Petrophysics and Formation Evaluation: Well Log Interpretation, Shale Volume and Water Saturation

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Amsterdam - Zuidas business district hotel



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Introduction:

Petrophysics and formation evaluation decisions on whether a logged interval holds producible hydrocarbons are often made from uncorrected logs, borrowed Archie parameters and cut-offs nobody has tested, which leads to bypassed pay and wet completions. This Core Concept course trains geoscientists to quality-control open-hole logs, compute shale volume, porosity and water saturation in clean and shaly formations, calibrate logs to core, pick fluid contacts from formation tester pressures and set net pay flags. Participants finish by producing a Well Evaluation Report with a computed petrophysical interpretation for one well.

Course Objectives:

- Quality-control open-hole log data for depth, borehole condition and tool response before any computation
- Calculate shale volume and porosity from gamma ray, density, neutron and sonic logs with lithology and gas effects accounted for
- Compute water saturation with Archie and shaly-sand equations and justify the selected Rw, a, m and n values
- Estimate permeability from log transforms and NMR responses and calibrate log results against core measurements
- Interpret formation tester pressures and gradients to identify fluid types and pick gas-oil and oil-water contacts
- Produce a Well Evaluation Report with zoned log interpretation, net pay summation and stated uncertainty ranges

Target Audience:

- Petrophysicists who run log interpretation and deliver computed results for exploration and appraisal wells
- Development and petroleum geologists who pick zones, correlate wells and sign off net pay
- Geoscientists who use log-derived porosity and saturation in maps and static models
- Operations geologists who follow logging runs and decide on formation tester and sidewall core programmes
- Log analysts in service and consulting teams who process and report open-hole data for clients

Course Outline:

Day 1: Formation Evaluation Workflow, Open-Hole Log Suite and Log Quality Control

- Formation Evaluation Data Sources: Wireline, LWD, Mud Log, Cuttings and Sidewall Cores
- Gamma Ray and Spontaneous Potential Logs for Sand-Shale Discrimination
- Laterolog and Induction Resistivity Tools, Invasion Profile and Depth of Investigation
- Density, Neutron and Sonic Tool Physics with NMR Logging at Overview
- Log Quality Control Checklist: Depth Matching, Repeat Sections, Caliper and Washout Flags

Day 2: Log Corrections, Lithology, Shale Volume and Porosity

- Environmental Corrections for Hole Size, Mud Type and Filtrate Invasion
- Gamma Ray Index and Linear and Non-Linear Shale Volume Transforms
- Neutron-Density Crossplot for Lithology, Gas Effect and Matrix Density Selection
- Density, Sonic and Neutron-Density Porosity with Shale Correction
- NMR Porosity Partition: Clay-Bound, Capillary-Bound and Movable Fluid Volumes

Day 3: Water Saturation: Archie and Shaly-Sand Equations

- Formation Water Resistivity from SP, Water Samples and Resistivity-Porosity Plots
- Archie Equation Parameters a, m and n in Clean Sandstones and Carbonates
- Pickett Plot Construction for Rw and Cementation Exponent Checks
- Clay Conductivity, Cation Exchange Capacity and the Waxman-Smits Equation
- Flushed Zone Saturation, Movable Hydrocarbon Indicators and Invasion Diagnostics

Day 4: Permeability, Core-Log Integration, Formation Tester Pressures and Fluid Contacts

- Permeability Estimation from Porosity-Permeability Transforms and NMR Log Responses
- Core-Log Depth Shifting and Core Porosity Calibration of Log Porosity
- Wireline Formation Tester Pretest Quality: Supercharging, Tight Tests and Mobility
- Pressure-Depth Gradient Plots and Fluid Density Interpretation
- Gas-Oil and Oil-Water Contact Picking from Resistivity, Neutron-Density Separation and Gradients

Day 5: Well Evaluation Case Study: Computed Petrophysical Interpretation

- Well Data Pack Loading, Log Header Review and Quality Control Report
- Zonation and Parameter Picking for Shale Volume, Porosity and Saturation
- Net Pay Cut-Off Sensitivity and Net Sand, Net Rock and Net Pay Summation Table
- Low-Resistivity Pay, Thin Beds and Uncertainty Ranges on Computed Results
- Well Evaluation Report Presentation and Peer Challenge

Skills You Will Gain:

- Open-Hole Log Quality Control
- Lithology Crossplot Interpretation
- Shale Volume Estimation
- Shaly-Sand Saturation Analysis
- Formation Water Resistivity Determination
- Core-to-Log Calibration
- Formation Pressure Gradient Analysis
- Net Pay Determination

Why Attend This Course:

- Return with a Well Evaluation Report containing a zoned, computed petrophysical interpretation you can defend line by line
- Stop borrowing Archie parameters by deriving Rw, m and n from your own logs, samples and core
- Recognise low-resistivity pay, gas effect and poor borehole data before they distort porosity and saturation results
- Compare log interpretation practice with petrophysicists and geologists working clastic and carbonate wells in different basins

Conclusion:

Reliable formation evaluation depends on clean log data and parameters that are chosen and tested rather than assumed. The week moves from tool physics and log quality control through corrections, shale volume, porosity and water saturation in clean and shaly formations, then adds permeability estimation, core calibration, formation tester pressures and fluid contacts. The final day applies every step to one well and produces a Well Evaluation Report with net pay summation and uncertainty ranges ready for the next well review.