COURSE OVERVIEW DE0897
2D & 3D Seismic Data Interpretation (E-Learning Module)

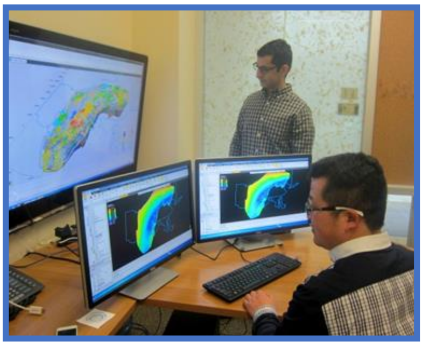
Course Title
2D & 3D Seismic Data Interpretation
(E-Learning Module)

Course Reference
DE0897

Course Format & Compatibility
SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration
30 online contact hours
(3.0 CEUs/30 PDHs)

Course Description



This E-Learning is designed to provide participants with a detailed and up-to-date overview of 2D and 3D seismic data interpretation. It covers the preparation of 3D volumes in depth for several geological framework cases; the relation between the property that is being predicted and the effect it will have on seismic data; the use of software packages to perform time-depth conversions in 2D and 3D for well and surface seismic; the production of volumes and maps in depth on a timely basis; the identification of appropriate technique and workflow for a given project; the leadership on small teams and projects in seismic modeling; and mentoring of inexperience geoscientists in seismic modeling.

During this course, participants will learn the seismic interpretation and basic background; the acquisition offshore and onshore, seismic processing, normal move out correction and stacking; the reflector, data, common depth points and floating datum; the time in comparison to depth and reflection coefficient (RC); the polarity conventions, convolutional theorem and the data required for synthetic calculation; and the vertical and horizontal resolution as well as interpretation workflow.

Course Objectives

After completing the course, the employee will:-

- Apply and gain a comprehensive knowledge on 2D and 3D seismic data interpretation
- Acquire specialized knowledge about preparing 3D volumes in depth for several geological framework cases (velocity anomalies, extreme faulting, over thrusts, salt deformation, and more)
- Be able to lead in understanding relation between the property that is being predicted and the effect it will have on seismic data.
- Use software packages independently to perform time-depth conversions in 2D and 3D for well and surface seismic
- Produce volumes and maps in depth on a timely basis
- Identify appropriate technique and workflow for a given project
- Lead small teams and projects in seismic modeling
- Mentor inexperienced geoscientists in seismic modeling
- Carryout seismic interpretation and discuss basic background
- Differentiate acquisition offshore versus onshore and employ seismic processing, normal move out correction and stacking
- Identify reflector and review data, common depth points and floating datum
- Describe time in comparison to depth and define reflection coefficient (RC)
- Apply polarity conventions and explain convolutional theorem as well as identify the data required for synthetic calculation
- Describe vertical and horizontal resolution as well as employ interpretation workflow

Who Should Attend

This course provides an overview of all significant aspects and considerations of 2D and 3D seismic data interpretation for geologists, petrophysicists, geophysicists and reservoir engineers.

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- USA International Association for Continuing Education and Training (IACET)

  Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Fee

As per proposal

Course Contents

- Seismic Interpretation
- Basic Background
- Seismic acquisition offshore
- Seismic acquisition onshore
- Seismic Processing
- Normal move out correction
- Stacking
- What is a reflector?
- Understanding the data
- Common Depth Points
- Floating datum
- Time versus depth
- Define reflection coefficient (RC)
- Polarity Conventions
- Convolutional Theorem
- Data required for synthetic calculation
- Vertical Resolution
- Vertical Resolution (Summery)
- Horizontal Resolution
- Horizontal Resolution Fresnel Zone
- Seismic Interpretation
- Interpretation Workflow
- Basic Structural Geology Background
- Fault Classes
- Basin Analysis
- Various Folds
- Fault Movement Indicators
- Hydrocarbon Traps
- Horst -Graben Inversion -Southern North Sea
- Seismic Interpretation
- Automated Structural Interpretation

- Initial Check List
- Initial Questions Migration Type?
- Digitization of Geophysical Data
- Amplitude Fidelity and Filtering
- 3D Data Load QC
- Amplitude Fidelity and Footprints
- Structural and Stratigraphic Interpretation: Good
- 3D Data Comparison
- Polarity and Phase
- Ideal Vertical Resolution
- Vertical Resolution and Tuning Thickness
- Borehole to seismic tie
- Review of Well Tie - Synthetics in time domain
- Borehole to 3D seismic
- Checkshot Data
- Do's and Don'ts - Borehole to seismic tie
- Review of Seismic Interpretation - Picks in time/depth domain
- Structural consistency
- Review of Velocity Modelling and Depth Conversion
- Data Review Completed
- Geologic Correlations
- Horizon Selection
- Structural Interpretation - Traditional Fault picking
- Data Conditioning
- Noise Removal
- Structural Framework - Screening and Panning of Amplitude data
- Screening of Amplitude data
- Screening of Dip and Azimuth Volumes
- Screening of Edge Enhancement Attributes
- Interpretation- Structural Mapping
- Screening of Structural Framework - Auto-tracking time structural map
- QC Your Horizon Picks In 2D and 3D Views
- Velocity Modeling and Depth conversion
- Seismic Geomorphology

- Stratal Slice of Amplitud Maps
- Interpretation Summary
- BASIC PRINCIPLES
- The Seismic Method
- Phase
- Phase Spectrum
- ‘Ricker’ Wavelet
- Phase of the Wavelet (1)
- Zero Phase & Minimum Phase
- Frequency Spectrum - Single Frequency Wave
- “Good” Wavelet
- Typical Wavelet
- Reflections
- Polarity Conventions
- Convolutional Theorem
- Seismic resolution
- What do we mean by Resolution?
- Vertical Resolution
- HFI’ Processing from Geotrace
- Vertical Resolution – Summary
- Maximising Vertical Resolution in Acquisition
- Horizontal Resolution
- Seismic Energy Reflects from a Patch, not a Point
- DMO/Post-Stack Migration with HFI
- Migration Collapses Diffractions
- Aperture and Horizontal Resolution
- Maximising Horizontal Resolution
- Optimising the Acquisition & Processing of 3D Seismic Data
- Maximising Vertical & Horizontal Resolution
- Unmigrated Data and Diffractions
- Migration Collapses Diffractions, Improves Resolution
- Seismic resolution
- Resolution decreases with depth
- Basic concept of seismic exploration

- Seismic waves - P-wave
- S-wave
- Surface wave
- Medium effects on waves
- Geometrical spreading
- Absorption
- Geometrical spreading versus absorption
- Reflection/refraction
- Snell's law
- Diffraction
- Reflection coefficients
- Magnitude
- Time-distance (T-X) curves
- Single horizontal layer
- Noise Test
- Seismic events
- Primary reflections
- Non-primary events
- The seismic wavelet
- Seismic data acquisition
- Recording
- 3-D Seismic Surveying
- Introduction
- 3-D Terminology
- 3-D Swath Shooting Method
- 3-D Marine Surveys
- Factors Controlling 3-D Survey Design
- Parameters of 3-D Survey Design
- Uncertainty 2D vs. 3D data
- Impact of 3D Data – Example
- 2D – 3D Seismic Comparison
- Color display and 3-D visualization
- Objectives
- Components of geovolume visualization and interpretation

- Color deficiency
- Color perception is a learned response
- Examples of good and bad color maps
- Exercise 1: Count the black dots!
- Exercise 2: Are the horizons straight or are they curved?
- Color Display
- Color Spaces
- Examples of good and bad color maps
- Opacity, Transparency and Alpha Blending
- Blending/transparency/opacity
- Blending seismic with coherence
- Impact of opacity on 3-D visualization
- Composite images
- HLS Color Space
- A 2-D color table
- Conventional workstation displays
- 2-D and 3-D color displays (t=1.0 s)
- Shaded relief to show reflector dip
- Shaded relief vs color display of dip/azimuth
- Full sense interpretation
- Summary
- Structural Interpretation Pitfalls
- Pitfall - Statics Busts
- Pitfall - Fault Shadow
- Pitfall – Sideswipe
- Pitfall – Multiples
- Reprocessing
- Structural Validation – Tie in Well Data
- Seismic Definition of Faults
- Seismic Data Considerations
- Fault Recognition
- Seismic Interpretation
- Seismic Pull-Up
- Automated Structural Interpretation

- Structural Smoothing Technique
- Ant Tracking Technique
- Structural Styles &Structural Interpretation
- TYPES OF NORMAL FAULTS
- Planners normal faults
- Planar Faults- Dip angle constant with depth Non-rotational faults
- Structural Geometry of Extensional Terrains Horst and Graben Structures- planar fault geometry Faults “die out” with depth
- Fault Growth
- Listric Faults - Curved faults, Dips decrease with depth Rotational Movement of fault blocks
- Detachment Systems
- Antithetic Faults
- Hanging wall collapse versus foot wall collapse
- Depth Conversion
- Contents
- Depth Migration
- Depth Conversion Summary
- Velocities – Sources of Information
- Depth Conversion - Simple Average Velocity
- Simple Average Velocity
- Downward Layer Building
- “Hybrid” Depth Conversion
- Complex Average Velocity
- Validation
- Depth Migration
- Anisotropic Effects
- Subsurface Mapping Techniques
- Subsurface Structural Mapping
- Basic Seismic Mapping
- Seismic Structural Interpretation
- Subsurface Structure Mapping
- Fault Polygon Definition
- The Mapping Process

- Coherency
- 3D Visualization
- Structural Validation Techniques
- Fault Growth & Displacement
- 3D Displacement Mapping.
- Vertical Linkage
- Displacement Mapping
- Construction of Balanced Cross-Sections
- Structural Restoration & Balancing
- Validation – Offshore Brazil
- Validation – Foz do Amazonas, Brazil
- Structural Timing
- Cross-Cutting Relationships
- Growth Strata
- STRUCTURAL INVERSION
- Stratigraphic Interpretation
- Definition
- Definition of Seismic Attributes
- An alternative working definition
- Spectral decomposition and thin bed tuning
- Color display and 3-D visualization
- Complex trace attributes
- Horizon and formation attributes
- Geometric Attributes
- Attribute expression of structure and stratigraphy
- Edge-preserving filtering
- Inversion for acoustic and elastic impedances
- Reservoir characterization workflows
- 3-D texture analysis and computer-aided object detection
- Impact of data quality on seismic attributes
- Multiattribute analysis tools
- Every day attributes and the search for hydrocarbons
- Advantages and disadvantages of seismic attributes
- Alternative workflows

- Seismic Time Slice
- Coherence Time Slice
- Coherence Horizon Slice
- Horizon Slice
- Time Slice
- Seismic
- Coherence without dip search
- Coherence with dip search
- Spectral Decomposition
- Spectral decomposition work flow
- 16 Hz amplitude component
- 26 Hz amplitude component
- Instantaneous envelope
- Simultaneous display of 3 attributes will therefore show more of the data!
- Summary
- Reservoir Identification
- Hydrocarbon Indicators
- The Character of Hydrocarbon Reflections
- Examples of Bright Spots, Flat Spots, Dim Spots And Phase Changes
- Polarity and phase problems, multiple contacts and transmission effects
- Use of Frequency, Amplitude Variations With Offset And Shear Waves