PETROSYNC'S GEOSCIENCE SERIES

FORMATION PRESSURE PREDICTION & EVALUATION

Master Formation Pressure Evaluation to Facilitate Effective Well Design, Reduce Drilling Risks, NPT, and Associated Costs

15-19 August 2016
Bandung, Indonesia
Course Overview
Formation pressure characteristic is a key factor to evaluate for exploration targets. It reflects hydrocarbon generation and migration, which are key considerations for exploration evaluation, as well as for drilling decisions.

This course will provide a better understanding of pressure characteristics found in the subsurface. Delegates will be able to define the fundamentals of pore pressure, fracture pressure, and overburden pressure as well as earth stresses.

Practical Methodologies and Techniques in Formation Pressure Evaluation
Techniques in evaluating formation pressure both qualitatively and quantitatively will be presented, including methods for pre-well prediction using seismic and basin modeling as well as evaluation using trend analysis and pore pressure indicators.

Integrated Evaluation from Subsurface and Drilling Data
Techniques on how to correlate and verify subsurface and drilling data will be developed into a working evaluation processing in order to fully understand formation pressures. You will be able to integrate subsurface data & drilling events, control data quality, identify non-pore pressure related hole problems, and understand the behavior of data before making any prediction analysis.

How Does This Course Benefits You?
Identify Pore Pressure Indicators and Learn Techniques to Detect Them
Identify pore pressure indicators and learn techniques to detect them through understanding of the different formation pressures from pore, fracture, and overburden.

Utilize Formation Pressure Analysis for Hydrocarbon Evaluation
Master the evaluation and calculation of subsurface pressures through both quantitative and qualitative methods.

Design Safe Drilling and Well Planning for HPHT Wells
Understand critical data requirements for pore pressure prediction and evaluation and understand the hazardous events of influxes and kicks during drilling operations.

Generate a More Informed Decision through Integrated Data Analysis
Integrate subsurface data & drilling events, control data quality, identify non-pore pressure related hole problems, and understand the behavior of data before making any prediction analysis.

PetroSync Quality Assurance
All PetroSync courses are developed with top quality to address all your training needs and purposes. Our courses are vetted strictly to ensure that we always deliver the best courses with the best industry expert.

PetroSync Inhouse Solutions
PetroSync can tailor our courses to meet your specific needs at your preferred location and schedule. Contact us for more information at +65 6415 4500 or email to general@petrosync.com
Who Needs This Program

- Those who are involved with analysis of formation pressure, either during development or during the operational stage

Job Titles Include:

- Operations Geologists
- Wellsite Geologists
- Operations Petrophysicists
- Exploration Geologists
- Geoscientists
- Exploration/Subsurface Managers

Course Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>08:00—09:00</td>
<td>Registration (Day 1)</td>
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<tr>
<td>09:00—11:00</td>
<td>Session I</td>
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<tr>
<td>11:00—11:15</td>
<td>Refreshment Session I</td>
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<tr>
<td>11:15—13:00</td>
<td>Session II</td>
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<tr>
<td>13:00—14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00—15:30</td>
<td>Session III</td>
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<tr>
<td>15:30—15:45</td>
<td>Refreshment Session II</td>
</tr>
<tr>
<td>15:45—17:00</td>
<td>Session IV (Last Session)</td>
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PetroSync Distinguished Instructor

Tim has over 35 years of experience in the industry both in operations geology and wellsite operations. He is a recognized expert in formation pressure evaluation in BP, ExxonMobil, and BG. Since 2000, he has worked on HPHT wells for ExxonMobil and BP for pore pressure projects and training manuals. He is the Founder and Principal Consultant of his own consulting firm, Tim Herrett Ltd, where he provides various services to upstream oil industry.

Training

Tim has been heavily involved in training throughout his career either on a one to one basis at the wellsites or presenting to classes. Over the last 15 years has written and presented a number of well-received courses on wellsite and operations geology and pore pressure evaluation to the oil industry. Tim is currently the principal presenter of BP’s in-house Operations Geology course. He is also a part time lecturer in Wellsite/Operations Geology and Wellsite Data Management on the petroleum geoscience master’s degree at the Universities of Manchester and Derby in the UK.

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Course Agenda — 5 Days

DAY 1

FORMATION PRESSURES — DEFINITION, INFLUENCES, CALCULATION METHODS, RELATION TO EARTH STRESSES

Overview of Formation Pressure Evaluation

Formation Pressure Background
- Fluid, Hydrostatic, and Pore Pressures
- Pressure Gradients and Equivalent Mud Weights
  - Stress Definitions
- Exercises: Conversion of Pressure and Pressure Gradient Units

Earth Stress—Definition and Theory
- Theory of Stresses
- Borehole Stresses
- Implications of Stress Imbalances
- Wellbore Stability Analysis

Overburden Pressures and Gradient
- Methods of Calculation
- Formation Density
- Exercises: Calculation of Overburden Gradient

Fracture Pressures and Gradients
- Influences on Fracture Pressure
- Methods for Estimating Fracture Pressure Gradient
- Techniques for Measuring Fracture Pressure
- Borehole Breakout
- Mud Losses and Loss Circulation
- Fracture Pressure Gradient — Role in Well Planning
- Exercises: Calculation of Fracture Pressure Gradient using LOT data and for Casing Placement

Plotting Formation Pressures
- Pressure Plots
- Equivalent Mud Weight Plot
- Effect of Measurement Datum

Other Formation Pressure Terminology
- State of Balance
- Static and Dynamic Densities
- Swab and Surge

DAY 2

PORE PRESSURE GENERATION MECHANISMS AND CONTROL ON DISTRIBUTION

Syn depositional/Compaction Related - Primary Mechanisms
- Undercompaction/Compaction Disequilibrium
- Syntectonic
- Chemical and Diagenetic Changes
- Osmosis/Ionic Filtration

Post Depositional/Non Compaction Related—Secondary Mechanisms
- Pressure Charging and Transfer
- Centroid Effect
- Aquathermal
- Structural/Tectonic
- Role of Faulting
- Hydrocarbon Generation and Cracking
- Salt and Shale Diapirs
- Hydrocarbon Buoyancy
- Exercises: Calculation of Fluid Densities, Hydrocarbon Densities, Buoyancy from MDT data

Impact of Mechanism on Prediction and Evaluation:

Seals, Cells, and Compartments
- Introduction
- Seals
- Cells and Compartments
- Seal Breach

Hydrodynamics
- Overview
- Buhrg’s Model
- Potentiometric Surfaces and Tilted Contacts
- Exercises: Application of Potentiometric Surfaces
DAY 3
FORMATION PRESSURE EVALUATION (PART 1)

Wellsite Formation Pressure Evaluation
- Introduction and Overview
- Fundamental Aspects

Quantitative Analysis Method
- Ratio Method
- Equivalent Depth or Matrix Stress Method
- Eaton Method
- Common Problems
- What method should be used?

Curve Trend Analysis
- Sonic Log or ITT
- Resistivity/Conductivity
- Density
- Exercise: Calculation of Pore Pressure from Sonic Log

Pre-Well Pressure Prediction Methods
- Seismic Methods
- Basin Modeling Methods
- Use of Offset Well Data
- Error Bar Management

Wireline and Logging While Drilling (LWD)
- Using Log Data
- Trend Line Set-Up
- Direct Pressure Measurements
- Influxes and Kicks
- Case Study: Analysis of Kicks Indications
- Exercise: Evaluation of Problematic MDT Data
- Exercise: Evaluation of Problematic MDT Data
- Drill Stem Tests

Fracture Pressure Measurements
- LOTS and FITs
- LOT Plots and diagnosis
- Mud Losses / Lost Circulation
- Background
- Stresses
- Wellbore Strengthening
- Case Study: LOT Plot Types

DAY 4
FORMATION PRESSURE EVALUATION (PART 2)

Indirect Pressure Indicators :
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
- Shale Resistivity

Hole Conditions
- Terms for Hole Conditions
- Typical Hold Conditions with Increasing Pressure

Trip Condition Log
Non-Pore Pressure Related Hole Problems :
Cuttings and Cavings
- Cutting Size and Appearance
- Pressure Cavings
- Other Types of Cavings
- Monitor Cuttings and Cavings Sizes

Gas Relationships
- Gas Terminology
- Typical Gas Reactions
- Underbalanced drilling
- Connection Gas Uncertainty
- 10-10-10 - Isolating Gas Events Gas Ratios
- Summary
- Exercise: Calculation of Pore Pressure from DXC and Using Background Gas & Gas Events

Geothermal Gradient
- Mud Temperature
- Plotting the FLT Data

Mud Chlorides
- Case Study: How we got a wrong evaluation (Diagnosis & Analysis)

Other Support Tool
- LWD Tool Drilling Measurements and PWD
- Mud Flow In/Out and Pit Levels
- Pump Pressure
- Calcimetry

Good Evaluation Practice
Case Study: Unexpected Pore Pressure Increase
Post Well Evaluations
- End of Well Reporting
DAY 5
PREVENTION AND MANAGEMENT OF INFLUXES AND KICKS

Overview
- What is an Influx?
- Causes of Influx
- Influences on Kick Severity
- How do we stop an Influx?

How do we recognize an Influx?
- When do Influx occur?
- Influx Detection by Operation
- Actions on Detecting an Influx- Example of a Kick While Circulating

Kick Evaluation
- Initial Kick Evaluation
- Other Required Data
- Equations and Calculations
- Exercises: Calculation of Kill Density and Influx Type from Shut-In Pressures and Well Data

Well Kill Processes
- Description of Well Kill Methods
- Complications
- End of Kill Processes

Geologists’ Roles in Kick Control
- Wellsite Geologist
- Operations Geologist
- The “Post Mortem”

Course Summary and Conclusion
INVESTMENT PACKAGES (Please Circle)

<table>
<thead>
<tr>
<th>INVESTMENT PACKAGE</th>
<th>DEADLINE</th>
<th>FULL MASTERCLASS</th>
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<tbody>
<tr>
<td>Standard Price</td>
<td>12 August</td>
<td>USD 3,395</td>
</tr>
<tr>
<td>Early Bird Offer</td>
<td>15 July</td>
<td>USD3,195</td>
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<tr>
<td>Group Discount (3 or more Delegates)</td>
<td>12 August</td>
<td>USD 3,055</td>
</tr>
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Group Discount is based on Standard Price

*To enjoy the promotion & discount offer, payment must be made before deadline
* For 7 or more delegates, please inquire for more attractive package.
* Prices include lunches, refreshments and materials. Promotion & discount cannot be combined with other promotional offers.
* Important: Please note that registration without payment will incur a SGD 200 administration fee.

DELEGATES DETAILS

1st Delegate Name:               
Direct Line Number:              Email:         
Job Title:                      Department:    
Head of Department:             

2nd Delegate Name:               
Direct Line Number:              Email:         
Job Title:                      Department:    
Head of Department:             

3rd Delegate Name:               
Direct Line Number:              Email:         
Job Title:                      Department:    
Head of Department:             

PAYMENT TERMS
Payment is due in full at the time of registration. Full payment is mandatory for event attendance.

PAYMENT METHOD

☐ By Credit Card: Please debit my credit card: Visa ☐ MasterCard ☐ AMEX ☐ Security Code: 
Card Number:             Expiry Date: 
Name Printed on Card:       

☐ By Direct Transfer: Please quote invoice number(s) on remittance advice
PetroSync Global Pte Ltd Bank Details: 
Account Name: PetroSync Global Pte Ltd
Bank Name: DBS Bank Ltd
Account No: SGD: 288-901898-0 USD: 0288-002682-01-6
All bank charges to be borne by payer. Please ensure that PetroSync Global Pte Ltd receives the full invoiced amount.

CONFIRMATION

I agree to PetroSync’s terms & conditions, payment terms and cancellation policy.

Authorized Signature: ____________________________

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