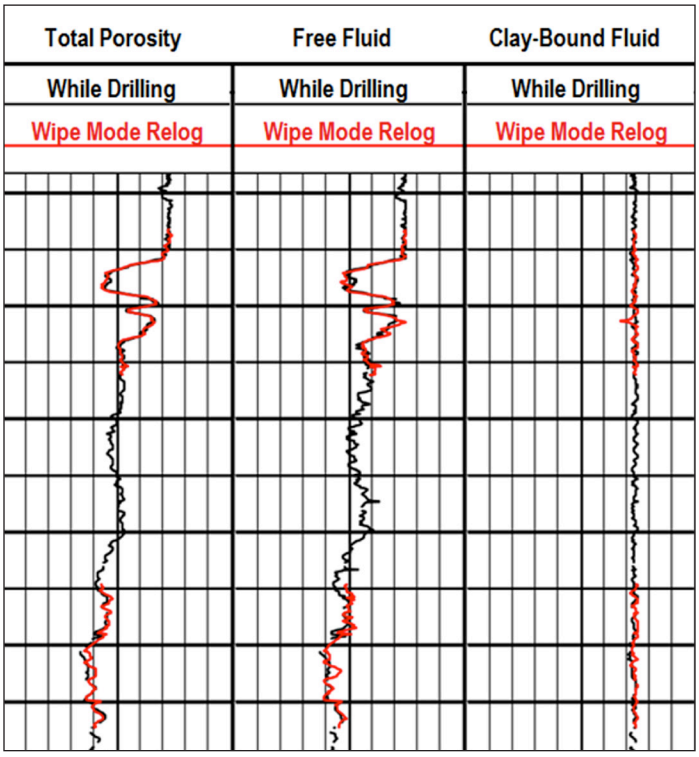
In order to verify that the MRIL-WD data could be used as an alternative or an addition to the conventional LWD porosity analysis, density and neutron measurements from the Sperry Drilling ALD™ and CTN™ tools, along with deep-reading resistivity measurements from the ADR™ tool, were included within a Geo-Pilot® 5200 rotary steerable system (RSS) bottom hole assembly (BHA). Comparison of both while-drilling and relog wipe pass data sets showed excellent agreement between the nuclear magnetic resonance (NMR) porosity and the conventional porosity analysis, verifying that the MRIL-WD service can be used to enhance petrophysical evaluation and fluid identification in multiple applications.

A potential challenge to NMR LWD data quality is the impact of the lateral tool movement associated with vibration, such as torsional resonance and inconsistent rotation resulting from stick-slip. The use of the T_1 acquisition method while drilling addresses this challenge since data quality is not impacted by lateral drilling motion. This feature was validated by comparing a drilling pass during which the BHA encountered significant levels of high vibration and a low-vibration relog wipe pass. The back-to-back comparison of while-drilling and relog passes across sections of varying porosities showed excellent consistency between the fundamental petrophysical parameters, confirming that the real-time data could be used with confidence to enhance reservoir understanding.

Despite the BHA being exposed to high levels of vibration while drilling, there was no observed mechanical damage to the MRIL-WD tool, addressing the operator's objective of verifying the tool's mechanical integrity within long lateral sections, and validating the use of T_1 NMR data for real-time petrophysical evaluation.



Comparison of while-drilling and relog wipe pass MRIL-WD T_1 data sets, including T_1 spectra with ALD and CTN porosity measurements. Excellent agreement was observed between the NMR porosities and the conventional porosity analysis.



Comparison of while-drilling and relog wipe pass partial porosities showing excellent agreement, confirming that the T_1 measurement data quality is not impacted by high levels of lateral tool motion.

This case study includes data from technical paper SPWLA-2018-LL, prepared for presentation at the SPWLA 59th Annual Logging Symposium held in London, United Kingdom, June 2018.

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