Wellsite Operations
Training Courses
2020

Wellsite Geology
Mudlogging
Formation Evaluation
Drilling Technology

www.stag-geological.com
Training Overview

### Scheduled Open Courses

Since 1995 Stag have been providing wellsite operations and formation evaluation training courses for personnel from Major Operators and Service Companies throughout the world.

We provide regular open sessions at our training centres in Reading, U.K. and Perth, Western Australia.

### In-House Programmes

All our programmes can be presented in-house. In 2019 we presented courses in Dubai, Sydney, London and Solihull.

### Bespoke Course Design

We can design programmes to suit your specific needs for presentation at any time, in any location, world-wide.

### Course Accreditation

We have received accreditation from The Geological Society of the United Kingdom for the following courses:

- WO1: Introduction to Drilling & Wellsite Geology
- G2: Operations & Wellsite Geologist
- FE1: Basic Log Interpretation
- P1: Formation Pressure Evaluation
Bespoke Training

- All our scheduled public courses are available to organisations on a proprietary basis for presentation at any location, world-wide at a mutually convenient time.

- Rates for proprietary courses are based upon location, course length, numbers of participants and the need for any re-design to suit specific requirements.
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<th>Month</th>
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<td>WO1: Introduction to Drilling &amp; WSG</td>
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Wellsite Operations Training

G2: Operations & Wellsite Geology

Target Audience
- Wellsite Geologists
- Operations Geologists
- Mud Loggers
- MWD Operators
- Directional Drillers
- Technical & Support Staff

Course Length
4 days

Course Fee
£1950 (+VAT)

Operations & Well Planning
- Well Planning Processes
- Geological Prognosis
  - Geology & Stratigraphy
  - Pore Pressure/Fracture Gradient
  - Site Survey & Shallow Gas
  - Other Geological Hazards
- Geological Data Acquisition Procedures

Wellsite Geology
- Duties and Responsibilities
- Supervision of Wellsite Services
  - Mudlogging
  - Coring
  - Wireline Logs
  - MWD
- Lithology and Completion Logs
- Geological Reports

Geological Control & Geosteering
- Wellsite Geological Techniques
  - Drill Cuttings Evaluation
  - Gas Evaluation
  - Log Interpretation
- Geosteering Techniques
  - Drilling Overburden
  - Landing the Well
  - Drilling the Reservoir
Course Aims

To provide an overview of the role of Operations and Wellsite Geologists in Well Planning and Drilling Surveillance phases. To provide practical instruction in wellsite geological techniques and geosteering co-ordination.

Delegates will learn how to:

• Describe & Evaluate drill cuttings

• Produce a Formation Pressure Profile to include estimated pore pressure and fracture gradient data

• Determine Lithology and Reservoir information from well logs

• Use Mudlogging and MWD data to perform real-time geosteering co-ordination

Operations Geology Overview
Duties & Responsibilities
Well Planning Processes
G&G Chapter of Drilling Programme
Geology & Stratigraphy
Pressure Profile
Site Survey & Shallow Gas
Geological Hazards
Data Acquisition Procedures
Provision of Wellsite Services
Identification & Selection
Logging Programmes
Data Management & Distribution
Technical Support

Wellsite Geology
Duties and Responsibilities
Supervision of Wellsite Services
Mudlogging Services
Mudlogging Units
Sensors
Data Acquisition
Gas Detection
Sampling and Cuttings Evaluation
Depth and ROP
Coring Services
Conventional
Sidewall
Coring Procedures
Retrieval and Packing

Wireline Logs
Witnessing & QA Procedures
Quick-Look Log Interpretation
MWD/LWD Services
Directional Surveys
Formation Evaluation Services
Documentation & Reports
Daily/Weekly
Lithlog & Composite Log Preparation
End-of-Well Report

Practical Wellsite Geology
Description & Evaluation of Drill Cuttings
Oil Show Evaluation
Basic Log Interpretation
Construction of Lithlog from cuttings and log data
Geosteering & Geological Control
Strategies & Teamwork
Horizontal & ERD Formation Evaluation
Geological Targets
Structural & Well Path control
Landing the Well
Drilling the Reservoir
Calling T.D.

Geosteering Case Study
Real-time geosteering case study using LWD, MWD & Mudlogging data in a role-play exercise
Wellsite Operations Training

Stag Geological Services Ltd.
3 Fortuna Court, Calleva Park
Aldermaston, Reading
RG7 8UB, United Kingdom

tel: +44 (0) 118 982 0151

Target Audience
- Wellsite Geologists
- Operations Geologists
- Mud Loggers
- Drilling Engineers
- Directional Drillers
- MWD Operators
- Technical & Support Staff

Course Length
5 days

Course Fee
£2050 (+VAT)

WO1: Introduction to Drilling & Wellsite Geology

Drilling Technology
- Well Planning & Rig Selection
- Drilling Equipment & Techniques
  - Drillstring Design & Bit Technology
  - Drilling Fluids & Well Control
  - Casing & Cementing
  - Directional Drilling

Wellsite Geology & Mudlogging
- Data Acquisition Systems
- Evaluation of Drill Cuttings
- Gas Detection Equipment
- Lithology Logs
- Safety Monitoring

Formation Evaluation
- Cuttings Descriptions
- Coring Procedures
- Wireline Logging
- Measurement While Drilling
- Oil & Gas Show Evaluation
- Geosteering Techniques
WO1: Introduction to Drilling & Wellsite Geology

Course Aims

To provide an introduction to drilling technology and wellsite geological techniques for those personnel new to the industry or transferring from non-operational roles.

Delegates will learn:

About the fundamental processes of drilling oil and gas wells

About the rig types, onshore and offshore drilling techniques, the drillstring components, drill bits, drilling fluids, casing and cementing operations, well control and directional drilling operations

How wellsite geologists collect & interpret geological data during the drilling process

About Surface data Logging, Coring, Wireline Logging and LWD Services

About, and receive instruction and hands-on practice in, the microscopic description of drill cuttings and oil shows

Drilling Rigs

- Land Rigs
- Offshore Rigs
- Platforms

Drilling Technologies

- Bit Technology
- Design: Roller cone; PDC Applications
- BHA Design, Drill Pipe
- Hoisting, Rotating, Motion Compensation
- Well Control Equipment
- Drilling Fluids
  - Properties & Specifications
  - Fluid Systems:
    - Oil Based Mud
    - Water Based Mud
    - Polymer Fluids
    - Synthetic Systems
- Fluid Circulation System
- Hydraulics Calculations
- Casing and Cementing
- Directional Drilling
  - Applications
  - Steering Systems
  - Formation Evaluation
  - Survey Processes/calculations

Drill Returns Logging

- Mud Logging Services
- Cuttings Recovery
- Lag Time Calculations
- Hydrocarbon Gas Evaluation
  - Total Gas Chromatographic Analysis
  - Interpretation of Gas Shows

Wellsite Geology

- Cuttings Sampling and Preparation
- Cuttings Description
  - Clastics
  - Carbonates
  - Evaporites
- Reporting Procedures
- Lithology Logs
- Oil and Gas Show Evaluation
  - UV Light and Solvent tests

Coring Operations

- Conventional Coring
- Sidewall Cores

Formation Evaluation

- Wireline Logging Operations
- MWD Operations
Target Audience

- Wellsite Geologists
- Operations Geologists
- Mud Loggers
- Directional Drillers
- Technical & Support Staff

Course Length

3 days

Course Fee

£1500 (+VAT)

Obtaining Well Logs

- The nature of well logs
- Conveyance Methods
- Borehole Environment
- Invasion
- Log Scales and Presentation
- Theory of Operation
  - Gamma Ray
  - Resistivity
  - Neutron Porosity
  - Density
  - Sonic

Log Interpretation

- Log QC
- Lithology Determination
  - Gamma & S.P.
  - Density/Neutron Logs
- Crossplots
- Facies & Environments

Reservoir Evaluation

- Recognition of Permeability
- Identification of Hydrocarbons
- Fluid types & contacts
- Porosity and Permeability Determination
- Water Saturation (Sw) estimation
FE1: Basic Log Interpretation

Course Aims
To enable delegates to determine lithology, reservoir and pore fluid characteristics using Quick-Look log interpretation techniques from traditional open hole Wireline and LWD logs.

Delegates will learn how to:

• Identify lithology from well logs
• Identify and evaluate potential reservoir rocks
• Determine porosity from Sonic, Bulk Density and Neutron Porosity logs
• Identify and evaluate hydrocarbon bearing zones and calculate Sw using Archie and graphical methods
• Correct for borehole and environmental conditions

Wireline Logs: Basic Concepts
Types of Open Hole Logs
Information Required
Log Header
Relationships
Borehole Environment
Invasion Profiles
Rw & Rmf
Porosity and Permeability
Resistivity and Water Saturation
Temperature Corrections

Theory of Operation
Spontaneous Potential
Gamma Ray
Resistivity Logs
Laterologs
Induction Logs
Microresistivity Logs
Neutron Porosity
Sonic
Formation Density
Dipmeter Tools

MWD & LWD Tools
Theory of Operation
Transmission Systems
Tool Configuration
Sensors
Operating Procedures and Practice
MWD/Wireline Response Comparison
Borehole Imaging Logs

Geological Interpretation
Identification of Lithology
Environment and Facies
Identification of Permeability
Identification of Porosity
Geosteering Applications

Reservoir Evaluation
Quick Look Porosity Calculations
Identification of Hydrocarbon Bearing Zones
Hydrocarbon Type Evaluation
Saturation Calculations
Archie
Shaly sands
Carbonates
Resistivity Ratio
Cross-Plots

Imaging logs
Sonic
Density
Resistivity

Case Studies and Worked Examples
Wellsite Operations Training

Target Audience

- Wellsite Geologists
- Operations Geologists
- Mud Loggers
- MWD Operators
- Drilling Engineers
- Directional Drillers
- Technical & Support Staff

Course Length

3 days

Course Fee

£1500 (+VAT)

Well Planning

Planning Wells with a safe operating window
Health, Safety, Security and Environment
Drilling HPHT Wells
Shallow Gas

Pressure Concepts and Gradients

Definitions and Normal Pore Pressure
Overburden Pressure Calculations
Pressure Gradient Calculations
Fracture Pressure Calculations & Modelling

Abnormal Pressure

Causes of Abnormal Pore Pressure
Pore Pressure Prediction from:
- Dxc, ROP, Mud-Gas relationships
- Resistivity, Sonic, Density data
- Borehole Stability: cavings, torque and drag, overpull

Fracture Pressure

Evaluation of Rock Fracture Pressure:
- Leak-Off Tests
- Mathematical Modelling
- Kick Tolerance

Well Control Procedures
Course Aims

To familiarize delegates with the challenges of planning and drilling wells in a safe operating window to minimize Health and Safety Incidents and Non-Productive Time.

To provide practical instruction in pore pressure and fracture pressure prediction to produce PPFG plots.

Delegates will learn:

• How to calculate and plot normal hydrostatic pore pressure and overburden pressure

• About the mechanisms that generate abnormal pore pressures

• How to calculate fracture pressure for LOT data and mathematical models

• How to produce PPFG plots from offset well data

Introduction
Well Planning Requirements
Safe Operating Window (PP-FG)
Pore Pressure prediction and detection
Wellbore Stability
Fracture Pressure

Health, Safety, Security, Environment
Requirements and Well Planning
Recent Incidents
Operator Responsibilities
Individuals' Responsibility
General Duty

HP/HT Drilling: Definitions & Challenges
Definitions of HPHT
High Fluid Density
High Formation Temperature
Narrow Operating Windows
Managed Pressure Drilling

Formation Pressure Evaluation
Fundamentals
Hydrostatic Pressures
Pressure Gradients
Elevations and Datums
Formation Balance Gradient
RFT data and PZ plots
Overburden Pressure Gradient
Data Sources
Calculation methods

Origin of Abnormal Pore Pressure
Compaction Disequilibrium
Aquathermal Processes
Clay Diagenesis
Stratigraphic Processes
Tectonic Processes
Fluid Expansion

Practical Formation Pore Pressure Evaluation
Seismic Data
ROP and Dxc
Formation Gas Evaluation
Borehole Behaviour
Drilling Parameters
Drill Cuttings and Cavings
Geothermal Gradients
Wireline/MWD Data

Methods
Trend Line Methods
Ratio
Eaton
Equivalent Depth
Unloading
Bowers

Fracture Pressure Gradients
Kick Tolerance

HP/HT Drilling: Definitions & Challenges
Definitions of HPHT
High Fluid Density
High Formation Temperature
Narrow Operating Windows
Managed Pressure Drilling

Formation Pressure Evaluation
Fundamentals
Hydrostatic Pressures
Pressure Gradients
Elevations and Datums
Formation Balance Gradient
RFT data and PZ plots
Overburden Pressure Gradient
Data Sources
Calculation methods

Origin of Abnormal Pore Pressure
Compaction Disequilibrium
Aquathermal Processes
Clay Diagenesis
Stratigraphic Processes
Tectonic Processes
Fluid Expansion

Practical Formation Pore Pressure Evaluation
Seismic Data
ROP and Dxc
Formation Gas Evaluation
Borehole Behaviour
Drilling Parameters
Drill Cuttings and Cavings
Geothermal Gradients
Wireline/MWD Data

Methods
Trend Line Methods
Ratio
Eaton
Equivalent Depth
Unloading
Bowers

Fracture Pressure Gradients
Kick Tolerance
G1: Introduction to Geology

Target Audience
- Drilling Engineer
- Directional Drillers
- MWD Operators
- Bit Design Engineers
- Drilling Fluids Engineers
- Technical Assistants
- Office Support Staff

Course Length
3 days

Course Fee
£1500 (+VAT)

Geological Processes
- Structure of the Earth
- Stratigraphy & the Time Scale
- Rock Classification
  - Sedimentary Processes
  - Surface Processes
- Environments of Deposition

Structural & Petroleum Geology
- Bedding & Lamination
- Dip & Strike
- Folding
- Faulting
- Geological maps
- Petroleum Geology
- Origin & Migration
- Reservoirs & Traps
- Reservoir Fluids

Sedimentary Petrology
- Grains & Minerals
- Textures
- Porosity & Permeability
- Pore Fluids
- Log Interpretation
- Wellsite Geology & Drilling
Course Aims

To provide an introduction to petroleum geology and practical wellsite geological procedures for engineers and those without formal geological training.

Delegates will learn how to:

- Recognize the physical and chemical properties of the major sedimentary rocks
- Examine hand specimens and drill cuttings of all the major rock types
- Understand sub-surface structures and basic reservoir geology
- Understand the effect of geology on key drilling practices
- Interpret lithology & geological features from LWD & Wireline Logs

Introduction to Geology
Structure of the Earth
Plate Tectonics/Continental Drift
The Geological Time Scale
Stratigraphy and Fossils
Rock Forming Minerals
Rock Classifications
  - Igneous
  - Metamorphic
  - Sedimentary

Sedimentary Rocks
Classification Schemes:
  - Clastics
  - Carbonates
  - Chemical Rocks

Geological Processes
Surface Processes
  - Weathering, Erosion, Transportation
  - Environments of Deposition
    - Continental
    - Fluvial
    - Marine

Depositional Features
  - Bedding & Lamination
  - Sedimentary Features
  - Erosional Features

Structural Geology
  - Dip & strike, Folding and Faulting

G1: Introduction to Geology

Geological Maps
Creating surface maps from outcrop data
Drawing structural cross sections

Petroleum Geology
Origin of Hydrocarbons
Migration
Traps
Reservoir Properties

Sedimentary Petrology

Mud Rocks:
  - Textures, Colours, Mineralogy, Environments

Sandstones:
  - Grain Texture, Components, Cements, Porosity and Permeability, Environments

Carbonates:
  - Components, Grains, Cement/Matrix, Diagenesis, Environments, Dunham Classification

Chemical Rocks:
  - Evaporites, Others

Drill Cuttings /Oil Show Evaluation
Sample Collection/Processing
Sample Description & Analysis
Oil Show Evaluation

LWD & Wireline Logs
Lithology from Basic Open Hole Logs
Target Audience
- Wellsite Geologists
- Operations Geologists
- Petrophysicists
- Exploration & Development Geologists
- Reservoir Engineers
- Technical & Support Staff

Course Length
3 days

Course Fee
£1500 (+VAT)

Overview
- The course will be a combination of short lectures, practical workshops and plenary discussions to consolidate learning.
- Each topic will be presented by the expert tutor using MS PowerPoint presentations.
- Sessions will be structured carefully to ensure optimisation of learning expectations verbally and on PowerPoint, 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.
- Attendees should be familiar with basic calculation and charting functions in Excel.
- Attendees will have opportunities to share their own experiences, discuss data and explore any issues they may have had relating to core and core analysis data.
C1: Best Practices in Core Handling & Analysis

Day 1
- Course Introduction – Why do we Core?
- Introduction to Coring
- Coring in ‘Problematic’ Formations: Fractured, Vuggy and Unconsolidated Formations
- Pressure Coring
- Safe Core Recovery
- Wellsite Core Handling: inc. Core Stabilisation Methods
- Core Transport to the Laboratory
- Factors Affecting Core and Log data Quality
- Introduction to Scales of Measurement in Core Analysis and Logs

Day 2
- The Effects of Heterogeneity on Core and Log Data
- Core to Log Depth Shifting Theory and Practice
- Sidewall Coring/Plugging: Tool Types, Sample Recovery Handling, Limitations
- Designing a Core Analysis and SCAL Test Programme
- Core Analysis Laboratory Selection
- Core Handling in the Laboratory
- Sample Selection, Plugging, Core Slabbing and Preserving
- Sample Cleaning and Dying Methods
- Core and Log Porosity: Understanding Different Measurements Factors Affecting Data Quality and Integration
- Permeability: Controlling Factors, Measurement Choices and Quality Control
- Pore Volume Compressibility and Net Overburden Pressure: Its Effects on Core Analysis Data
- Mineralogy from Core: Different Measurement Types and Integration with Log Data
- Definition of Pore Geometry from Core using Mercury Injection Capillary Pressure, Backscattered Electron Microscopy and CT Imaging
- Course Conclusion and Review

Course Aims
- To provide an understanding and appreciation for best practice in core handling and processing.
- Provide an awareness of the effects of mineralogy and heterogeneity on core and log data quality.
- Be able to design a core sampling strategy and build a core analysis programme for all stakeholders.

Delegates Will Learn:
- About different coring techniques
- How to recover and process core safely and competently
- The importance of heterogeneity and mineralogy and their effects on sampling strategy
- How to design a core analysis test programme and work successfully with laboratories
- How to measure porosity, permeability and water saturation in core
- Gain an understanding of methods to integrate core analysis data with log interpretation and geological models.
WPFT1: Geological control on drilling performance

Target Audience

Subsurface and Drilling personnel involved in Well Planning and Delivery:

- Well Planning Engineers
- Drilling Engineers
- Exploration Geologists
- Operations Geologists
- Wellsite Geologists

Course Length

5 Days

Course Style

A practical workshop, predominately field based using locations in and around Dorset and Somerset, southern UK.

Workshop Overview

A short field course to examine Geological control and influence on drilling predictability and performance.

This trip is suitable for all Subsurface and Drilling personnel involved in Well Planning and Delivery.

Course Summary

The standard workshop is based in Dorset and travels to other locations in Somerset.

Bespoke workshops can be designed around other areas of relevant geology specific to client requirements. This is particularly useful if a team wants to gain an appreciation of drilling considerations around a particular stratigraphy, structure or lithology, or perhaps to gain a better understanding of perceived or historically recognised problems.
WPFT1: Geological control on drilling performance

Course Aims

- To examine rocks in the field and build a mutual understanding, within the team, of why rocks drill the way they do.
  - To understand the geological significance to drillers.
  - To understand the drilling significance to geologists.
  - To appreciate geology that is predictable and what is not.
  - To help reduce uncertainty and geological NPT.
  - To promote the value of field and outcrop analogue, in the well planning process.
  - To improve performance in a cost challenged environment.

Delegates will learn that:

- During post-well evaluation of drilling problems it is often apparent that warning signs were missed, not recognised or ignored.
- Inappropriate reaction to observed warning signs often exacerbate or escalate problems.
- Many geology related issues experienced while drilling, or geological NPT, can be predicted and mitigated during well planning.
- Appropriate mitigation to unforeseen geological events experienced while drilling can be developed and promoted within a team to ultimately yield improved performance.

Common Scenarios

Scenarios that are considered and measured during this workshop:

- An event that was identified and predicted during the well planning process that became managed.
- An event that was identified and predicted during the well planning process but was worse than anticipated while drilling, but with appropriate planning as actively managed with little NPT.
- An event that was not predicted during planning, but due to enhanced reaction and mitigation planning, was managed with some NPT, but a significant event was avoided.
- An event that was not predicted during planning, was difficult to manage and resulted in significant NPT.
Discussion Topics

• Drilling unconsolidated, and poorly cemented sands
• Mudrocks matter to drillers!, and getting to grips with gumbo
• Sandstones, Chalk, Marl and Limestone - Planning for and managing losses
• Geological Scale - Seismic vs log resolution vs outcrop scale
• Faults, folds and other geological structures at various scales, and the problems that they can cause
• Bedding, Joints and other discontinuities and their influence on drilling
• Hard bands and negative drill breaks
• Geological control on directional drilling and geosteering
• Ledging, Key-seating and wellbore geometry
• Considerations for casing running and shoe positioning
• Predicting and mitigating drilling problems during the well planning process
• Using drilling data to interpret geology in the absence of logs
• Geosteering, geostopping and geology at the bit
• Predicting and mitigating wellbore Instability
• Understanding how geological uncertainty adds to the challenge of drilling
• Reservoir, Source and Seal rocks, Oil seeps

Discussion Topics Delegates will learn that:
Martin B. Saunders
Training Manager

has forty four years experience as wellsite geologist and technical training manager. He specializes in wellsite operations and petroleum geology training and has been teaching oilfield courses for twenty five years. Martin holds a B.Sc. (Hons.) degree in geology from the University of Wales, Aberystwyth and began his career with EXLOG (now Baker Hughes Inteq) in 1974 and worked at the wellsite before joining the training department of Baker Hughes in the UK in 1982. Here he was responsible for all internal technical training for the Europe/Africa/Middle East Division and was also responsible for the expansion of its external, commercial training operations.

He has presented courses throughout the world to personnel from major operators and service companies including BP, Exxon, Anadarko, MOL, Chevron, Maersk, Total, Wintershall, Perenco, ADNOC, Saudi Aramco, GDF Suez, Tullow Oil, Spirit Energy, Ophir Energy, Baker Hughes and Halliburton among many others.
Dr. Adam K. Moss  
Core Analysis Expert

Adam is a core analysis expert with over 25 years' experience working in petrophysics. He has designed and presented training courses internationally on a wide range of topics, including:

*Special Core Analysis for Reservoir Modelling, Guildford, UK, NAMCOR, September 2017*
*An Introduction to Special Core Analysis, Reading, UK, BG Group. January 2016*
*Unconventional Reservoir Core Analysis, Brisbane, Australia, Queensland Gas Company, November 2013.*
*NMR – Basic to Expert User, Abu Dhabi, UAE, Public Course, December 2003*

In 2017 Adam formed AKM Geoconsulting Ltd, to offer core and special core analysis consulting services to industry. From 2006 to 2016, he was the Global Group Technical Authority for Core Analysis at BG Group. He was responsible for all aspects of BG Group's coring and core analysis projects worldwide. This included defining best practice workflows and working with assets and multi-functional teams to ensure core analysis data was of the best quality and used appropriately. Prior to joining BG Group, he was the Senior NMR Petrophysicist at ResLab UK, and responsible for all aspects for the company’s NMR core analysis services.

Adam has an established track record in teaching and research in academia, working at the Royal School of Mines: Imperial College (1995-2001) and since 2015, as Honorary Assistant Professor at Heriot-Watt University. He served as president of the London Petrophysical Society (LPS) from 2010-2012.

He holds a PhD on the ‘Characterisation and Modelling of the Pore Structure of Reservoir Sandstones.’
Training Centre Locations

Reading, Berkshire, U.K.
3 Fortuna Court, Calleva Park
Aldermaston, Reading
RG7 8UB, United Kingdom
tel +44 (0) 118 982 0151

Aberdeen, Scotland, U.K.
Westpoint House
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