TETRA TECH RPS ENERGY | TRAINING

N528: Petrophysics of Tight and Unconventional Oil Reservoirs

Format and Duration
Classroom - 3 Days

Instructor(s): Dick Merkel

Summary

Unconventional reservoirs are typically dual porosity and dual permeability, which often forces petrophysical modeling into two-dimensional analysis. This course explores how the physical and chemical nature of mudstones constrains our petrophysical approach and how core, log, image, and geochemical data can be integrated to develop an appropriate petrophysical evaluation workflow. The analysis can be applied to pilot wells to determine favorable zones to go horizontal, or to horizontal wells to determine optimum completion intervals.

Business Impact: Application of the learnings of this course will empower participants to understand the petrophysical concepts to allow for determination of flow units and hydrocarbons in place (HIP) in mixed or oil wet formations.

Learning Outcomes

Participants will learn to:

1. Evaluate the fluid distribution in unconventional reservoirs.
2. Determine how maturation affects pore distribution and connate water salinity.
3. Distinguish geologic environments that require special logging tools.
4. Select advanced techniques for the analysis of NMR and/or dielectric measurements.
5. Formulate special core analysis techniques to calibrate or verify petrophysical models.
6. Judge pore size distributions in heterogeneous formations.
7. Formulate reservoir wettability from logs and core.
8. Determine with accuracy the amount of clay bound water and free water.

Training Method

This is a classroom or virtual classroom course comprising a mixture of lectures, demonstrations, and discussions.

Who Should Attend

Anyone involved in the petrophysical evaluation of shale reservoirs, including geologists, geophysicists, petrophysicists and engineers.

Course Content

Part 1: The Physics of Log Measurements

- Introduction to well logging

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- Principles and theories behind log measurements
- Logging tools and their applications in unconventional reservoirs

Part 2: Log Normalization, QC, and Measurement Error

- Normalization techniques for well logs
- Quality control procedures for log data
- Understanding measurement errors and their impact on resource evaluation

Part 3: Mineralogy Determination from Logs

- Log responses related to mineralogy
- Interpretation methods for mineralogical analysis from logs
- Quantitative mineralogy estimation using log and core data

Part 4: Clay Responses and Clay Bound Water

- Clay mineral identification from well logs
- Clay responses in vertical pilot holes and horizontal production wells
- Clay-bound water estimation from log and core data

Part 5: TOC Models

- Introduction to Total Organic Carbon (TOC)
- TOC estimation methods using well logs and various core measurements
- Application of TOC models
- Organic porosity in unconventional reservoirs

Part 6: Porosity Determination

- Log-based porosity calculations
- Different porosity models, their assumptions, and NMR log and core measurements
- Evaluating reservoir quality using total and effective porosity data

Part 7: Fluid Saturation Models and Measurements

- Introduction to fluid saturation and its significance
- Interpretation methods for fluid saturation using standard and specialty well logs
- Unconventional reservoir saturation models and hydrocarbon recovery

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Part 8: Permeability from Core and Logs

- Core analysis techniques for permeability determination
- Log-based permeability estimation models
- Integration of core and log data for dual permeability evaluation

Part 9: Rock Mechanics

- Introduction to rock mechanics and its importance in reservoir engineering
- Logging tools for rock mechanical analysis
- Interpretation of rock mechanical properties in vertical and horizontal wells

Exercises Included

This course integrates practical exercises to complement theoretical learning. You will:

- **Determine key petrophysical properties** such as Kerogen Volume, PHIT, VCBW, and PHIE using Core NMR.
- **Analyze log data distribution** in formations through Log NMR-Dielectric exercises.
- **Calibrate logs** by determining PHIT and PHIE at specific depths using Core PHIE data.
- **Calculate water saturation and effective porosity** (SWT and SWE) under various conditions in Core SWE Determination exercises.
- **Determine initial water saturation** (BVWi) using XRD & GRI core data in Core BVWi Determination exercises.

These hands-on activities will enhance your understanding and application of theoretical concepts in petrophysics.