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DOI:10.30632/PJV66N2-2025a8

The Road Through Microannuli: Advanced Ultrasonic Log Analysis and Mechanistic Modeling for Leak Rate Quantification¹

Saida Machicote, Marco Pirrone, and Giuseppe Galli
PETROPHYSICS, VOL. 66, NO. 2 (APRIL 2025); PAGES 331–344; 16 FIGURES, 4 TABLES.
DOI:10.30632/PJV66N2-2025a9

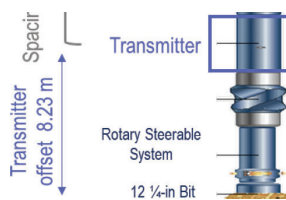
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Cuadros et al.

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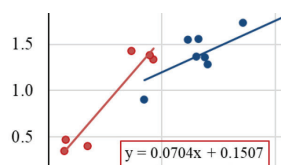
This paper discusses how ultradeep azimuthal resistivity (UDAR) look-ahead technology was applied in Brazil's presalt environment to provide real-time geological insights ahead of the bit. The authors describe key workflow adaptations needed to maintain look-ahead capability in extremely high-resistivity intervals such as halite. Case studies showcase how these solutions can be used to identify drilling hazards ahead of the bit and optimize casing placement.



Chen et al.

PAGES 267–282

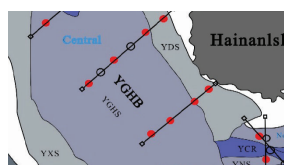
This study presents a new ultrasonic microscopy method for imaging carbonate reservoir pore structures. It also introduces a quantitative analysis technique for oil and gas development and resource utilization.



Cheng et al.

PAGES 250–265

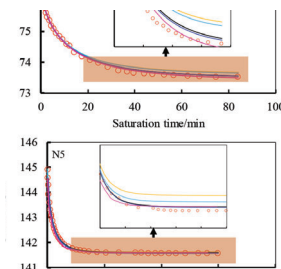
This paper reviewed the methodologies, applications, and uncertainties of several laboratory methods (crushed rock analysis, retort, and nuclear magnetic resonance) for measuring the total porosity and fluid saturations of unconventional tight rocks. A case study on core samples from the Bakken petroleum system was presented for data comparison.



Hu et al.

PAGES 283–293

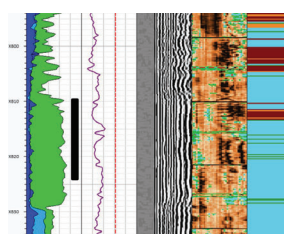
The Yingqiong Basin in the South China Sea is characterized by high formation pressure and complex genesis. This study demonstrates that methane carbon isotope logging data collected during drilling can be used to identify the genetic type of formation overpressure, significantly improving formation pressure monitoring accuracy.



Jiang et al.

PAGES 237–249

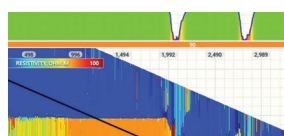
This study addresses the challenges of rapidly and accurately measuring porosity in shale gas reservoirs with low porosity, ultralow permeability, and high nanopore content. It proposes an improved gas intrusion porosimetry (GIP) method that utilizes a mathematical model based on mass conservation and Darcy's law to predict equilibrium pressure before full experimental stabilization, reducing saturation time to 10 to 15 minutes. The refined method minimizes the effects of saturation time, achieves results consistent with true porosity, and demonstrates high repeatability.



Machicote et al.

PAGES 331–344

The study aims to shed light on the open problem of possible leakage through microannuli between casing and cement. A fully analytical approach based on ultrasonic logging and published experimental data has been developed to provide a flow rate quantification of such possible leakages. Its primary novelty is the downhole estimation of microannulus thickness from the quantitative use of ultrasonic logging. This is also true for flow rate estimation through microannulus since only theoretical attempts have been made up to now.

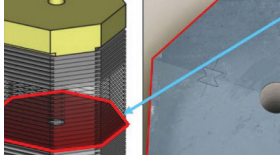


Sviridov et al.

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The paper presents a recently developed high-performance stochastic inversion software for real-time interpretation of ultradeep azimuthal resistivity data. The software capabilities are demonstrated on a series of industry-adopted benchmarks and on field data sets.

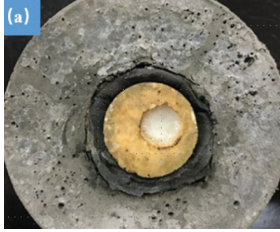
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Varignier et al.

PAGES 294–316

This paper aims to demonstrate the feasibility of fast-forward modeling for a neutron-neutron porosity logging tool through casing and cement. It also compares measurements and Monte Carlo simulations in a laboratory axial and radial experiment to validate the concept of sensitivity function in a casedhole environment.



Yang et al.

PAGES 318–330

To optimize the cementing process by quantifying the relationship between drilling fluid filter cake (DFFC) thickness and zonal isolation at the interface between the cement sheath and formation, this study developed a DFFC structural force evaluation device to classify DFFC structures and introduced SI sealing capacity evaluation equipment and methodology. The results showed that the DFFC's dense layer, which has less than 15% residue (0.6 mm), had little effect on SI sealing capacity.