N666: Special Core Analysis

Instructor(s): Dr. Adam Moss

Format and Duration

Classroom - 4 Days
Virtual - 8 Sessions

Summary

Participants will learn how to maximise the value of their core by learning how to design an integrated core analysis and SCAL programme that provides data required for all disciplines involved in formation evaluation, reservoir characterisation and modelling. You will learn how to quality check new and legacy core analysis & SCAL data to provide the best quality inputs into formation evaluation workflows and reservoir models, thus providing more accurate volume in place and production estimates. Participants on this course will learn to measure and integrate conventional and special core analysis (SCAL) data into petrophysics and reservoir models. The expert instructor has over 25 years' experience working in core analysis laboratories and an operating company. The course is structured to demonstrate the complete workflow from core acquisition to petrophysical and reservoir model construction.

Learning Outcomes

Participants will learn to:

1. Design a core analysis & SCAL test programme to supply all data required for petrophysics and reservoir modelling.
2. Perform quality checking of core analysis & SCAL data.
3. Describe how core and log data are depth matched.
4. Determine the Archie cementation and saturation exponent from electrical measurements on core plugs.
5. Define the test methods to determine Wettability, Capillary Pressure and relative permeability.
6. Build a saturation height function for use within the reservoir model.
7. Measure and quality check relative permeability data and integrate these data into the reservoir model.

Training Method

This classroom or virtual classroom course will be a combination of short lectures, practical workshops and plenary discussions to consolidate learning. Sessions will be structured carefully to ensure optimisation of learning expectations through presentations, followed by practical exercises to embed understanding. Discussions and question and answer sessions are encouraged to ensure understanding. Each session will contain a practical exercise which will be either on paper and in Excel.

Participants will have opportunities to share their own experiences, discuss data and explore any issues they may have had relating to core analysis and SCAL data. We encourage the clients to send us examples core analysis data, so these can be included in the practical workshops.

Who Should Attend

The course is designed for those who are planning to cut core, for all geoscientists that work with legacy data and for anyone involved in formation evaluation, reservoir characterisation and modelling.

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Course Content

Part 1

1.1: Introduction to the Course

1.2: Data Requirements for Reservoir Characterisation & Reservoir Simulation

1.3: Overview of Coring & Core Recovery

1.4 The Effect of Core Handling on Data Quality

1.5: The Impact of Core Quality on Core Analysis Data

1.6: The Impact of Heterogeneity on Core Analysis Data

1.7: Core Plug Sampling Strategies

Part 2

2.1: Core Porosity – Understanding Different Measurements and Factors Effecting Data Quality

2.2: Permeability – Controlling Factors, Measurement Choices, and Quality Control

2.3: Pore Volume Compressibility and its effects on Porosity and Permeability

2.4: Water Saturation from Core – Dean-Stark Measurements – Theory, Best Practice and Integration with Log and Other Core Data

2.5: Clean Sand Resistivity-Saturation Models. Measuring the Archie 'm' & 'n' Parameters

Part 3

3.1: Calibration of the Waxman-Smits Shaley Sand Model using Core data, including CEC and BQV

3.2: Capillary Pressure - Theory & Understanding the Controls on Fluid Distribution

3.3: Capillary Pressure – Laboratory Measurements

3.4: Capillary Pressure – Conversion to Reservoir Conditions

3.5: Integration of Capillary Pressure into Saturation Height Function Models

Part 4

4.1: A Review of the Common Saturation Height Function Models – Including Pros & Cons of Each

4.2: Integration of Saturation Height Functions with Log Data and Reservoir Models

4.3: Wettability – Definition, Impact on Fluid Distribution and Flow, Factors Effecting Wettability and Laboratory Measurement of Wettability

4.4: Relative Permeability – Theory and Controls on Two Phase Fluid Flow

4.5: Relative Permeability – Laboratory Measurement

4.6: Quality Checking Relative Permeability Data

4.7: Integration of Relative Permeability Data into Reservoir Models

4.8: Integrating all Data and Quality Checking Legacy Data & Reports - Including What to do When You Have Very Little Data

4.9: Course Conclusion and Review

Classroom Tasks

Task 1 Depth Shifting. Use the log and core gamma data to shift the core to the log

Task 2 Porosity & Permeability QC. Quality check the core plug porosity and permeability data by reading the comments for each plug and remove any samples you think are damaged or not suitable for measurement. Compare the quality checked poro-perm plot with the original.

Task 3 Klinkenberg Corrections. Use the permeability and pressure data for the four plugs to calculate the Klinkenberg permeability.

Task 4 Building Stress Correction Models. Use the supplied SCAL data to derive models to stress correct the quality checked ambient 'routine' porosity and permeability data from the Task 2.

Task 5 Converting lab to reservoir capillary pressure and Height. Use the supplied values for contact angle & interfacial tension (IFT) to calculate the reservoir gas/brine capillary pressure from the mercury injection data supplied Then convert the reservoir capillary pressure values to an equivalent height above free water level (HFWL) using the water and gas column pressure gradients.

Task 6 Building a J-Function Saturation Height Function Model. Use the capillary pressure and poro-perm data for the six samples in the spreadsheet, plus the supplied fluid properties to build a J-function type saturation hight function.

Task 7 Relative Permeability End Point Calculation. Use the data supplied to calculate initial water saturation, volume of oil recovered during waterflood, residual oil saturation, recovery factor and relative permeability to water at residual oil saturation.

Task 8 Review of old laboratory core analysis & SCAL reports