AFES 2016 Seminar on Cased Hole Logging

RAPTOR TOOL
Case Studies from a Next Generation Pulsed Neutron Tool

Wireline interpretation & processing services

20th April 2016

Roberto Rinaldi
Geoscientist
RAPTOR TOOL

- Largest detector array
- LaBr3 detectors
- High speed electronics
- Fast neutron detector
RAPTOR TOOL

- Single-well, high-fidelity response characterization for CO, N-Vision, and Sigma

- **Each well** is characterized for:
  - Hole size
  - Casing size, weight
  - Sand, Lime, Dolomite
  - Borehole fluid density/salinity
  - Formation oil density
  - Tubing strings
  - Tubing/annulus fluids
RAPTOR TOOL

- Calibrates the **tool sensitivity**
- Calibrates the **tool** to the **characterization**
  - CO
  - NVision
Applications

- CO – Oil Saturation
- SIGMA – Water Saturation
- Nvision – Gas Saturation
- Lithology Identification
- Water Flow
- Borehole holdup
- Gravel Pack evaluation
Gas “Saturation” techniques

- Density-Neutron Crossover (OH)
- Sigma (CH)
- Carbon-Oxygen (CH)
- Pulsed Neutron Curve Overlays (CH)
RAPTOR TOOL: Example 1

Are the zones with low Sigma, low CPOR and Low Burst ratio
- Gas zones or
- Very low porosity?
This problem solved by Scheibal (SHELL) et al in 1992 and published in “Formation Evaluation” 1996 SPE 24737

A simple burst ratio Vs near burst count overlay
RAPTOR TOOL: Example 1

2 detector tool response

Gas

Tight
RAPTOR TOOL: Example 1

4 detector tool response

Gas

Oil

Tight
RACTOR TOOL: Example 2

Raptor was used onshore and offshore Adriatic on several wells with the following objectives:

- **Identify the gas-water contact in the formation**
- **Construct the gas saturation profile over the logged intervals**

*Field Trials of a New Array Pulsed Neutron Formation Evaluation Gas measurement in Complex Completions*
11th Offshore Mediterranean Conference and Exhibition in Ravenna, Italy, March 2013
RAPTOR TOOL: Example 2

**RAPTOR TOOL**

**VIRGIN LEVEL**

**PRODUCED LEVEL**

**Open Hole**

<table>
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<tr>
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<tr>
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<td>OH Gas Volume</td>
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<td>OH SW Volume</td>
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**Pore Volume**

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<td>OH SW Volume</td>
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RAPTOR TOOL: Example 2

APPARENT PORE DENSITY CHANGE

GAS FLASHING EFFECT

RAPTOR GAS SATURATION COHERENT TO PNC
Quantifying Gas Saturation with Pulsed Neutron Logging – An Innovative Approach

Mamdouh N. Al-Nasser, S. Mark Ma, SPE, Nedhal M. Al-Mushrafi, SPE and Ahmed S. Al-Muthana, SPE; Saudi Aramco; Steve Riley, Abel I. Geevarghese, SPE; Weatherford International. SPE 166025

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<th>Mineral</th>
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Surveillance of Complex Displacement Mechanisms in Mature Reservoirs to Maximize Recovery

Adrian Zett, Mike Webster, Hilary Rose – BP
Steve Riley, Darryl Trcka, Nilesh Kadam – Weatherford. SPE 159185
References

Differentiation of Hydrocarbon Type in Gulf of Mexico Clastic Reservoirs by Inelastic Pulsed Neutron Capture Data
Schebal, J.R.; Welland J.L., (Shell Offshore Inc.); Worrell, J.M. (Atlas Wireline Services); Bayer J.E., Shell Offshore Inc.
SPE Formation Evaluation, June 1996

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