PEA
PETROLEUM ENGINEERS ASSOCIATION

# 2 WEEKS PRACTICAL TRAINING ON

# INTEGRATED FORMATION EVALUATION

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# INTRODUCTION

- Reservoir management is an on-going, dynamic process of collecting, analyzing, validating, and integrating reservoir description data and performance data into an optimal reservoir development and depletion plan.

- This training course provides the participants with an advanced understanding of the integrated formation evaluation techniques and well log analysis applications. The course will cover the physical principles of the logging tools and the full advanced interpretation workflow for reservoir characterization.

- The course progresses from the measurement fundamentals to the essential evaluation and assessment of the results and onto the practical applications in example studies and exercises.

- More specifically, the participants will understand the properties of the rocks and the reservoir fluids; analyze and integrate the core analysis datasets; evaluate the NMR logs and run the full NMR interpretation workflow; run pressure plots and detect the free water level/oil water contact and run saturation height modeling.

- The course will cover the log interpretation workflow with the quantitative techniques for the quality control and quality assurance procedures for the raw datasets. Different real examples from different parts of the world will be used throughout the course to help the attendees understanding the reservoir characterization concept and the integrated analysis.

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# OBJECTIVES

- Conventional tools principles and their applications in log interpretation
- Logs QC/QA, depth matching, splicing and logs normalization
- Predict reservoir or well production and determine asset lifetime
- Formation evaluation overview
- Wireline logging operations
- Physical principles of logging tools
- Open hole logging measurements
- Log interpretation workflow
- Applications of conventional and special core measurements (SCAL)
- Advanced logging measurements and tools
- Core data analysis and Integration with conventional and advanced E-Logs
- NMR tool principles/interpretation and saturation height modeling
- Practical training examples using different wells in different reservoir types
- Integration of the core analysis with conventional/advanced logs workflows
- Reservoir electrofacies and permeability modelling
- Reservoir fluid and pore volume characterization
- Case studies and exercises

# WHO SHOULD ATTEND

- Geologists and Geophysicists
- Petrophysicists and Log Analysts
- Reservoir and Petroleum Engineers
- Geomodellers

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# DAY 1

- Oilfield lifetime & development
- Integrated reservoir characterization workflow
- Reservoir modeling overview
- Role of reservoir rocks & fluids
- Reservoir geology & geological structures
- Depositional environments
- Wellsite Geology & mud logging
- MWD/LWD vs. wireline logging
- Openhole vs. cased-hole logging
- Log data acquisition, data processing, log runs, and log presentations
- Logs QC/QA, Depth matching, and log normalization
- Log interpretation - correlate and depth match logs.

# DAY 2

- Wireline logging operations
- Open hole logging measurements
- Integrated formation evaluation plan
- Logging tools specification, depth of penetration and vertical resolution
- Lithology tools
- Radioactivity and Gamma Ray (GR) logging tools
- Shale volume calculation
- Applications of Spectral GR
- Spontaneous potential measurements and SP log interpretation
- Calculation of formation water resistivity (Rw) using SP log
- Applications of crossplots to detect lithology, porosity and mineralogy
- Discussions and class exercises

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## DAY 3

- Porosity logging tools
- Density and neutron logging tools
- Porosity logs (NPHI, RHOB, PEF, DT, etc.)
- Density-Neutron Logs Applications
- Sonic logs and sonic scanners
- Porosity compatible scales
- Porosity calculation from individual tools
- Various corrections for porosity tools
- Crossplots applications in formation evaluation
- Crossplots for complex formations: neutron-density, sonic-density,
- sonic-neutron, density-photoelectric, M-N crossplots
- Porosity evaluation through the different porosity tools
- Porosity evaluation in clean and shaly formations
- Gas effect on density-neutron logs
- Matrix correction for clastics and dolostone rocks

## DAY 4

- Independent porosity tools/core measurements
- Acoustics logging tools
- Effect of different parameters: clays, secondary porosity, and fractures.
- Nuclear magnetic resonance tool - its principle of operation.
- Conventional core analysis
- Core data statistics; detecting the reservoir heterogeneity
- Rock Quality Index (RQI) and Flow Zone Indicator (FZI)
- Reservoir electrofacies and permeability modeling
- Examples and practical exercise using actual core data for advanced reservoir evaluation
- Core integration with wireline and LWD logs
- Coring practices and reservoir rock properties
- Hydraulic flow units & rock typing
- Integration of core and logging porosity data
- Discussions and class exercises

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## DAY 5

- Resistivity logging tools
- Dual Laterolog and Array Induction Logs
- Borehole environment and invasion profiles.
- Resistivity Logs (MSFL, MCFL, LLS, LLD, RLA3, RLA5, AIL, etc.)
- Water resistivity calculation methods
- Hingle and Pickett plots
- True resistivity determination
- Clean reservoir vs. shaly reservoirs

## DAY 6

- Archie equation and parameters
- Electrical measurements on core samples
- Saturation calculation in clean and shaly reservoirs
- Saturation determination: resistivity vs porosity crossplot, microresistivity vs porosity crossplots, resistivity ratio methods, shaly formations.
- Effect of cementation factor and saturation exponent
- Shale sand models: dual-water, Waxman-Smits, and Thomas-Steiber models.
- Low resistivity – low contrast pay
- Independent saturation tools/core measurements
- Cementation factor and saturation exponent from the core analysis
- Saturation-height modeling
- Quick look log analysis for real-time decisions
- Discussions and class exercises

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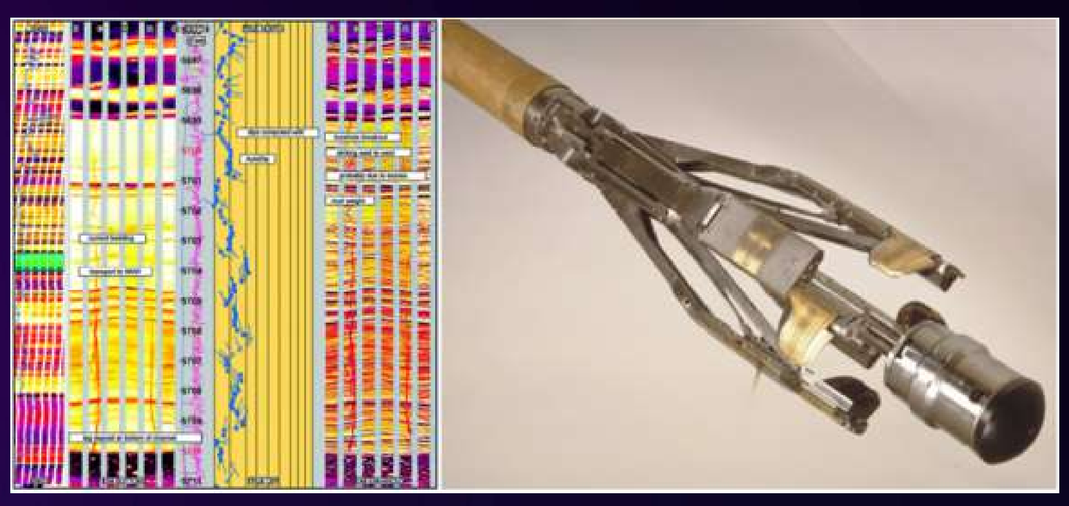
## DAY 7

- Development of clastics and carbonate reservoirs
- Rock mechanical properties
- Image logs (FMI, XRMI, etc.)
- Applications of image logs
- Wireline formation testers (MDT, XPT, and RDT)
- MDT/RFT principles and operations
- Pressure measurement quality control
- Reservoir drive and fluid properties
- Applications of pressure data for integrated evaluation
- Determination of the fluid contacts
- Fluid sampling techniques
- Cutoff concepts

## DAY 8

- Advanced nuclear magnetic resonance (NMR) logs
- Applications of NMR logs for porosity and permeability measurements
- Overview of casedhole logs
- Cement evaluation logs
- Saturation monitoring logs (RST and pulsar)
- Permeability prediction models
- Petrophysical inputs for static and dynamic modeling
- Advanced logging tools
- Physics of NMR tools
- NMR measurements on core samples
- NMR interpretation integration with conventional logs





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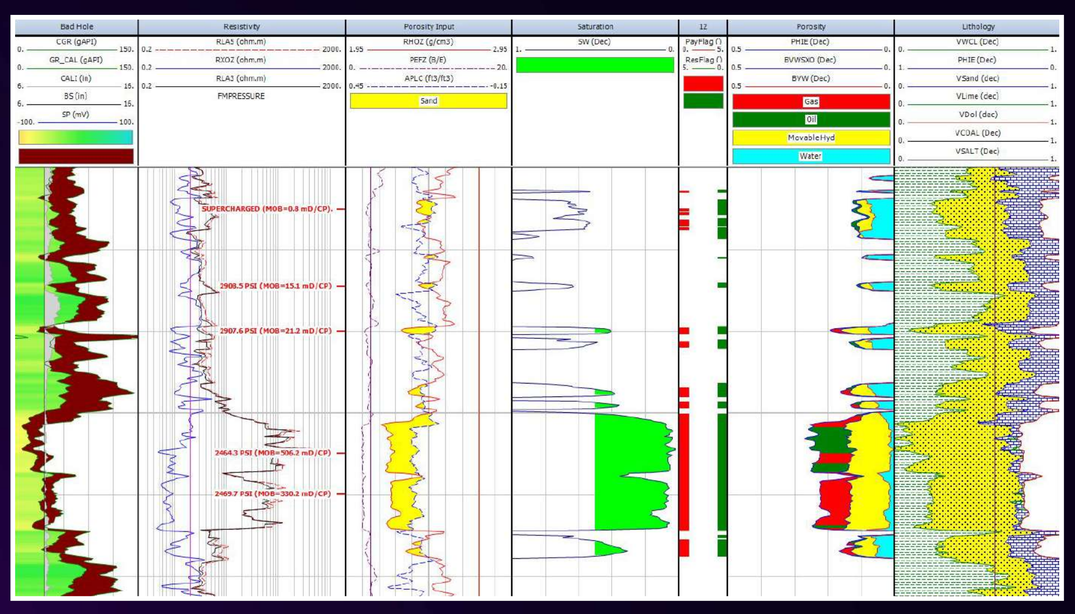
## DAY 9

- Capillary pressure data
- Facies variations from the capillary pressure curves
- Reservoir pressure analysis
- Understanding the concept of the oil water contact and FWL
- Upscaling of well logs

## DAY 10

- Overview of 3D property modeling
- Clay versus Shale – difference between the two workflows
- Mineralogical interpretation
- Calibration of the shale volume, porosity and water saturation
- Practical examples/exercises using different well log data in clastic and carbonate reservoirs
- Analysis using Petrophysics Software Packages
- Integrated log interpretation
- Discussions and class exercises

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