

Effectively measuring propped fracture geometry in challenging unconventional wells

CARBONRT helps detect fracture height in challenging well conditions and restrictive HSE environment.

Kingdom of Saudi Arabia

The challenge

In its push to increase gas production, Saudi Arabia embarked on an ambitious and multi-faceted exploration and appraisal program, using hydraulic fracturing to target non-associated reserves in tight gas and shale reservoirs. Determining adequate geometry and conductivity of the propped fractures is paramount in the extremely low permeability reservoirs so that flow tests can be conducted in order to assess reservoir characteristics, quantify reserves and determine the economic viability of a potential development program. The wells were completed with dual casing strings across the zone of interest and high natural gamma ray radiation levels were expected in the shale wells, both of which could restrict accurate detection of tracer technologies.

The solution

To avoid the host of environmental and safety issues associated with radioactive tracers, the operator selected the proppant-delivered CARBONRT[®] inert tracer technology. Chosen after an extensive multi-team assessment, the new-generation tracer comprises a high thermal neutron capture compound (HTNCC) at low concentrations, which is incorporated in all of the proppant grains during the manufacturing process. The low concentration not only eliminates the HSE limitations of radioactive tracers, but has no detrimental effects on any proppant physical property, including strength and fracture conductivity. To determine the viability of the neutron absorbing approach to fracture detection for these challenging conditions, a field trial was performed on three wells. Standard Compensated Neutron Log (CNL) and Pulsed Neutron Capture (PNC) tools were employed in the trial to compare the response of the two device types.

Well Data

Location: Onshore, northern Saudi Arabia

Operator: Middle East Operator

Well type: Shale and tight gas; dual casing string designs

Reservoir: Clastic sandstone and shale

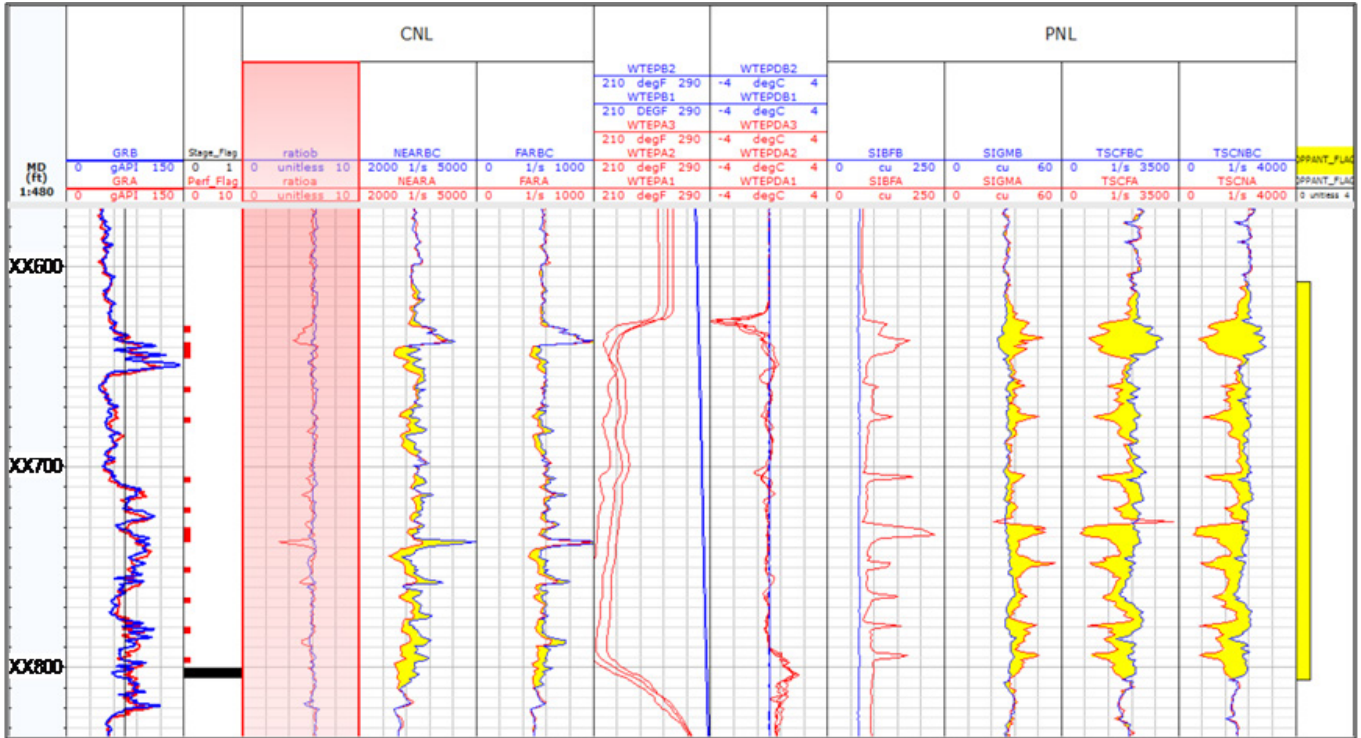
Detection tools: Compensated neutron logs (CNL); pulsed neutron capture (PNC)

Proppant: CARBOPROP 30/50 with CARBONRT



The results

Despite the twin-string well design and the high natural gamma ray radiation encountered, the evaluation was successful as CARBONRT was consistently detected with closely correlated fracture height interpretations from both the PNC and CNL tools. Most notably, the trial provided valuable insight for future fracture designs as one of the trial wells represented the first time in the industry that both PNC and CNL results were compared in the same wellbore. Since the PNC tool exhibited higher sensitivity to the proppant, and is safer and easier to operate than CNL, it was recommended that it be used exclusively in the future jobs employing CARBONRT.



Fracture height evaluation in a hot shale well, using “processed” logs. From SPE-168094, “Hydraulic Fracture Geometry Evaluation Using Proppant Detection: Experiences in Saudi Arabia”. Tracks 4-6 show the height interpretation using CNL and track 10 shows the interpretation with the PNC tool. Both are in good agreement.

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