

# Advanced Quantitative Seismic Techniques

An integrated approach to minimize risk, achieve cost saving and improve success rate through learning the latest principles and practical applications

JW Marriott Hotel, Kuala Lumpur, Malaysia • 16,17 &18 March 2011



## Course Facilitator:

**Drs. Paul de Beukelaar**  
Director of SoleGeo

- Geophysicist & GeoScience Consultant
- 30 years of industrial experience
- SEG, AAPG, EAGE, PESGB, NPF member

Capitalise on expert knowledge to gain maximum value on these vital issues

- ❖ **OVERVIEW** of the entire workflow from acquisition, processing, interpretation to reservoir characterization
- ❖ **MASTER** key areas including 4D time lapse, AVO, seismic stratigraphy, inversion and rock physics
- ❖ **UNDERSTAND** the difference of QI application in carbonate and clastic reservoirs as well as in weathered and fractured igneous rocks
- ❖ **GRASP** the latest principles of quantitative, volumetric and visualisation methods
- ❖ **UPDATE** the latest techniques and operational excellence in advanced topics
- ❖ **INTEGRATE** seismic and borehole data for enhanced accuracy
- ❖ **LEARN** to deal with increasing complexity and high data volumes due to advances in seismic technology
- ❖ **INCREASE** success rate of hydrocarbon exploration with minimized risks
- ❖ **REDUCE** costs and **OPTIMIZE** reservoir development

**UNI** training courses are thoroughly researched and carefully structured to provide practical and exclusive training applicable to your organization.

Benefits include:

- Thorough and customized programmes to address current market concerns
- Illustrations of real life case studies
- Comprehensive course documentation
- The number of participants is strictly limited to 20 to ensure a valuable dialogue between participants and course facilitator

Official Hotel:



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## Prerequisites:

Delegates should have some exposure to seismic interpretation methods and practice to gain maximum benefits of this course.

## Workshop Overview

The first day of this training course will give an overview of all the current methods that help in making **seismic interpretation** more quantitative. That means getting a more accurate three dimensional definition of the subsurface based on deriving **physical quantities**. These methods might also include the use of **borehole measurements** for local time-depth and/or petrophysical calibration and spatial delineation and the use of known **geology**. Depending on background of the audience a brief review of seismic acquisition and processing methods will be presented, together with an introduction to classic and advanced seismic interpretation methods. Advanced **amplitude studies** show the importance in using seismic data for **reservoir characterisation**, reservoir monitoring and often as an enabler based on "what could be measured and predicted" in ranking prospects in exploration and production.

The second day presentations will be illustrated with case studies that show the integrated approach and the use of methods like **Amplitude versus Offset**, **Inversion** and the use of **Seismic Attributes** and also several methods from other geoscience disciplines in reducing risk and uncertainty. Quantitative seismic methods are also based on the fundamentals and empirical laws of **rock physics**. Core and log data analyses together with the most recent findings in **geomechanics** often help in making a detailed seismic interpretation at the appropriate scale size and within the physical limit of seismic **resolution**. Special attention will be given to characterisation of **Natural Fractured Reservoir** as this vast subject gets more and more important seen in a global perspective, shifting from passive margins to rifting, traps: fractured to e.g. stratigraphic and matrix: igneous/metamorphic/carbonate compared to clastic intragrain.

The third day more attention will be given to **Seismic Inversion** that branch of geophysics that evolved very rapidly last 10-20 years enabling both the selection of sweet spots in exploration as well as for making detailed maps of rock and fluid fill in quantitative reservoir characterisation. After a review of methods, an integrated AVO-Inversion: a case study will illustrate the importance of combining these two major techniques. More examples of geometric and more physical seismic attributes will be discussed. Seismic **stratigraphic studies** will be shown that include **facies and lithology mapping** by using **statistical** as well as **neural network** computations on borehole and seismic data. Other themes that will be presented are: The importance of reprocessing, Reservoir **monitoring** by the use of **4D or time lapse seismic** methods, in which repeated surveys can be compared, predicted or leading to **simulation models** and that reveal much detail in e.g. sequential production stages as well can be used to save large amounts of money through better well planning.

Further attention will be given to **passive seismic** and the increasing use of non primary wave type measurements and from measurements recorded in different directions (components). The present technical feasibility in measuring and recording **full azimuth, multichannel** and **long offset** seismic data, together with advanced techniques from e.g. earthquake seismology provide also better and better and more accurate interpretations of the subsurface to the benefit of the petroleum industry.

## DAY 1 / 16 March 2011

### SEISMIC DATA

- ❖ Acquisition brief review : parameter selection, survey, field QC and early processing
- ❖ Processing brief review : wavelet, fourier transform, work flows, NMO stretch, seismic velocity etc
- ❖ Quantitative interpretation methods: key elements, traditional and advanced methods

### ADVANCED AMPLITUDE STUDIES

- ❖ Seismic data for reservoir characterisation, reservoir monitoring and ranking prospects in exploration and production

### SEISMIC MODELLING, INVERSION, VSP AND DSI

### WELLS: INTERPRETATION, CALIBRATION AND TIME-DEPTH CONVERSION

### INTEGRATION OF BOREHOLE AND SEISMIC

- ❖ Core and log data analyses
- ❖ Most recent findings in geomechanics help in making a detailed seismic interpretation at the appropriate scale size and within the physical limit of seismic resolution
- ❖ Borehole measurements for local time-depth and/or petrophysical calibration and spatial delineation and the use of known geology

## DAY 2 / 17 March 2011

### ROCK PHYSICS ANALYSIS

- ❖ Stress-strain, velocity, density, modulus, velocity-porosity model, Vp-Vs relation, velocity density relation
- ❖ Rock property analysis: well logs, porosity and saturation
- ❖ Fluid replacement modeling: physical properties of gases and fluids, Batzle-Wang, Biot-Gassman etc

### NATURALLY FRACTURED RESERVOIR

- ❖ Characterisation of natural fractured reservoir
- ❖ AVO for fluid analysis in carbonate: carbonate reservoir properties
- ❖ Analysis, calibration and fracture characterization
- ❖ Fractured compared to e.g. stratigraphic
- ❖ Igneous/metamorphic/carbonate compared to clastic intra grain

### QUANTITATIVE INTERPRETATION

- ❖ Coping with increasing numbers of data volumes in most recent seismic technology
- ❖ Latest principles: quantitative, volumetric and visualization

### AMPLITUDE VERSUS OFFSET (AVO)

- ❖ Seismic gather, stack, different classes
- ❖ Stacking responses and AVO attributes
- ❖ Pitfalls

## ADVANCED SEISMIC ATTRIBUTES

- ❖ Amplitude attribute, complex attributes and time frequency attributes
- ❖ Types, physical-mathematical meaning and geological application

DAY 3 / 18 March 2011

## SEISMIC INVERSION

- ❖ Definition and purpose
- ❖ Acoustic and elastic
- ❖ Cross plots of well and seismic attributes
- ❖ Lambda Rho Mu Rho, EI and EEI
- ❖ Simultaneous rho, Vp, Vs
- ❖ Porosity and net to gross estimation

**Case study 1 :** Integrated AVO-inversion

**Case study 2:** Prestack inversion

Sweet spots in exploration as well as for making detailed maps of rock and fluid fill in quantitative reservoir characterisation

The importance of combining these two major techniques

More examples of geometric and more physical seismic attributes

## SEISMIC STRATIGRAPHY, FACIES AND NEURAL NETWORKS

- ❖ Theory and application
- ❖ Facies and lithology mapping by using statistical as well as neural network computations on borehole and seismic data

## 4D SEISMICS – TIME LAPSE

- ❖ Theory , criteria and reservoir simulation
- ❖ Multicomponent
- ❖ Reservoir monitoring
- ❖ Repeated surveys and reprocessing
- ❖ Prediction and simulation models
- ❖ Sequential production stages and better well planning

## PASSIVE SEISMIC AND NON PRIMARY WAVE TYPE MEASUREMENTS

- ❖ From measurements recorded in different directions (components).
- ❖ The present technical feasibility in measuring and recording **full azimuth**, **multichannel** and **long offset** seismic data, together with advanced techniques derived from e.g. earthquake seismology, which provide more accurate interpretations of the subsurface to the benefit of the petroleum industry

## Who Should Attend?

Geophysicists, Seismic Interpreters, Geologists, Petrophysicists, Reservoir Engineers, Technical Support Staff, and Data Processing Managers involved in exploration and development of oil and gas reservoirs.

## Why You Should Attend

Exploration companies need to be willing to accept and implement new technology. The slow pace of adoption of technology caused many companies to lose competitive edge. High Drilling costs force the need for more accurate seismic interpretation techniques. With the increasing exploration data volumes, interpreters struggle with them, and increasing the need for better interpretation techniques like quantitative and volumetric interpretation that gives accuracy to interpreting exploration data. This workshop will help you overcome these important issues with the latest practical interpretation techniques and useful workflows, using practical case studies and course material selected for this advanced training class. It is based on the 30 years of experience of Drs. Paul de Beukelaar as well as authors from academics, contractors and industry.

## PRE-COURSE QUESTIONNAIRE

To ensure that you gain maximum value from this course, a detailed questionnaire will be forwarded to you upon registration to establish your exact training needs and issues of concern. Your completed questionnaire will be analysed by the course trainer prior to the event and addressed during the event. You will receive a comprehensive set of course documentation to enable you to digest the subject matter in your own time.

## In-House Training

Cost effective In-house courses, tailored specifically to your organisation's needs, can be arranged at your preferred location and time. If you would like to discuss further, please contact our In-house division at iht@unistrategic.com.

## Program Schedule

### (Day 1 - Day 3)

08:30	Registration
09:00	Morning Session Begins
10:40 - 11:00	Refreshments & Networking Break
12:45	Luncheon
14:00	Afternoon Session begins
15:30 - 15:50	Refreshments & Networking Break
17:00	Course Ends

Maximum of 20 different questionnaires

## About your course facilitator

**Paul de Beukelaar** is a highly committed geophysicist and GeoScience consultant, with **30 years** of industrial experience. He has been actively involved in E&P companies in several G&G roles. Paul is experienced in **exploration risk assessments** and very skilled in the practice of **geophysical reviews**, such as writing reports, reserve estimate, well proposal and evaluation preparation, and bringing clear messages through cross-sections and attribute maps.

His recent successful effort includes the completion of a comprehensive **worldwide naturally fractured reservoir analogues database**. The early part of his career, he was a consultant and contractor in exploration and production teams, having responsibility in a variety of assignments in **seismic data processing, lithology prediction, seismic stratigraphic inversion and integrated projects**. In his graduation thesis work, he worked on pre-stack seismic data analysis even before anybody was talking about AVO.

Presently, Paul is providing GeoScience support to exploration companies in **Norwegian Awards in Predefined Areas (APA)** and open rounds and in **India** as principal project advisor for Quantitative Seismic Analysis and Naturally Fractured reservoirs in both Exploration and Production. Paul is regularly in charge worldwide, as advisor and consultant in **reviews, farm-ins, and QC** of existing 3D interpretations and inversion studies.

**Drs. Paul de Beukelaar's consulting work has extensive geographical coverage including** Northern, Central- and Southern North Sea, Norwegian Sea, Netherlands onshore, Paris Basin, Yemen, Carpatian Forelands, Southern Sumatra, Indonesia, Cooper Basin & Timor Sea, Australia, Sarawak Basin, Malaysia, Sirt, Murzuq and Al Jurf, Libya, Congo and Kwanza basins, Angola, Rajasthan and Bay of Bengal, India.

During last 12 years he worked as an independent consultant and contractor with and for exploration and production companies:

- ✓ Total
- ✓ Shell
- ✓ Schlumberger
- ✓ NAM (Shell/ExxonMobil)
- ✓ CPTL (Total Libya)
- ✓ Sonangol Angola
- ✓ Santos Australia
- ✓ GNPOC
- ✓ Petronas
- ✓ Pertamina
- ✓ GDF-Suez
- ✓ Marathon Oil
- ✓ PDVSA
- ✓ Maersk Oil
- ✓ Lundin
- ✓ FugroJason
- ✓ CGGVeritas
- ✓ EPTS
- ✓ IFP