AVO, Inversion, & Attributes - Analysis and Application

Enhance Your Capability in Seismic Data Interpretation with Modern AVO and Inversion Techniques
16th JUNE 2013 - 20th JUNE 2014 at Kuala Lumpur, Malaysia

PetroSync Distinguished Instructor
DR FRED AMINZADEH
Executive Director, Reservoir Monitoring Consortium USC
Professor of Petroleum Engineering, University of Southern California

Course Objectives

- UNDERSTAND the key principles and concepts of Seismic Attributes
- LEARN the fundamentals of conventional and unconventional statistical tools
- FIND out how to relate seismic and log data to reservoir properties for characterization application
- UNDERSTAND how pre-stack attributes are used for AVO and elastic inversion
- MANAGE risk factors and error margins in reservoir prediction
- OVERCOME the limitations and problems faced in applying these technologies
- OPTIMIZE the interpretation accuracy of seismic data in determining reservoir properties
- GAIN insight to tackling real-life E&P problems through real life case histories
- INTEGRATE different data and methods to optimize E&P

Specially Designed for

The course is designed for those who are involved in exploration activities who need a good understanding of the application of AVO, Inversions, and Attributes to seismic interpretation & reservoir modeling

- Exploration Geophysicists
- Exploration Geologists & Geoscientists
- Seismic Interpreters
- Seismic Processors
- Reservoir Engineers
- Exploration & Production Managers
This course contributes to better understanding of the key principles, analysis, and practical application of AVO Inversion and Seismic Attributes to seismic interpretation and reservoir characterization. This includes coverage of statistical and modern computing tools (i.e., geostatistics, neural networks, and fuzzy logic analysis) to better understand the nature of seismic images reflective of hydrocarbon presence. This technology allows for more effective interpretation of seismic images, to avoid pitfalls in interpretation, and to generate better representation of the rock attributes found in the subsurface.

The course emphasizes on practical aspects of seismic attribute analysis to improve interpretative capability of seismic data and determination of reservoir properties. Conventional and unconventional statistical methods used to calculate AVO/Inversion and Attribute results will also be tackled – focusing on when and how these methods should be combined to take advantage of their strength and minimize their weakness. Participants will learn how different seismic attributes and AVO/inversion results can be integrated to further enhance their usefulness.

This course will tackle various case studies in determining the hydrocarbon probability of an exploration target. Furthermore, the application of the AVO Inversion & Attributes to the characterization of the reservoirs as well as to monitoring of the changes in the reservoirs will also be tackled through examples. There will be several hands-on exercises which will enable participants to use the concepts taught to solve actual problems related to E&P process.

Course Content

Day One: Key Principles and Features of Seismic Attributes

Introduction & Summary of the Course

Seismic Attributes Categories vs. Hydrocarbon Reservoir Categories
- Hydrocarbon Reservoir Categories
- Seismic Attribute Categories
- Indirect Hydrocarbon Indication
- Direct Hydrocarbon Indication
- Evolving Roles of Seismic Attributes
- Issues in Linking Attribute Anomalies to Reservoir Properties

Seismic Attributes (SA) Technologies & Tools
- Technologic Evolution of SA Usage
- Software Categories of SA Tools
- Conventional Algorithms of Attribute Extraction
- Advanced Algorithms of Attribute Extraction
- Use of SA for Carbonates & Clastic Reservoirs
- New Directions for SA Software Developing

Problem Sets: Application of Seismic Attributes in Hydrocarbon Indication

Seismic Attributes: What are the Key Issues (Cont’d)
- Seismic Time-Scale and Time-Frequency Attributes
- Seismic Attribute Anomaly Patterns
- Tuning Effects on Seismic Attributes
- Acoustic, Elastic, and Inelastic Rock Physics Models
- Ten Types of Relationships between Attributes and Rock Properties

Significance of Seismic Attributes and Seismic Features
- Discrimination of Seismic Attributes
- Sensitivities of Seismic Attributes
- Correlation between Seismic Attributes and Log Properties
- Clustering of Seismic Attributes
- Pattern Recognition and Feature Detection

Existing Seismic Attribute Tools
- Tools for Improving Seismic Processing
- Tools & Workflow for Seismic Interpretation
- Tools for Integrating Seismic & Well Log Attributes
- Tools for Static & Dynamic Reservoir Characterization
- Assumptions and Limitations of Seismic Attribute Tools

Problem Set: Reservoir Analysis and Monitoring using Multiple Seismic Attributes
Over the years, there has been a growing demand for hybrid training programs. It is an excellent option to maximize your training dollar for your specific training needs. We make it possible to run a training program that is customized to your training needs at a fraction of an in-house budget!

If you like to know more about this program, please contact us on +65 6415 4500 or email general@petrosync.com
Day Four: Reservoir Property Prediction & Characterization

Amplitude and Inversion for Reservoir Quality
- Correlation between Amplitude and Porosity
- Reservoir Permeability from Impedance Information
- Reservoir Pressure: From Amplitude / Velocity to Lithology/Mud-Weight
- Reservoir Continuity and Connectivity from Seismic Amplitudes

Inversion/AVO Vendors (Software Review and Examples)
- STRATA Hampson-Russell; Petrel; Geoframe; SMT Kingdom

Seismic Attribute Applications to Reservoirs
- Knowing acquisition and processing histories of Seismic Datasets
- Seismic Attributes for Structural and Stratigraphic Imaging
- Seismic Attributes for Lithologic Interpretation
- Seismic Attributes for Fluid Imaging
- Multi-Attribute Seismic-Well Tying
- Seismic Attribute Workflow for Reservoir Characterization
- Misusage and Abuse of Seismic Attributes

Time Lapse Attributes
- Dynamic Reservoir Characterization
- Reservoir Monitoring
- Reservoir Management

Problem Set: Application of Seismic Attributes in Carbonate/Clastic Reservoir Characterization

Day Five: Case Histories and Participant Project Presentations

Highlighting Selected Case Histories
- Lithofacies Prediction: Unsupervised/Supervised
- AVO and Absorption (Hydrocarbon Probability)
- Reservoir Characterization (Sand Thickness, Porosity, Lithology, and Saturation)
- Assessing Changes in Reservoir Parameters with Time

Review of Examples of Attribute Project Work by Participants
Open Room Problems Discussion and Solutions Brainstorming
One to One Discussion Session
Summary and Conclusion

PROGRAM SCHEDULE

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<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>08:00</td>
<td>Registration (Day1)</td>
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<tr>
<td>09:00</td>
<td>Session I</td>
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<td>11:00</td>
<td>Refreshment &amp; Networking Session I</td>
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<td>Session II</td>
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<td>Session IV</td>
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IN-HOUSE SOLUTIONS

SAVE COST • IMPROVE PERFORMANCE • REDUCE RISK

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If you like to know more about this program, please contact Jerry Tay (Conference Director) on +65 6415 4502 or email jerry.t@petrosync.com
Dr. Fred Aminzadeh is the Executive Director of USC’s Reservoir Monitoring Consortium. He is also a professor of Petroleum Engineering at the University of Southern California as well as the Induced Seismic Consortium. Fred has over 30 years of international experience in the exploration industry. He was the President of FACT Incorporated, a geophysical consulting, training, and sub-surface service company based in the USA. He has served on the advisory board of Saratoga Resources.

His technical expertise include: seismic attributes, inversion, AVO, reservoir characterization and monitoring, smart oil fields, passive and 4D seismic, fractured reservoir, and geothermal. He was the president of Society of Exploration Geophysicists (2007-2008).

He previously worked in technical and management positions, including Manager of Geophysical Technology at Unocal (now Chevron), and was president and CEO of dGB-USA. He has served on the NSF National Research Council and the DOE’s Unconventional Resource Technology Advisory Committee (URTAC). He has given many industry courses, keynote speeches, webinars, and interviews on both technical and strategic issues on various aspects of geophysical technologies in many countries. At USC, he teaches graduate level courses on Intelligent and Collaborative Oilfield Systems Characterization & Management, Advanced Oilfield Operations with Remote Visualization and Control.

He led a $25 MM 3D Seismic Modeling project, and received the 2005 SEG Special Commendation Award. He holds 3 US patents, authored 12 books and over 350 papers on pattern recognition, image processing, neural networks, fuzzy logic, 3D seismic modeling, seismic attributes, advanced seismic data processing, AVO, gas chimneys, absorption and reservoir characterization. He received the SPE 2012 SPE Western North America Regional Award for Reservoir Description and Dynamics. He holds a Ph.D. degree from USC.

**DR. AMINZADEH'S PARTIAL CLIENT LIST**
- BP
- CHEVRON
- SAUDI ARAMCO
- ONGC (INDIA)
- KMS TECHNOLOGIES
- ENI (AGIP)
- STATOIL
- ANADARKO
- PDVSA (INTEVEP)
- PEMEX
- SARATOGA RESOURCES
- REPSOL
- CGG VERITAS
- SINOGEOD (CHINA)
- US DEPT OF ENERGY

**TESTIMONIALS from previous attendees:**

“Good training! Start from basic concepts to explore deeper knowledge.”
- Geophysicists, Husky- CNOOC Madura Ltd (2013)

“Instructor was knowledgeable and experienced. Overall the course was very nice and full of knowledge.”
- Exploration Geologist and Geophysicists, Pertamina (2013)

‘Very good materials and course!”
- Survey and Drilling Operations, SKKMigas (2013)
**INVESTMENT PACKAGES**

<table>
<thead>
<tr>
<th>Investment Package</th>
<th>Deadline</th>
<th>Standard Price</th>
<th>Early Bird Offer</th>
<th>Group Discount (3 or more Delegates)</th>
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<td>10% discount for groups of 3 registering from the same organization at the same time</td>
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<td><strong>Standard Price</strong></td>
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<td><strong>Early Bird Offer</strong></td>
<td>02 MAY 2014</td>
<td>SGD $ 5,795</td>
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*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.

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1st Delegate Name [ ] Mr [ ] Mrs [ ] Ms [ ] Dr [ ] Others [ ]

Direct Line Number: __________________________ Email: __________________________

Job Title: __________________________ Department: __________________________

Head of Department: __________________________

2nd Delegate Name [ ] Mr [ ] Mrs [ ] Ms [ ] Dr [ ] Others [ ]

Direct Line Number: __________________________ Email: __________________________

Job Title: __________________________ Department: __________________________

Head of Department: __________________________

3rd Delegate Name [ ] Mr [ ] Mrs [ ] Ms [ ] Dr [ ] Others [ ]

Direct Line Number: __________________________ Email: __________________________

Job Title: __________________________ Department: __________________________

Head of Department: __________________________

**INVOICE DETAILS**

Attention Invoice to: __________________________

Company: __________________________ Industry: __________________________

Address: __________________________ Postcode: __________________________

Country: __________________________ Email: __________________________

Direct Line Number: __________________________ Fax: __________________________

Please note:  
- Indicate if you have already registered by Phone [ ] Fax [ ] Email [ ] Web [ ]
- If you have not received an acknowledgement before the training, please call us to confirm your booking.

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☐ By Credit Card : [ ] Visa [ ] MasterCard [ ] AMEX

Please debit my credit card: [ ]

Card Number: __________________________ Expiry Date: __________________________

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Name printed on card: __________________________

☐ By Direct Transfer : Please quote invoice number(s) on remittance advice

PetroSync LLP Bank details:

Account Name: PetroSync LLP

Bank Number: 7144 • Branch Code: 013 • Account No: 13-1-005531-6

Name of Correspondent Bank: Standard Chartered Bank, 6 Battery Road, Singapore 049909

SWIFT Code of Correspondent Bank: SCBLSGSGXXX

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

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Please debit my credit card: [ ]

Card Number: __________________________ Expiry Date: __________________________

Security Code: __________________________

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**CHARGES & FEE(s)**

- For Payment by Direct TelegraphicTransfer, client has to bear both local and oversea bank charges.

- For credit card payment, there is additional 4% credit card processing fee.