Avatar Technical Courses in Oil&Gas Exploration

In Avatar we are prepared to assist your organization with the challenges that can arise during the development of your assets. We have the technical skills and expertise to help you to make your business profitable and sustainable. One of our area of expertise is capacitation and training.

We believe that the main resource of your organization is the people. Avatar offer a panel of experts in the Oil&Gas sector with experience in coaching and mentoring. Our panel of experts are prepared to help your human resource.

We are ready to strengthen the knowledge and skills of your exploration team and as well provide them with update in the lasted technologies and exploration techniques.

Here you can find some of examples of the training courses that we are ready to delivery. Our training courses are dynamic and can be updated according your requirements or simple just tell us what are your interest and we will tailor the training course according to your needs.

1. - Onshore Seismic Acquisition

Objectives: The course is designed to familiarize the attendees with the principles of onshore seismic data acquisition; starting with seismic wave characteristics, types of seismic sources; comparison between explosive sources, vibroseis and surface impulsive sources. Acquisition requirements in a variety of terrains, environments, and surface conditions with the optimum criterion for seismic source selection according to survey settings.

The course reviews the physical and electronic construction of vibroseis systems, correlation techniques, sweeping efforts and production time, tapers, non-linear sweeps, dual source vibroseis, as well as modern techniques such as slip sweeping and distance separated simultaneous sweeping. By developing a sound understanding of vibrosetis units, participants will gain an appreciation for the techniques used for optimizing the seismic signal generated by vibroseis and its quality control practices.

On the second day, the participants are taken through the seismic sensors, seismic receiver specifications, and the function of conventional geophone array as a spatial filter to attenuate source generated coherent noise. The course then move to cover the different recording systems with thorough comparisons between conventional cable recording and nodal cable-free systems. Field quality control procedures will be discussed with case histories on the best practices to maintain the highest data quality standards.
At the end of the course, participants will be familiar with the current and emerging land seismic data acquisition technologies; how and when they can be used to deliver improved seismic data quality, efficient field operations and better cost benefits. Recent developments such as broadband techniques, boosting low-end and high-end frequencies, simultaneous source – high productivity vibroseis, and point receiver / point source field operations will be presented. Learning will be supported through numerous case studies that illustrate the value of each acquisition technique.

**Audience:** Field Geophysicists, QCs, Project Managers, Project Supervisors, and Observers. In addition to Geophysicists with limited experience in seismic data acquisition, or experienced staff including seismic data Processors, Interpreters and Operational Managers who need to keep up with the benefits of the rapidly developing field of modern seismic acquisition techniques.

**Agenda:**

**Day One:**

**Fundamental Seismic Principle**

- Seismic waves, period, frequency, wavelength
- Elastic properties of solid
- Types of seismic waves
- Attenuation of seismic waves, transmission loses, spherical divergence
- Seismic resolution and frequency bandwidth
- Seismic terminologies and definitions

**Seismic energy sources**

- Seismic source signature characteristics
  - Dynamite
  - Vibroseis
  - Weight drop / Thumper
  - Airgun
  - Other land sources
  - Advantages and limitations of seismic sources

- Source Selection Benchmarks
  - Seismic Data Quality
  - Depth and Scope of investigation
  - Environmental constrains
  - Operational Safety Standards
  - Resources Accessibility
  - Survey Budget

**Vibroseis Theory and Practices**

- Vibroseis theory and field operations
- Vibroseis mechanical & electronic description
- Sweeping Parameters optimization
  - Sweeping efforts, length, tapers
  - Sweeping types, what they achieve
- Vibroseis field tests & Quality Control
- Vibroseis Array, synchronisation, array effort
- Source Array versus Point Source
- High-productivity simultaneous Vibroseis operations
  - Dual Source flip-flop / ping-pong
  - Slip Sweeps
  - ISS and DSSS
- Vibroseis case studies in different survey conditions

Day Two:

Seismic Receivers

- The Geophones, natural frequency, damping, sensitivity and coupling
  - Vertical Component Geophones - 1C
  - Three Components Geophones - 3C
  - MEMS - Digital Sensors
- Hydrophones
- Geophone Arrays
  - Spatial anti-alias filter
  - Attenuation of near surface coherent noise
  - Advantages and limitations
- Geophone Array Versus Point Receiver

Seismic Recording Systems

- Analogue versus Digital Recording
  - Temporal and Spatial Aliasing
  - Dynamic range
- Seismic Instrumentation
  - Cable Recording – Sercel, ARAM, I/O
  - Nodal, Cable-free Systems – Fairfield Zland, Geospace GSR/GSX, Sercel Unite, Geospace OBX
- Cable Versus Nodal recordings, comparison with case studies

Overview of Seismic Records

- Seismic Noise
  - Direct Wave
  - Ground Roll
  - Refraction
o Other Noise events

Seismic Signal

- Reflection events
- Multiples

Quality Control and Quality Assurance

- Industry Recording Standards
- Project’s Start-up Tests
  - Field Equipment Tests
  - Recording systems and seismic source synchronization
  - Prerecording survey parameters optimization
  - Infield source effort tests and fine-tuning
- Quality Control Daily Procedures and Practices

Day Three:

Advances in Seismic Data Acquisitions

- High resolution seismic surveys, small bin size and high trace density
  - A smaller, tighter bin size retains higher seismic signal bandwidth and wider range of frequencies.
- Wide-azimuth, long offsets surveys
  - Well sampled seismic data for better velocity and anisotropy analyses.
  - Homogenous sampling at all offset and azimuthal ranges, for enhanced pre-stack migration, anisotropy and AVO analysis in regions of steep dipping or complex geology.
- Broadband seismic surveys
  - Interpretability of seismic wavelet is proportional to the number of octaves contained within the bandwidth of the signal. With more than six octaves of bandwidth, the seismic wavelet becomes sharp and impulsive, and with sufficient low-frequency content (down to 1.5 Hz), side lobes are minimised.
  - Low frequencies are less affected by attenuation and help to image deep targets and areas beneath signal’s absorbing formations and complex overburdens. Low-frequency data provides coherent images for deep under-salt targets.
- Point source and point receivers surveys
  - Requirements and applicability
  - High productivity surveys
  - Optimum integration between different seismic sources and recording systems
- Case Studies, Analysis and Discussion
2. - Seismic Survey Design

Objectives: The course covers the survey design principles for 2D and 3D seismic surveys with detailed procedures leading to the highest data quality that illuminates the geological section at the targeted time/depth windows in the most economical practices. Participants will become familiar with the seismic survey design requirements, starting with temporal and spatial resolution, seismic frequency, azimuthal and offset ranges vital for enhancing the image at the survey targeted horizons. The definition of the representative horizons for a survey is the beginning of design creation and management of acquisition survey.

Assessing the challenges for a specific project and the seismic characteristics (velocity, dominant frequency, dip, and depths) within the geological column are crucial aspects for estimating the survey design parameters; such as, spatial sampling, migration aperture, offset/azimuth distribution, and fold. Optimization of survey geometry is the key to a successful implementation of reflection seismic method in exploration.

Utilizing 2D and 3D case studies the participants will explore the different facets of seismic survey design and an industry standard software (MESA) for handling and manipulating survey design attributes, including trace fold distributions at selected offset and azimuthal ranges. At a later part of the course the participants are taken through survey designing via hands-on practice where the group works together to design solutions to typical survey objectives and challenges.

At the end of the course, participants will be familiar with the current and emerging land seismic acquisition technology and techniques; the principles and workflows employed to design seismic surveys; how to make a first run try to assess whether a proposed survey design will be successful, economic; and to endorse further areas of investigation if required.

Survey design outcomes are necessary to complete the survey technical specifications, outline operational constraints and tendering documentations for acquisition contracts.

Audience: Senior Geophysicists, QCs, Project Managers, Project Supervisors, Senior Observers, and Senior Surveyors. In addition to Geophysicists with limited experience in seismic survey pre-acquisition planning, or experienced staff including seismic data Processors, Interpreters and Exploration Managers who like to be acquainted with the latest practices in seismic survey designs, methods of achieving high standard seismic data quality that validates the geological requirements for the survey at the anticipated timeframe and budget.
Agenda:

Day One:
Seismic Wavefield Fundamentals
- Seismic Waves
- Period
- Frequency
- Wavelength, wavenumber
- Bandwidth
- Seismic terminologies and definitions

Seismic Signal Recording
- Analogue signal recording
- Digital signal recording
- Temporal Aliasing
- Spatial Aliasing
- Dynamic range of Seismic Instrumentations
- Typical Shot record
  - Seismic Noise
  - Seismic Signal

Bin Size - Design Basic Unit
- Bin Size
  - Bin Size estimation methods
  - Bin Size impact on Seismic data
- Receiver Station Interval - Group Interval
- Geophone arrays as spatial anti-alias filter
- Point Receiver versus Geophone Array
- $f^k$ plots and $f^k$ filtering
- Array Response versus Receiver-Source Point; Debate

Day Two:
Seismic Survey Background
- Survey coordinates – e.g. shapefile
- Geological / Structural maps
- Topographic maps – high resolution digital terrain grids
- Satellite – Lidar images
- Previous seismic sections – if any
- Depth to targeted geological horizons – geological section
- Maximum dips
- Well logs information – if any
- Maximum and Dominant frequencies
- Stacking velocities
Geophysical parameters to be considered

- Target depths versus offsets
- Signal frequency requirements
  - Low frequencies for inversion
  - High frequencies for resolution and inversion
- Geological Dips
- Seismic Noise characteristics
- Fold
- Seismic Velocity
- Source – Receiver Azimuth
  - Dip direction for data acquisition
  - Complex geology

Survey Design considerations

- Sampling rate – Temporal Aliasing
  - Interpolation
- Spatial sampling – Spatial Aliasing
  - Dip aperture for zero offset
  - DMO aperture for non-zero offset
  - Bin size
  - Stratigraphic objectives
  - Diffraction energy
- Migration aperture
  - Dip considerations
  - Fresnel zones
  - Diffraction energy
- Common mid-point fold/trace density
- Offset distribution
- Azimuth distribution
- Survey orientation
- Record Length
- 2D versus 3D considerations

Seismic 3D Grid

- Basic Building block – single shot
- Bin, Fold and trace density
- Receiver station interval and receiver line interval
- Source station interval and source line interval
- Inline fold – crossline and total 3D fold
- Offset limited folds
- Aspect Ratio
  - Imaging considerations
  - Operational considerations
  - Cost considerations
Geometry Models

- Orthogonal
- Staggered Orthogonal
- Bricks – Slant
- Parallel
- Zig-Zag
- Random
- Available Bin / Trace analysis and statistics
  - Fold, Midpoint scatter
  - Offset, and offsets ranges fold distributions
  - Source – receiver azimuthal “Spider” distribution

Shooting Strategies

- Template / Patch recording
  - Advantages
  - Limitations
- Inline, crossline and maximum offsets
- Receiver template
  - Number of receiver points per receiver line
  - Number of receiver lines per template
- Source template
  - Number of source points per source line
  - Number of source lines per template
- Template rolling scenarios

Day Three:

Practical workshop - Seismic Survey Design Software “MESA”

Morning session

- Overview to MESA software
- Case studies of 2D/3D survey designs form different seismic surveys
- Using MESA software to navigate through the main aspects of survey design parameters, analysis and statistics

Afternoon session

- Building MESA data base for a basic survey geometry
- Applying different design models Orthogonal, Zig-Zag, etc
- Selecting a typical recording template
- Shooting the survey according to the recording template
- View and map the design attributes, fold, offsets, azimuth and midpoints distribution at different offset ranges
- Output the design SPS files, recording scripts for the next data acquisition stage

Course Review and Discussion
3. - Seismic Processing Course

Objective: To involve the non-geophysicist into the time seismic processing sequence, focusing in the description of the main seismic processing steps, concepts and the use of the deliverables in the further interpretation

40 hours course

Day 1:
• What is a time seismic image?
• Digital signal: Main concepts and procedures
• Digital sampling
• Fourier transform
• Main seismic formats: SEG-D and SEG-Y
• Raw data size estimation exercises

Day 2:
• Review of seismic acquisition concepts
• The seismic domains in Time Seismic Processing
• The Basic Time Seismic Processing Sequence
• Geometry: Headers description, SPS, Shot edition and QC
• Spherical Divergence
• True Amplitude Compensation

Day 3:
• Noise filtering (ground roll, electrical power line)
• Field Statics corrections: definitions and algorithms
• Deconvolution
Day 4:

- Seismic Velocity Analysis
- NMO correction and mute
- Stacking
- Residual Statics
- DMO and Post-Stack Migration
- Pre Stack Time Migration (PSTM)

Day 5:

- Post-Processes
- Deliverables checklist
- Seismic data estimation
- General review & discussion
- Designing of a Seismic Processing Sequence
4. - Seismic Attribute Course

Objective: To involve the non-geophysicist into the use of time seismic attributes in the interpretation process, focusing in the description of the mathematics inside the attributes and their relation with the geological and fluid features of the seismic data.

40 hours course

Day 1:
• What is a Seismic Attribute?
• Chronological evolution of the seismic attributes
• Classification of the seismic attributes
• Hilbert Transform
• Instantaneous Attributes

Day 2:
• Structural attributes
• Stratigraphic attributes
• Seismic attributes for siliciclastic reservoirs
• Seismic attributes for carbonates reservoirs

Day 3:
• Seismic inversion
• AVO

Day 4:
• Multi-attributes
• Statistical prediction of rock properties
• Seismic Attributes as Seismic Processing QC
Day 5:

• Exercises: Seismic Attributes for Exploration
• Exercises: Seismic Attributes for Production
• Final discussion
5. - Seismic Inversion Course

**Objective:** To involve the non-geophysicist into the generation and use of seismic inversion in the gas and oil prospecting and reservoir characterization

40 hours course

Day 1:

• What is Seismic inversion?
• Rock Physics Principles
• Post-Stack Seismic Inversion
• Post-Stack Seismic Inversion methods

Day 2:

• AVO: Definition and Attributes
• AVO modelling
• AVO linear approximation

Day 3:

• Independent Inversion
• Elastic Inversion
• Extended Elastic Inversion

Day 4:

• Simultaneous Inversion
• Stochastic Inversion
• Examples

Day 5:

• Exercises: Exploration
• Exercises: Production
6. - Fundamentals of Depth Imaging and Velocity Model Building

**Objective:** the aim of this course is to provide the student the basic concepts of depth imaging and its application, migration algorithms technology, velocity model building and QC and how to produce a successful imaging with the help of the contractor.

**Audience:** geologists, seismic interpreters and time processors willing to work in the depth domain in the future and any geoscientist involved in a depth processing project dealing with a seismic contractor. No mathematical background is needed as no equations are shown. Basic knowledge about seismic data processing would be ideal.

Duration: 2 days (to be confirmed).

Content:

1. **Introduction:** Seismic imaging through the time and fundamentals of wave propagation

2. **What is seismic migration?:** fundamentals of seismic migration, types of migration methods and domains of application, difference between time and depth imaging and their benefits and limitations, requirements to produce an accurate seismic image, examples.

3. **Migration algorithms:** ray-based and wave extrapolation migrations, basics of Kirchhoff, ray-based Beam and Reverse Time Migration, examples.

4. **Velocity model building:** work flow of a depth imaging project, seismic data pre-conditioning, fundamentals of anisotropy applied to velocity model building, Isotropic and Anisotropic velocity models, how to QC a velocity model with the help of the contractor, example of salt and basalt model building.

5. **Tomography and velocity model update:** basics on inversion and tomography, types of tomography for velocity model update, iterative tomographic update, examples.

6. **Seismic contractors:** who they are?, type of services and technology for the seismic imaging market.

7. **Summary.**
7. - Geological Modeling and Reservoir Characterization

Objective: Integrate geosciences disciplines to achieve an optimal and complete geological model in order to minimize the risk factors and uncertainties during the seismic interpretation.

PART I (2 days)

1. INTRODUCTION
   Petroleum Industry
   Tectonic Plates
   Rocks formation - Petroleum creation - Principles of Geochemistry
   Petroleum System

2. RISK ELEMENTS

3. EXPLORATION AND PRODUCTION PROCESS

4. PETROLEUM SYSTEM
   Risk Analysis and evaluation of potential
   Reserves calculation
   Delimitation and initial reservoirs characterization.
   Development
   Production
   Decline & Abandonment

5. METHODS IN EXPLORATION

6. IDENTIFICATION OF OPPORTUNITIES

7. TYPES OF WELLS

8. DRILLING PHASES

9. PROJECT PLANING

10. ANALYSIS OF SCENARIOS
PART II (3 days)

1. GEOCIENCES - MODULE I

   Introduction to Geosciences
   Seismic wave as analytical signals
   Characteristics of the seismic wavelet
   Acoustic and elastic Impedance
   Vertical and Lateral Seismic resolution
   Convolutional Model
   Seismic trace vs Seismic Section
   Seismic Attributes

2. GEOCIENCES - MODULE II

2.1. SEISMIC STRATIGRAPHIC

   Depositional systems
   Sedimentary systems
   Stacking patterns
   HST, LST, TST
   Unconformities
   Seismic-stratigraphic Interpretation

2.2. Modeling

   Seismic patterns
   Channels: sedimentation and stacking
   Input and integration of elements.
8. - SEISMIC INSTRUMENTATION

**Description:** The aim of this course is to provide to electronic technicians all the theoretical tools, concepts and practices that are essential for making the technical support to a Seismic Crew. Throughout the course the participants will be prepared to meet the Oil and Gas industry standards related with maintenance procedures for the central electronic and ground equipment which are basic to keep the high quality and productivity in Seismic Acquisition systems. In addition the course includes the basic organization of the Instrument Shops which are key point to keep in high performance the Recording Operation as a core of the Seismic Crew.

This course will be conducted at the customer facility as under-job training and it is highly recommended at the work site on startup operations.

**Participant requirements:**

The level of the course requires participants with at least 3-year degree in Electronics or equivalent technical knowledge. Not any Seismic experience is required.

**Audience:** This course is aimed at seismic instrument technicians, seismic observers and geophysical engineers

**Day 1:**

- Lay out of a typical Seismic acquisition System.
- Ground Equipment.

**Day 2:**

- Geophone String types: Land, Marsh
- Hydrophones.

**Day 3**

- Geophone testing and Repair
- Equipment required for Geophone strings maintenance
- Geophone string testers: Leakage tester, continuity tester, SMT, etc.
- Maintenance Procedures: Daily by line Crews during layout and pick up
  Monthly: Based in a daily rotation.
- Maintenance Records.
- Geophone part stock
- Organization of a Standard Geophone shop.

Day 4

- Equipment required for a Cable Shop.
- Cable Maintenance and logging
- Cable part stock
- Organization of a Standard cable shop.
- Field Electronic Modules: This section will be adapted to the specific system required by the client. By example, if the acquisition system is Sercel 428 will be included the Theory of operation and maintenance of: FDU, LAUL, LAUX.
- Test and repair stations (Example: TMS-428)
- Batteries and solar panels.
9. – Geophysical Operation Management and Logistics.

**Overview:** Seismic Surveys are an essential part in Oil and gas exploration. The data acquired as a final product of any seismic surveying is used to determine the location, the size and the direction of the flux of the oil and gas reservoirs. The seismic prospects, both 2D and 3D, normally are designed to cover extensive areas using big amount of human and economic resources during a relative short period of time; so in order to reach the goals of the prospect is necessary to base the Seismic Field Operations on a detailed daily plan which shall be implemented and managed considering all the geographic, environmental, cultural, legal, security, and hazardous aspects that are present in the area to be surveyed.

The **Geophysical Operations course** has been designed to provide to the participants with fundamental standard practices that will allow them to manage in the best way the Seismic Crew Field Operations in order to reach the targets in Safety, Quality, productivity and finance.

Participant Requirements:

The course is intended to contribute with the managerial education for new professionals in the oil and gas exploration business; also it aims to formalize concepts and standard accepted practices in seismic field operations.

**Audience:** APC’s, Head of departments (technical and administrative), Field Supervisors, Operating Geophysicist and Project Managers

**Content:**

**Day 1**

- Glossary: terms, definitions and basic concepts specifically for seismic surveying
- Structure of a Seismic Crew. Departments. Human Resources. Key personnel profiles
- HSE management system
- Hazards and map of the safety risks
- Permit and property damages evaluation
- Internal and Sub-contracted services.
- Base Camp Support Operations
- Communications and transportation
- Startup Operations
- Staging Support

**Day 2**

- Field Operations. Field Logistics and basic standard teams
- Survey and positioning operations
- Seismic drilling operations. Drilling teams for different type of areas (mountains, flat and muddy)
Drilling equipment for mountains. Drilling equipment for flat terrains. Drilling equipment for muddy areas.


Recording Operations: Source dynamite. Field Logistics. Basic field teams. Shooters. Ground equipment move (Back and front Groups)

Day 3

- Technical audits. Human resources assessments

Day 4

- Reporting: Daily, weekly, monthly reports. Statistics.
- Data field processing. Quality checking.
- Commissioning of a Seismic prospect. Environmental restauration.
- Final reports.

*We also can provide training courses in HSE management system in Exploration, Field QC and Infield Processing.

For more details please contact us in our website http://www.avatar-investments.co.uk/contact-us/.