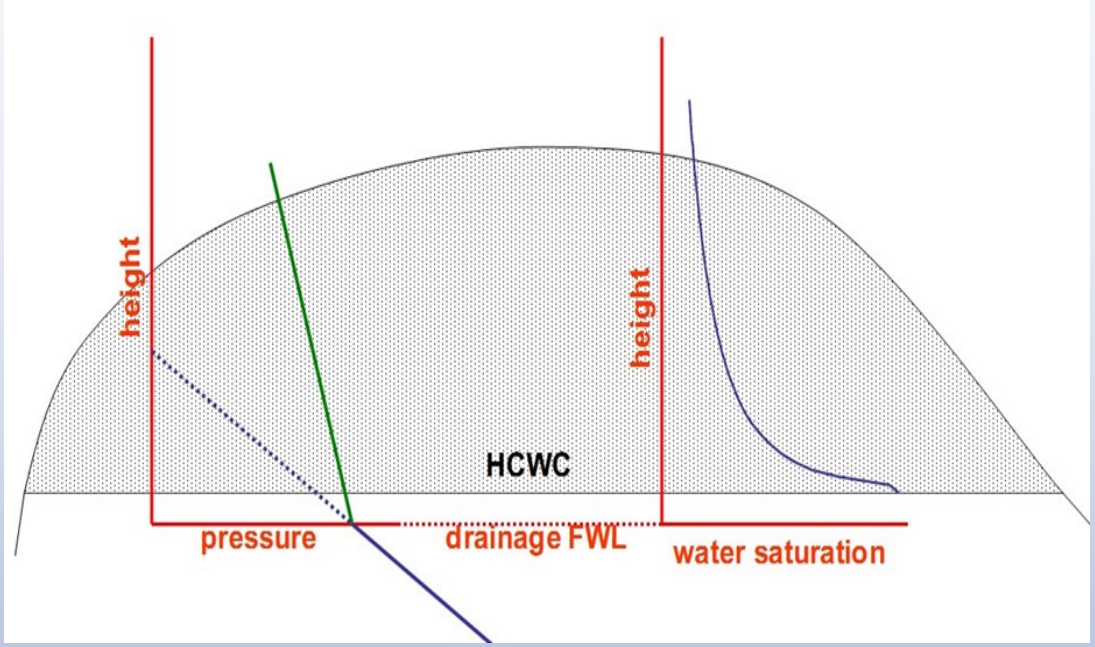
Short Course 1.00

Foundations of Petrophysics



presented by

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WHAT YOU NEED TO KNOW ABOUT PETROPHYSICS - ENOUGH TO DO MOST WORK AND KNOW WHICH QUESTIONS TO ASK

Wireline and LWD log evaluations combined with related core analyses provide the reservoir properties on which all (post-drill) subsurface planning and decision-making is made. Volumetric, Static & Dynamic models all depend on the Petrophysical work. Hence it behooves all Subsurface Professionals to have some understanding of the origins of these data.

COURSE OBJECTIVES

This course provides the background knowledge required to carry out robust deterministic petrophysical evaluations. The configuration of hydrocarbons in the subsurface is addressed first, then the available measurements and tool physics are outlined. The logic behind the interpretation of these measurements to give the required reservoir properties of net, porosity, permeability, water saturations, fluid types and contacts are described. Uncertainty in estimated properties and documentation of work down will also be addressed.

Emphasis will be placed on methodologies which can be satisfactorily audited by external technical experts and joint venture partners.

AUDIENCE

Geologists, Geophysicists, Reservoir & Production Engineers , Aspiring Petrophysicists and others involved in formation evaluation and/or reservoir modelling are the most likely audience. In particular, people who work with petrophysically derived properties in their models will find this course of considerable benefit .

SKILL PROPOSITION

The skills obtained will enable participants to derive robust reservoir property estimates and/or quality control work carried out by others. Uncertainties will be quantifiable, allowing recognition of those estimates needing further investigation. Users of Petrophysical data will also better understand it's validity and limitations.

VALUE PROPOSITION

Significant time will be saved in the analysis and interpretation phase by following the workflows outlined. In addition robust and auditable reservoir properties will be available for static & dynamic modelling. Avoiding repetition of work, while understanding the data limitations are likely to result in faster and more robust development and re-development scenario modelling. More fiscally advantageous decisions should result.

COURSE PROGRAMME

The following programme outline describes an intensive 2-3day course covering theory and hands-on interpretation skills. The course will cover the subject by alternating between lecturing and exercises with real data from clastic and carbonate oil and gas reservoirs, worldwide. A training manual will be provided to facilitate learning and use of the techniques. The exercises are intended to reinforce the methodologies discussed. MS-Excel will be used for the exercises rather than dedicated Petrophysics software so that the participants understand which algorithms they should use and why. Attendees will be encouraged to take their spreadsheets with them to use in the future.

COURSE SYNPOSIS

Introduction: Why is Petrophysics important? What will we talk about?

Part 1 – The Basics

The Reservoir: What are we looking for? How does it really look?

Why Logs & Core?:What sort of data can we collect? What does it represent?

Workflows: Typical measurements acquired and how they are used to get what we want.

Documentation: The significance of good documentation cannot be underestimated.

Part 2 – Log Measurements

Wireline: Gamma ray, SP, density, neutron, sonic, resistivity, NMR, formation pressures.

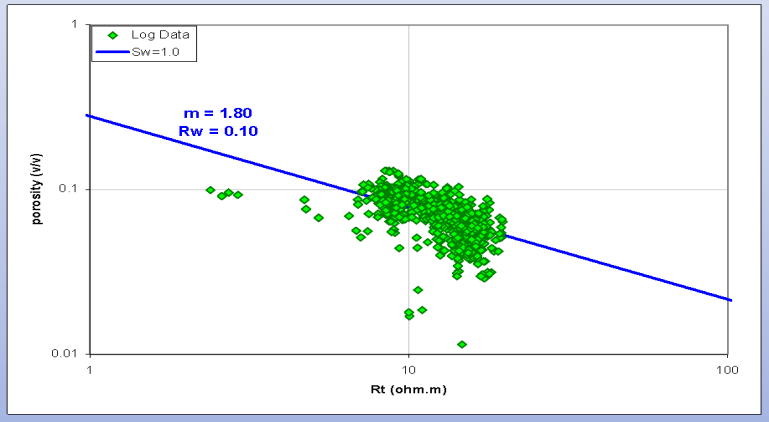
Logging While Drilling (LWD): Similar measurements to wireline, but different operating environment.

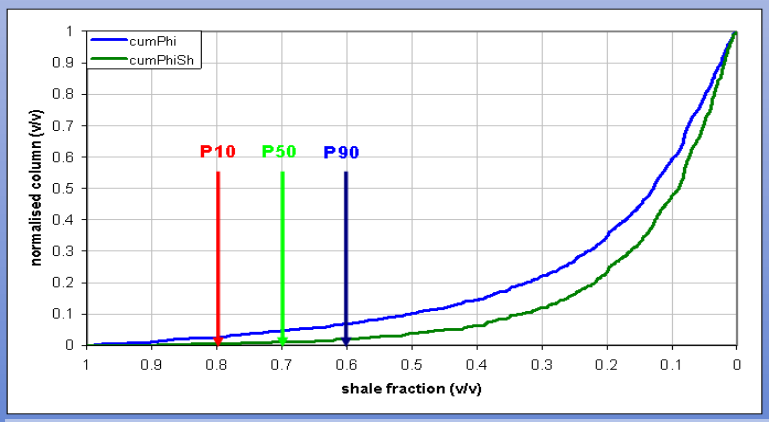
Quality control: Tool calibrations and witnessing. Data checks.

Part 3 – Core Measurements

Routine (RCA): Grain density, porosity, permeability, Klinkenberg, water saturation (Dean-Stark), stressed measurements.

Special Core Analyses (SCAL): clay conductivity, cementation & saturation exponents, formation water salinity, capillary pressures, residual hydrocarbon saturations.





Part 5 – Basic Interpretation

Preparation: Display logs, remove artefacts, depth-matching, borehole & environmental corrections, normalisation., borehole temperature.

Porosity/Lithology: Total & effective porosities, .density, density-Rxo, density-neutron, sonic, NMR & other porosities. Shale fraction. Gas effect.

Formation Water Salinity: Pickett plots, samples, apparent formation water resistivity, water salinity.

Water Saturation: Hydrocarbon saturations, Archie, Waxman-Smits/Dual-Water. Verification. Residual hydrocarbons.

Net and/or Pay: Definitions. & practical guides to determine meaningful values.

Part 6 – Specialised Interpretation

Permeability from Logs: Application of core relationships to log data.. Mobilities.

NMR Log Interpretation: Bound & Free Fluid, irreducible Sw, permeability, fluid typing & saturations.

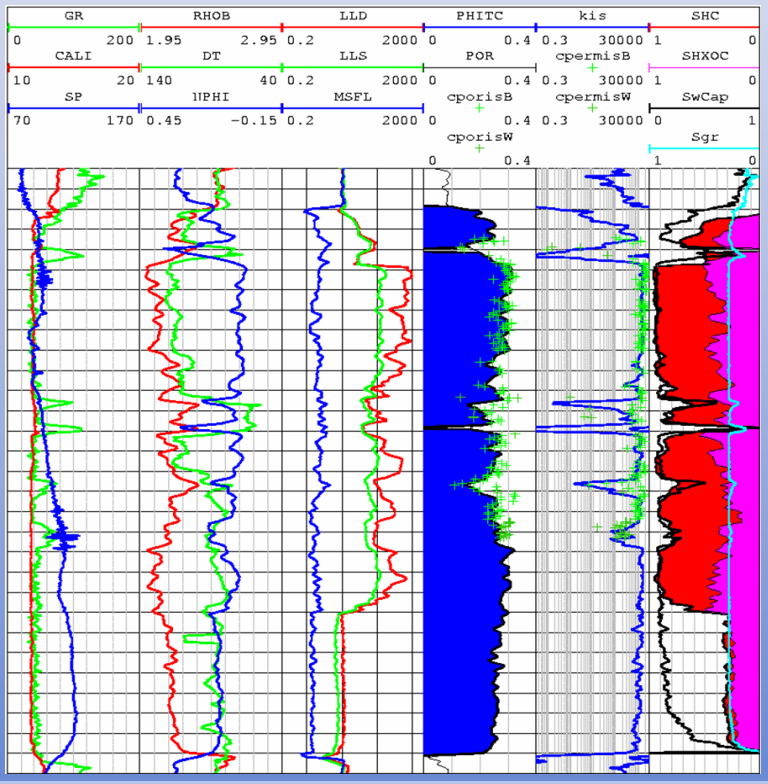
Formation Pressure Interpretation: Contacts, fluid densities , fluid configurations.

Verification with Core: Check log & core properties are similar or .have good reasons for being different. Consider upscaling.

Determining Likely Mobile Fluid: What can logs tell us about fluid types.

Reporting & Summations: The basics required for reporting.

Additional Matters: Probabilistic & Deterministic Methods, uncertainties, modelling requirements. Cased-hole logs.



Stephen Adams

Steve has been a Petrophysicist since 1987. Following training and an initial 7 years with Shell, he has worked as an independent consultant with clients in Australasia, Asia, the Middle East and elsewhere. He has been providing petrophysically focussed training courses since 2001.

Steve has more than 19 papers published and is well known in the industry as a Specialist in Saturation-Height Modelling. His 2016 book "Saturation-Height Modelling for Reservoir Description" has been well received by the Industry.

During his career, Steve has had a great deal of exposure to some challenging problems involving capillary pressure in different lithologies. Much of this work has been "leading edge" in that similar cases have not been described in the literature previously. Some of these examples will be referred to in the training where the work has been published or permission has been otherwise received.

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