



AFES 2016 Seminar on Cased Hole Logging

RAPTOR TOOL

*Case Studies from a Next Generation
Pulsed Neutron Tool*



Wireline
interpretation &
processing services

RAPTOR TOOL



- ✓ Largest detector array
- ✓ LaBr3 detectors
- ✓ High speed electronics
- ✓ Fast neutron detector

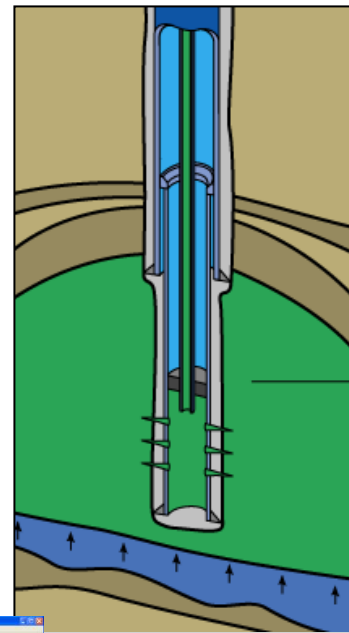
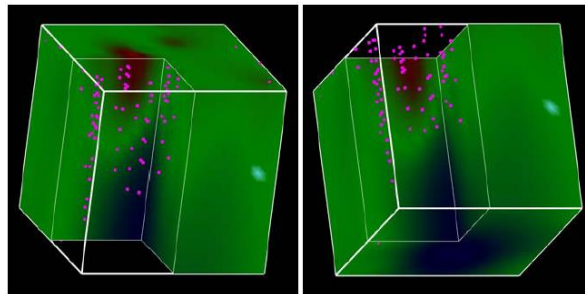
RAPTOR TOOL



- Single-well, high-fidelity response characterization for CO₂, N-Vision, and Sigma

- Each well is characterized for:

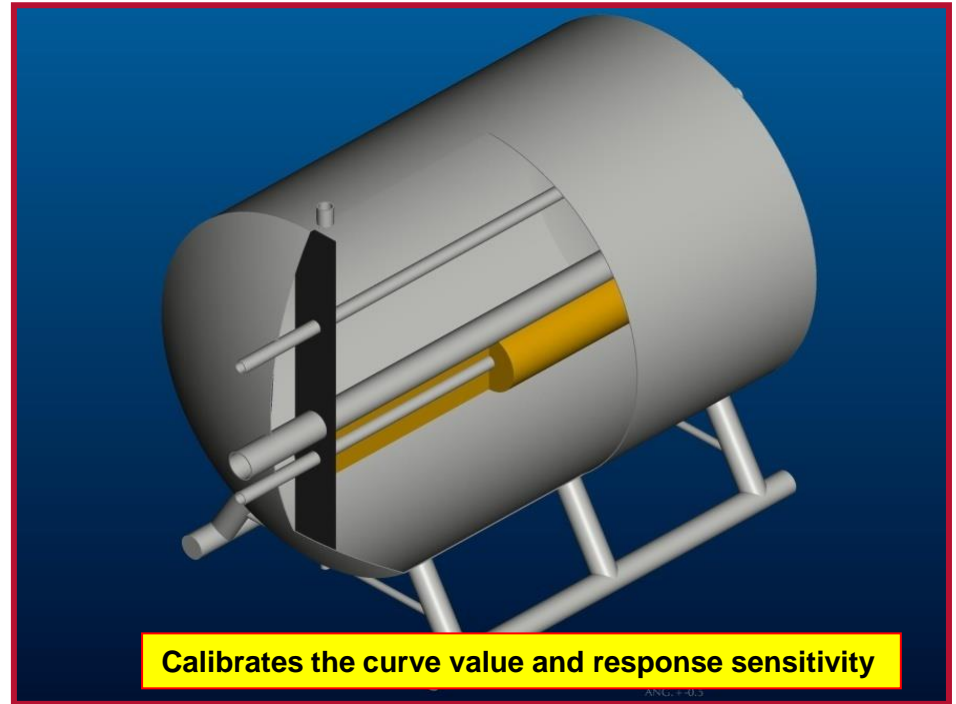
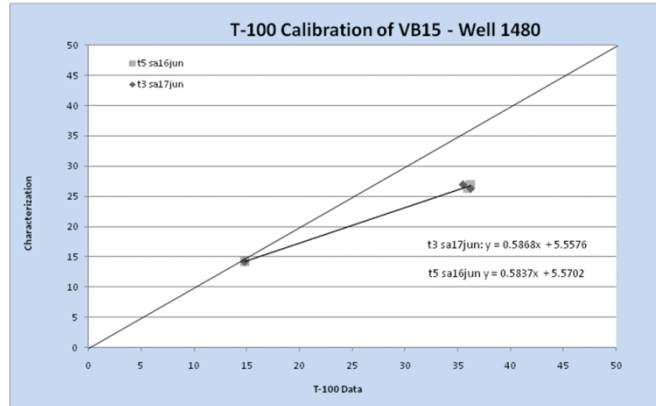
- Hole size
- Casing size, weight
- Sand, Lime, Dolomite
- Borehole fluid density/salinity
- Formation oil density
- Tubing strings
- Tubing/annulus fluids

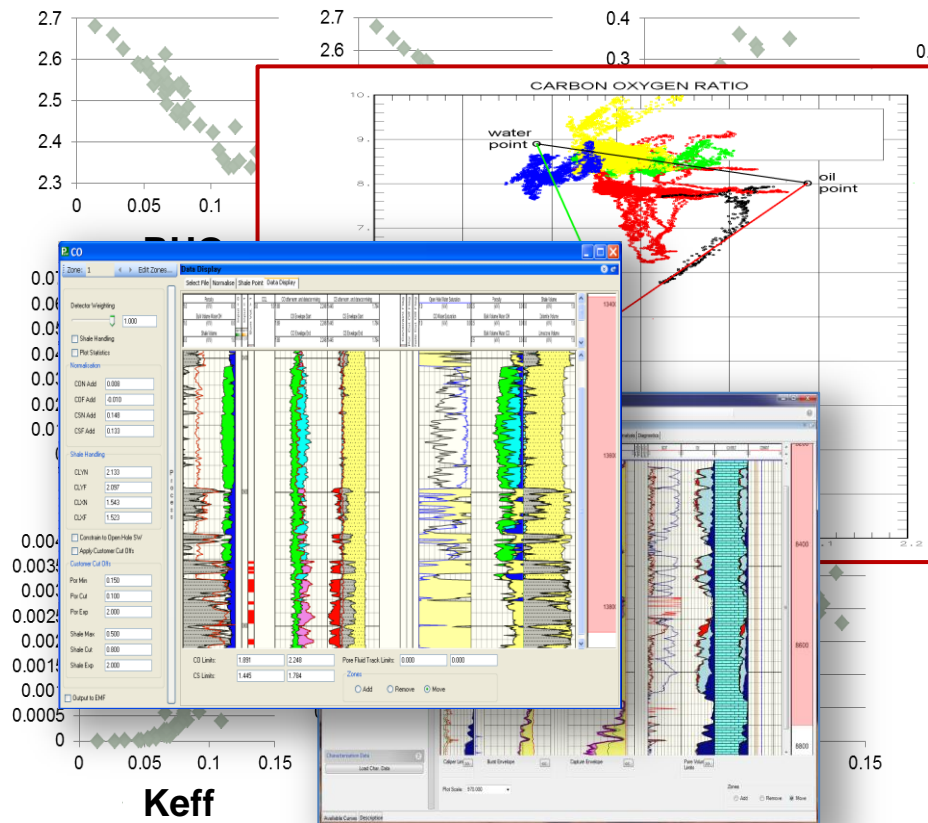


RAPTOR TOOL



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




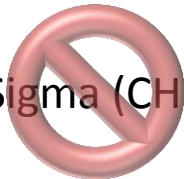




Applications

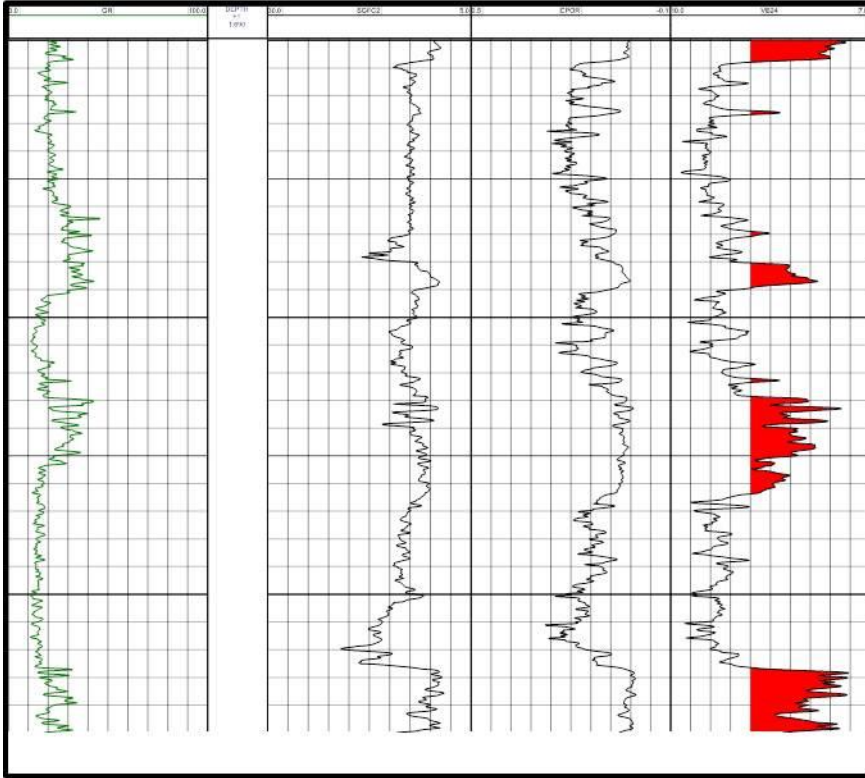
- CO – Oil Saturation
- SIGMA – Water Saturation
- Nvision – Gas Saturation
- Lithology Identification
- Water Flow
- Borehole holdup
- Gravel Pack evaluation



Gas “Saturation” techniques

- Density-Neutron Crossover (OH) 
- Sigma (CH) 
- Carbon-Oxygen (CH) 
- Pulsed Neutron Curve Overlays (CH) 

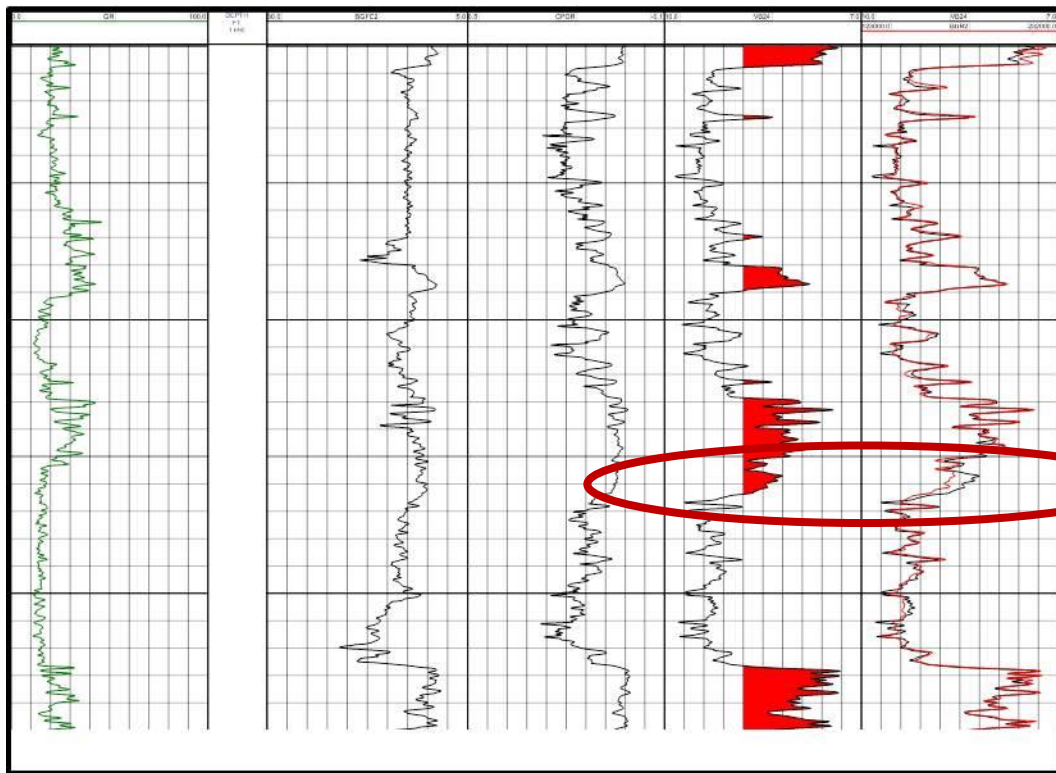
RAPTOR TOOL: *Example 1*



Are the zones with low Sigma, low CPOR and Low Burst ratio

- Gas zones or
- Very low porosity?

RAPTOR TOOL: *Example 1*



Tight

Tight

Tight

Gas

Tight

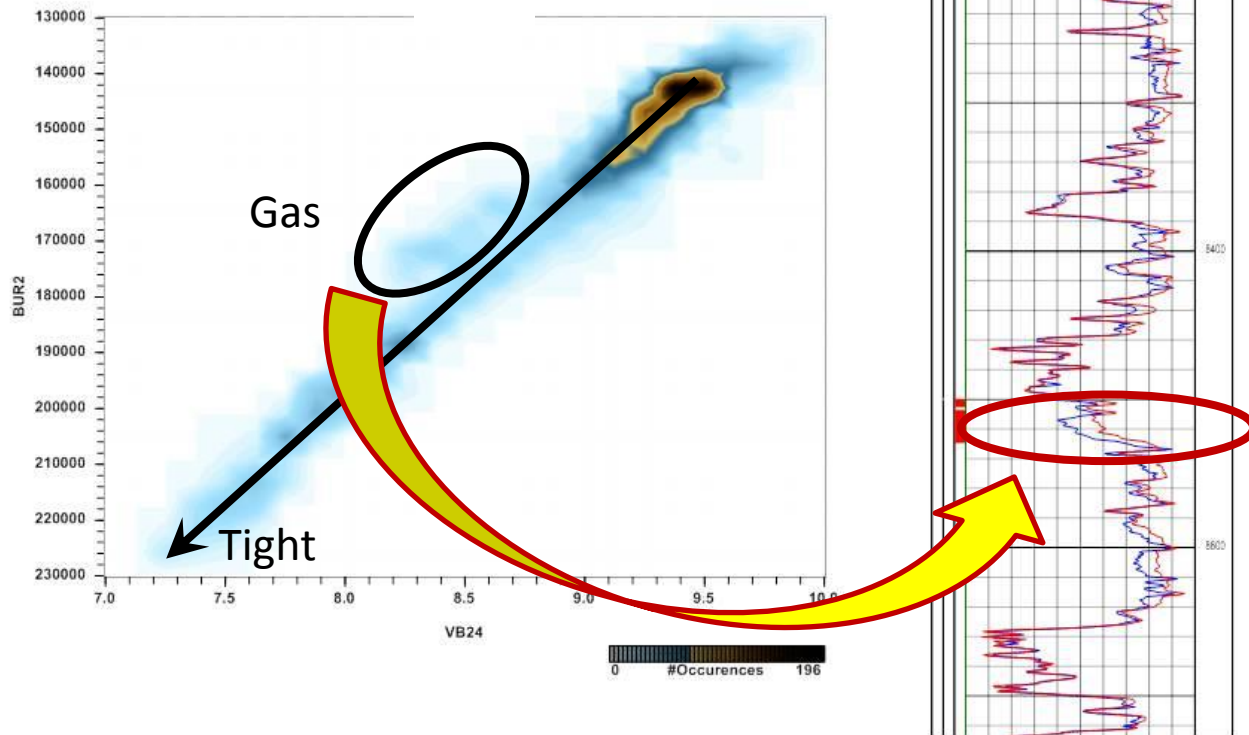
**This problem solved by Scheibal
(SHELL) et al in 1992 and
published in "Formation
Evaluation" 1996
SPE 24737**

**A simple burst ratio Vs near
burst count overlay**

RAPTOR TOOL: *Example 1*



VB24 vs BUR2 vs BUR2
tight.logdata: 8200.0000 FT to 8728.0000 FT
2 detector tool response

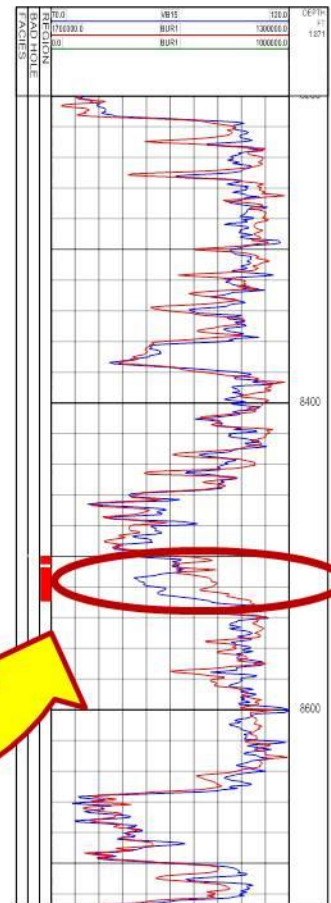
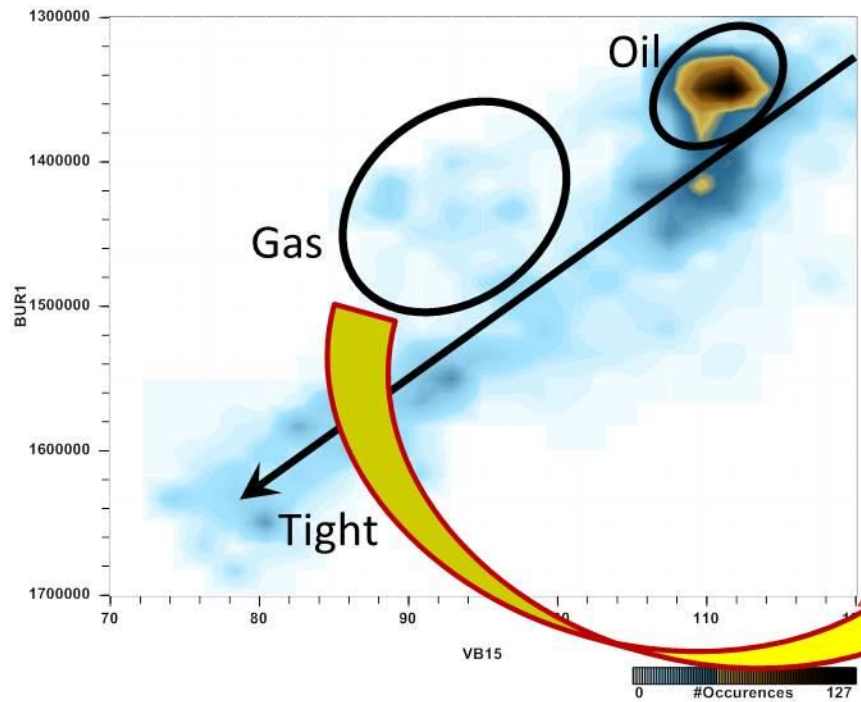


RAPTOR TOOL: *Example 1*



VB15 vs BUR1
tight.logdata: 8200.0000 FT to 8728.0000 FT

4 detector tool response



RAPTOR TOOL: *Example 2*



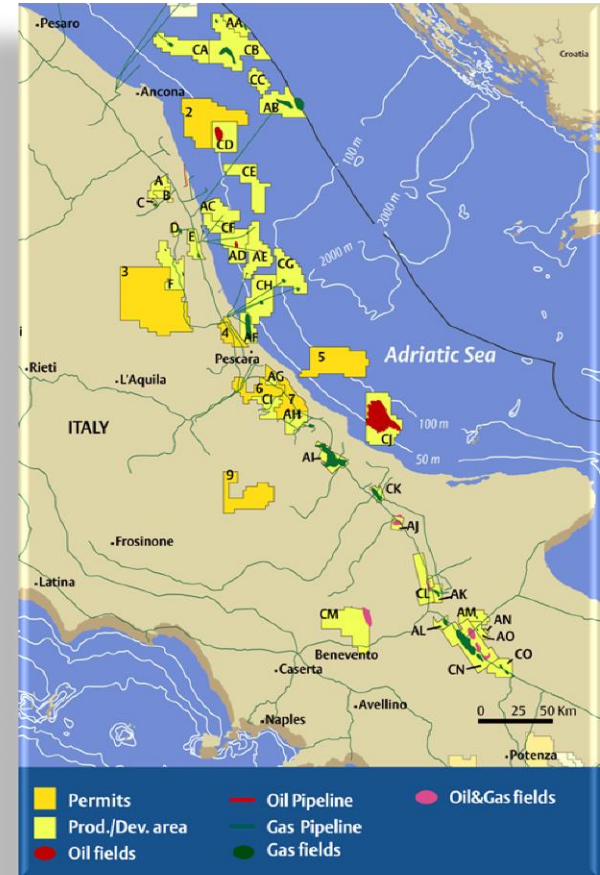
Raptor was used onshore and offshore Adriatic on several wells with the following objectives:

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

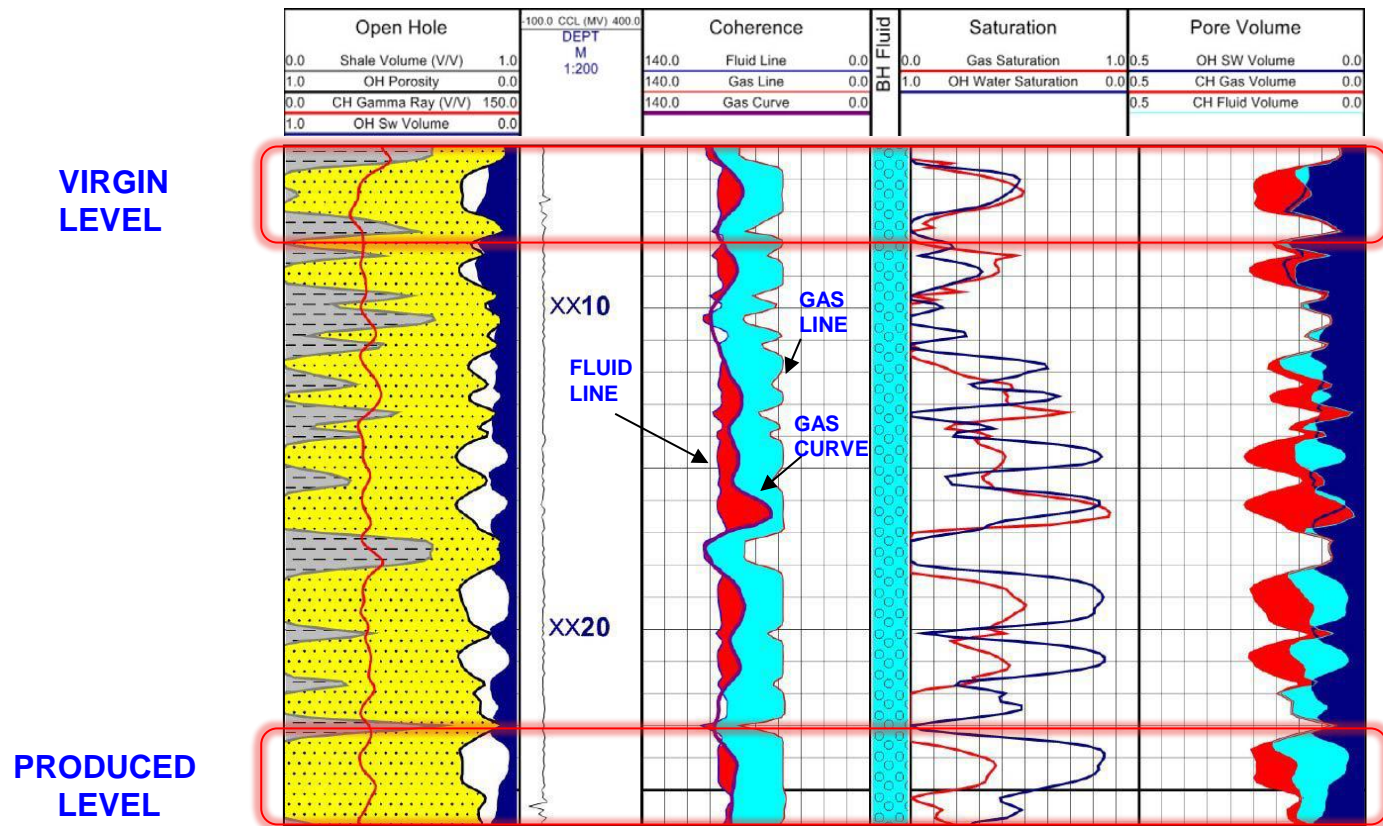
Field Trials of a New Array Pulsed Neutron Formation Evaluation Gas measurement in Complex Completions

S. Bertoli, M. Borghi, G. Galli, ENI E&P, A. Opreescu, S. Riley, Weatherford.

11th Offshore Mediterranean Conference and Exhibition in Ravenna, Italy, March 2013



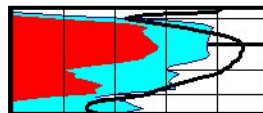
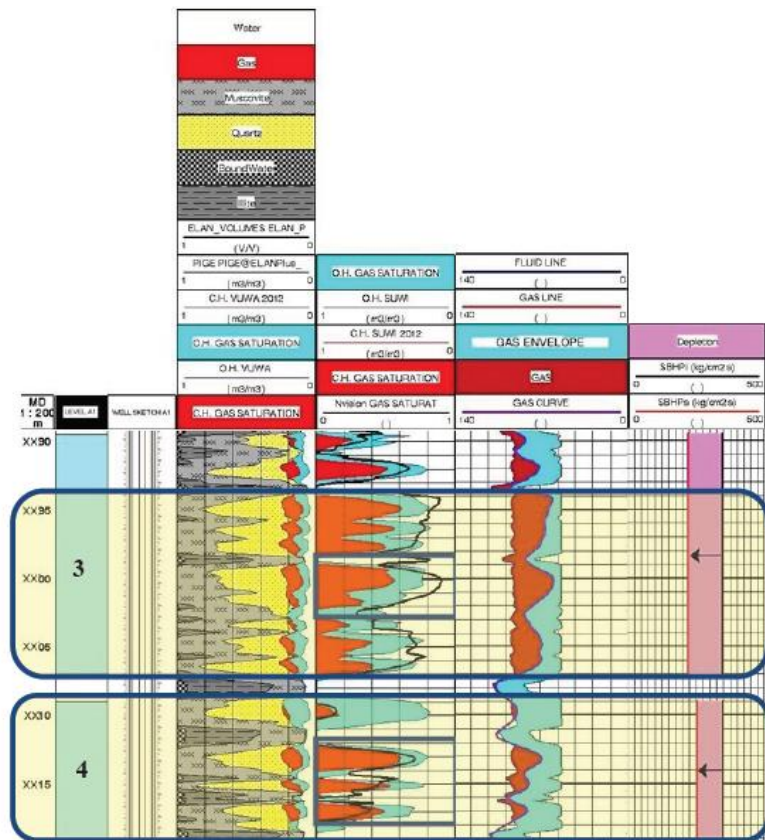
RAPTOR TOOL: *Example 2*



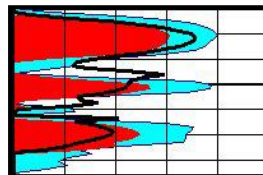
RAPTOR TOOL: *Example 2*



APPARENT PORE DENSITY CHANGE

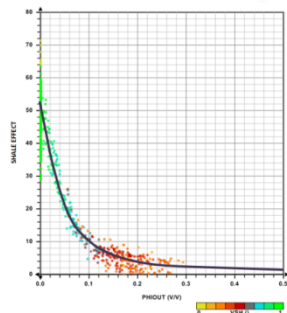
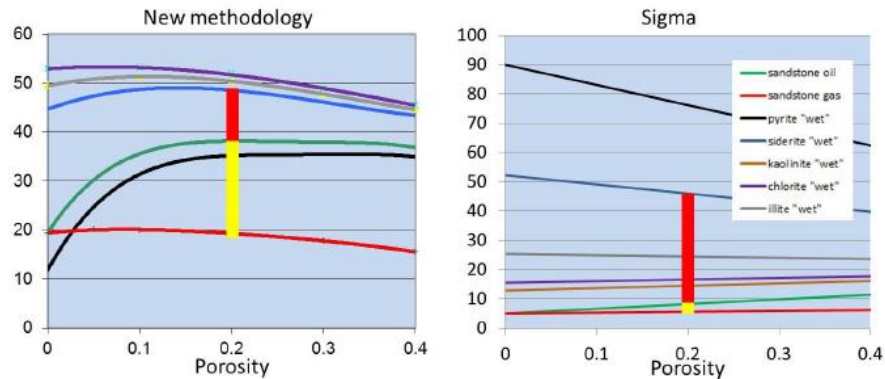


**GAS
FLASHING
EFFECT**



**RAPTOR GAS
SATURATION
COHERENT TO
PNC**

RAPTOR TOOL: *Example 3*



Mineral	Relative sensitivity		Merit figure
	Sigma	MDPN NB	
pyrite	26.12308	0.246568	105.9467
siderite	14.55385	0.544351	26.73616
kaolinite	2.4	0.649419	3.69561
chlorite	3.230769	0.722281	4.473009

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

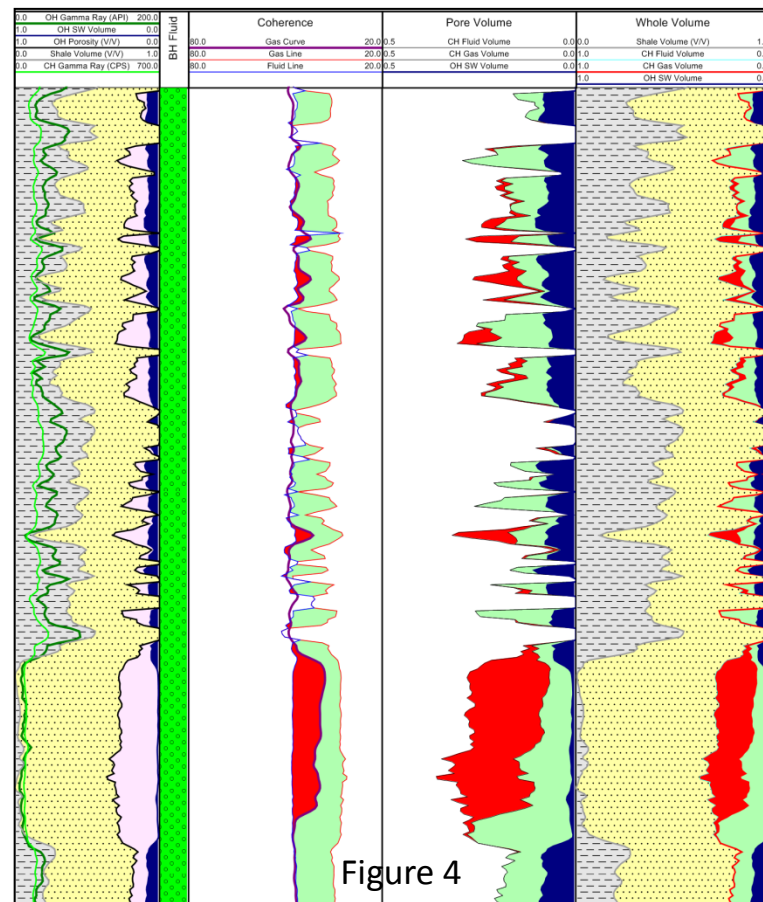
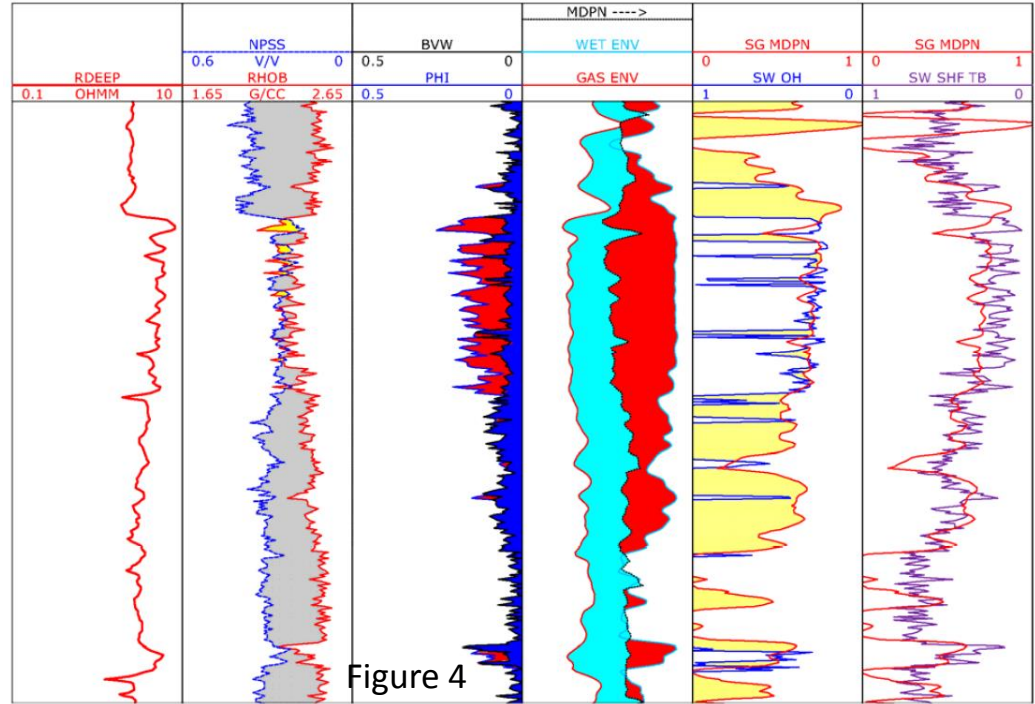
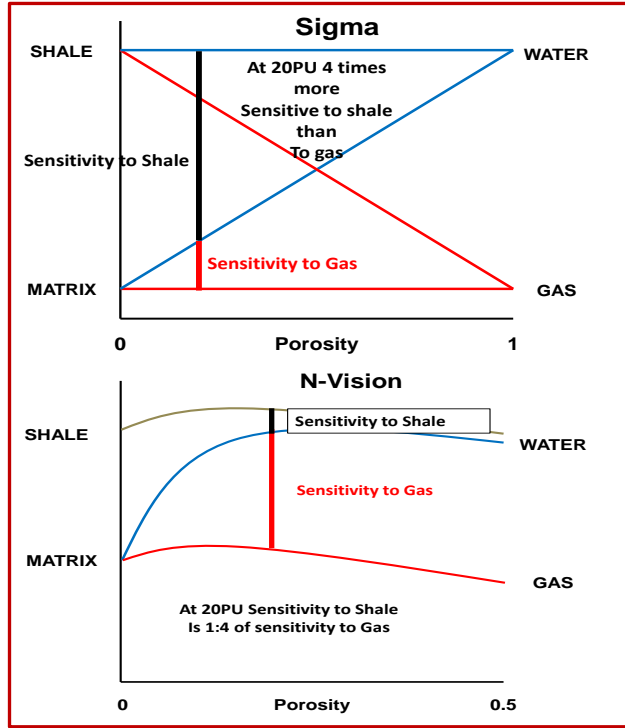


Figure 4

RAPTOR TOOL: *Example 4*



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

QUESTIONS?

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

Field Trials of a New Array Pulsed Neutron Formation Evaluation Gas measurement in Complex Completions

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