N054: Petrophysics and Low Resistivity Pay Evaluation for Conventional Reservoirs

Instructor(s): David Eickhoff

Format and Duration

Classroom - 3 Days
Virtual - 6 Sessions

Summary

This petrophysics course explains the physical properties of rocks and their constituent fluids, how their properties are measured and how this information is used in reserve estimation and reservoir characterization of conventional reservoirs. Particular emphasis is given to the interactions between rock and fluid volumes which are explained and then illustrated with real examples. The course explores some of the newer generation tools and methods used in formation evaluation for interpretation of low resistivity pay.

Business Impact: Application of the learnings of this course will empower participants to better understand reserve estimation, reservoir characterization and low resistivity pay evaluation of conventional reservoirs.

Learning Outcomes

Participants will learn to:

1. Evaluate through logs and core the key petrophysical properties such as lithology, porosity, Archie parameters, water saturation, permeability and net to gross.
2. Generate a comprehensive petrophysical evaluation of a drilled section using an appropriate workflow to integrate available petrophysical data from logs and core.
3. Assess the different modes of shale distribution, estimate shale volume from logs, appraise the different shaly sand interpretation models and understand the difference between effective and total porosity.
4. Identify and estimate hydrocarbon reserves in a thinly bedded, low resistivity sand/shale sequence using industry crossplot methods and resistivity anisotropy principles.
5. Judge the advantages and limitations of nuclear magnetic resonance measurements for porosity, saturation and permeability.
6. Develop a permeability model from nuclear magnetic resonance data by calibrating industry relationships to core data.
7. Assess the different rock typing methods and develop a saturation-height model of a heterogeneous reservoir using capillary pressure data and J-functions.
8. Consider the primary causes of Low Resistivity Pay and recommend the appropriate tools and measurements for evaluation.

Training Method

This is a classroom or virtual classroom course comprising a mixture of lectures, short exercise-based discussions, and log based interpretation exercises.

N054: Petrophysics and Low Resistivity Pay Evaluation for Conventional Reservoirs

Instructor(s): David Eickhoff

Format and Duration

Classroom - 3 Days
Virtual - 6 Sessions

Who Should Attend

The course is designed for subsurface geoscientists and engineers working on prospect generation, exploration, development, reservoir characterization and field studies of conventional reservoirs. Participants should have a basic understanding of petrophysical evaluation, as well as practical experience working with well logs.

Course Content

This is an integrated practical petrophysics course, not just another log interpretation session. Topics covered include: physical rock properties, fluid distribution, capillary pressure, log measurements and interpretation, rock typing for reservoir characterization, Low Resistivity Pay. This course does not consider unconventional reservoirs.

The application of petrophysical analysis to subsurface projects will be emphasized, and the value of this approach will be illustrated with case studies and exercises. Participants will be taught how petrophysical tools measure parameters related to both lithology and fluids, highlighting the strengths and pitfalls of petrophysical measurements and interpretation.

The course covers:

Introduction

- What is petrophysics? The role of the Petrophysicist.

Petrophysical Properties: Definitions and Controls

- Definition of rock physical properties (porosity, permeability, saturation, capillary pressure, relative permeability), and consideration of their measurement.

Petrophysical Properties: Estimation and Interpretation (Logs)

- Interpretation principles and workflows: determination of lithology and matrix identification from crossplots, porosity from nuclear and acoustic logs, determination of water resistivity (Rw) and Picket plots, Archie exponents, water saturation.

Shaly Sands and Thin Beds

- Shale distribution and clay types. Volume of shale estimation from logs. Effective and Total Porosity. Shaly sand models (Vsh, cation exchange capacity, Juhasz)
- Thomas Stieber crossplot methods, multicomponent induction tools and resistivity anisotropy.

Nuclear Magnetic Resonance (NMR) measurements

- Tool theory, T2 principles and measurements
- Porosity, saturation and permeability from NMR measurements.

Permeability and Rock Typing

- Porosity-permeability crossplot interpretation from quantile curves.
- Industry rock typing methods (Flow zones, Thomeer, Winland R35, J-Functions)

Low Resistivity, Low Contrast Pay (LRLC)

- Definitions and Causes of Low Resistivity Pay
- LRLC examples from Gulf of Mexico and Mid Continent US