

Pore Pressure Prediction and Evaluation

Course Price

£3050

Course Description

Starting from the very basics this course describes how we predict, calculate and evaluate overburden, fracture and pore pressures as well as subsurface stresses and how they are related. Theories of how overpressures are generated will be discussed, how these pressures are subsequently modified and how they impact on hydrocarbon generation and migration, well planning and risk identification as well as evaluation techniques.

Course Objectives

Understanding of:

- Basics of subsurface pressures and stresses and their interrelationships.
- Overburden pressures.
- Fracture pressure calculation and measurement using leak-off tests.
- Leak-off tests, FITs and XLOTs and their interpretation.
- Earth stresses and how they can cause wellbore instability.
- How overpressures develop and change through time.
- The centroid concept and pressure transfer.
- Impact of formation pressures on well planning and risk management.
- Pore pressure prediction and real-time evaluation using trend analysis.
- Identification of wellbore instability mechanisms
- Use of indicators such as hole conditions, shale caving and gas in pressure evaluations
- Pressure evaluation in non-clastic environments (carbonates/evaporites etc.)

The objectives are supported by numerous exercises and case studies.

Who Should Attend

Wellsite and operations geologists, drilling engineers and subsurface geologists/geophysicists. This course assumes little or no prior knowledge of formation pressures but will require an understanding of geology, drilling activities and associated terminologies.

Course Content

Day 1

Basics of Wellsite Pressure Evaluation

Overview

What is Formation Pressure Evaluation?

Why pressure evaluation is important

Formation Pressure Fundamentals

Units of Measurement

Fluid, Hydrostatic and Pore Pressures

Pressure Gradients and Equivalent Mud Weights

Stress Definitions

Stress Theory

Expressions of Stress

Relationship between vertical and horizontal stresses

Effective or Matrix Stresses

Borehole Stresses

Manifestations of Stress Imbalance

Rock Strength and Stress

Stress Related Drilling Problems

Horizontal or High Angle Well Direction and Stress

Horizontal Stress Problems in the North Sea

Wellbore Stability Analysis

Overburden Pressures and Gradients

Overburden Pressure, S

Calculating Formation Densities

Overburden Pressure Gradients

Overburden Pressure Gradients and ERD

Day 2

Fracture Pressures and Gradients

Definition

Influences on Fracture Pressure

Estimation of Fracture Pressure and Gradient

Pressure Test Variants, FIT, XLOT

Calculating Fracture Pressure – Rest of Well

Fracture Pressure Gradient – Role in Well Planning

Life of Field

Summary for fracture pressure calculations

Plotting Formation Pressures

Pressure Plots

Equivalent Mud Weight Plot

Effect of Measurement Datum

Changing Measurement Datum

More Terminology

State of Balance

Static and Dynamic Densities

Safe Mud Densities

Abnormal Pressure Mechanisms

Classification Basis

Compaction Mechanisms

Undercompaction/Compaction Disequilibrium

Undercompaction Modelling

Parameter Relationships

Syntectonic (Lateral Compressive Stress)

Fluid Expansion Mechanisms

Hydrocarbon Generation and Cracking

Aquathermal

Chemical and Diagenetic Changes

Other Diagenetic Transformations

Load Transfer Mechanism

Parameter Relationships

Pressure Charging / Structural

Pressure Charging and Transfer

Structural/Tectonic

Salt and Shale Diapirs

Hydrocarbon Buoyancy

Mechanism and Evaluation

Impact of Mechanism on Prediction and Evaluation

Mechanism Identification

Impact on Well Planning

Seals, Cells and Compartments

Introduction

Seal Definition

Types of Seal

Cells and Compartments

Seal Breach

Seal Capacities

Day 3

Hydrodynamics

Overview

Buhrig's Model

Potentiometric Surfaces

Tilted Hydrocarbon Contacts

Case Study: Kraka Field, Danish Sector

North Sea Palaeogene Hydrodynamics Case Study

Formation Pressure Evaluation

PART 1: Curve Trend Line Analysis Methods and Pre-Well Prediction

Pore Pressure Prediction and Evaluation Basics

Importance of 'shale'

Normal Compaction Trend (NCT)

Data Used in Trend Analysis

Quantitative Analysis Methods

Ratio Methods

Equivalent Depth or Matrix Stress Method

Eaton Method

Overlays

Common Problems

What Method Should Be Used?

Curve Trend Analysis – Well Data

Introduction

Sonic log or ITT (Interval Transit Time)

Resistivity (Conductivity) log

Density logs

LWD Wireline Curve Summary

Predictive Methods

Seismic Predictive Methods

Basin Modelling

Offset Well Data

Combining the Predictions

Part 2: Direct Pressure Measurements

Direct Pressure Measurements

Overview

Influxes and Kicks

Wireline and LWD Pressure Measurements

Drill Stem Tests

Fracture Pressure Measurements

LOTs and FITs

LOT Plots and Diagnoses

Mud Losses/Lost circulation

Wellbore Strengthening – ‘Stress Cage’

Measurement After Drilling (MAD)

Geologist’s Roles in Lost Circulation

Day 4

Part 3: Indirect Pressure Indicators

Indirect Pressure Indicators

Introduction

Drilling Indicators

Drilling rate and Drilling Exponents.

Using Drill Rate in While-Drilling Evaluation

Drilling Exponents

Using the Dxc

Shale Characteristics

Shale Density

Shale factor

Hole Conditions

Drilling Terminology – Swab and Surge

Other Drilling Related Terminology

Typical Hole Conditions with increasing pressure

Trip Condition Log

Non Pore Pressure Related Hole Problems

Cuttings and Cavings

Cuttings Size and Appearance

Pressure Cavings

Other Types of Caving

Monitoring Cuttings and Cavings Sizes

Summary

Gas Relationships

Gas Terminology

Typical Gas Reactions

Underbalanced Drilling

Connection Gas uncertainty

Isolating gas events

Gas Ratios

Monitoring Gas Events

Summary

Geothermal Gradient and Temperature

Overview

Mud Temperature

Plotting the FLT data

Summary

Mud Resistivity/Conductivity (Chlorides)

Formation Pressure Prediction and Evaluation in Non-clastics

The Problem

Non-clastics and Pore Pressure Prediction

Effect of Uncertainty in Well Planning

Formation Pressure Evaluation in non-clastics

Non-clastics case study

Day 5

Part 4: Other Support Tools and Evaluation Process

Other Support Tools

LWD Tool Drilling Measurements and PWD

Hole conditioning monitoring

Mud Flow In and Out/Pit levels

Pump Pressure

Calcimetry

Evaluation Process

Pressure Evaluation Process

Pressure Evaluation Software

Basic Pressure Evaluation

Identification of Wellbore Breathing

Good Practices

Overview

Good Practices

Post Well Evaluation

Overview

End of Well Reporting

CPD Unit

Continuing Professional Development

35 HOURS CPD