ASL
Avalon Sciences Ltd

ATC-4 Borehole Seismic Acquisition for Geoscientists

ATC 4

ATC 4	Module	Title
Day 1 AM	M. 0	Introduction to Borehole Seismic Acquisition
Day 1 PM	M. 6	ACQ Acquisition Software - Configuring a survey
Day 2 AM	M. 6	ACQ Acquisition Software (Cont'd) - Simulating various VSP's
Day 2 PM-DAY 3 AM	M. 7	Practical – Well Operations, Shooting a real impulsive source ZVSP either in Somerton Test Well or a more complex VSP at ASL Borehole Test Facility* (Vibroseis also available here).
DAY 3 - PM	M. 8	M. 8 Simple VSP Processing Fundamentals using VSProwess Software
Comments		*Subject to availability of ASL Borehole test facility (Allow extra 0.5 Day for travel to test site). Onsite Test well at HQ can always be used for a simple ZVSP using local airgun.

Module Overview

This course is targeted at Geoscience/Engineer trainees who may wish to have a general appraisal of our downhole tool systems, borehole seismic theory, and well deployment.
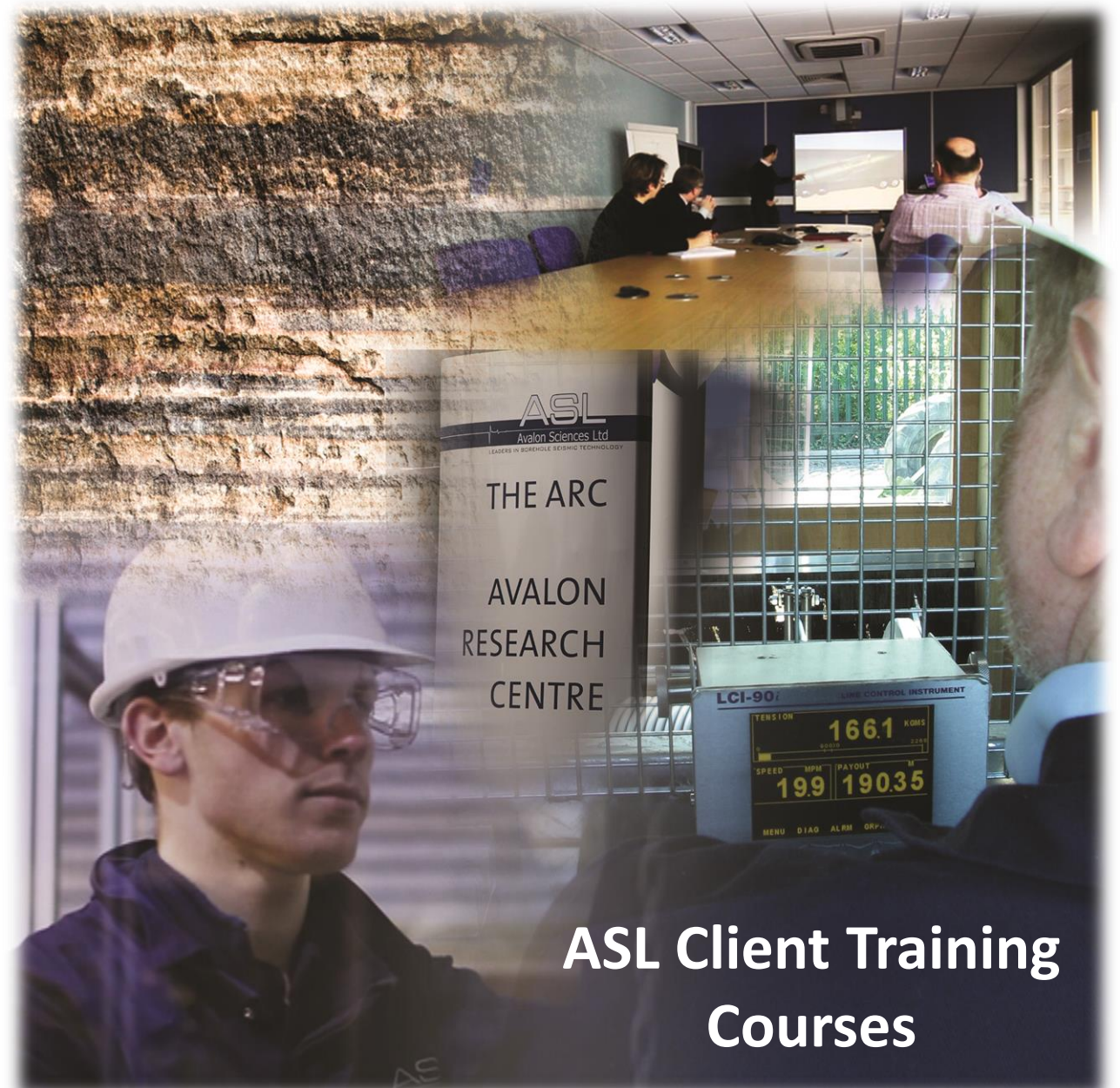
- **Difficulty:** Intermediate
- **Duration:** 3 days
- **Group Size:** Max 6 persons (Recommended 3-4).
- **Accommodation:** Discounted accommodation at Somerton staff house for up to 6 persons (subject to availability).
- **Prerequisites:** We would encourage groups to be of similar experience to allow best differentiation of learning. Trainee
  - The main prerequisite is a willingness to embrace both the classroom and practical theory. Knowledge of basic wave physics is assumed.
  - The courses are delivered in English. However we can assist with arranging translation services if required.
  - Trainees are required bring a laptop PC for classroom theory.
  - Health and Safety - All course tasks are risk assessed and take place in a safe environment. All PPE items are provided, although we advise trainees to bring their own protective footwear to ensure maximum comfort.

Module Topics

ASL Client Training Courses

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M1 – Introduction to Borehole Seismic Acquisition

Module Overview

This short module is designed to give trainees a basic understanding of borehole seismic theory and nomenclature which then will equip them for the practical tasks in which they will either rerecord or process a simple VSP survey. This is useful for both staff new to Geophysics and those whom require a refresher.

Difficulty: Foundation

No Prior Experience of using ASL Products Required

M1.1 Overview of Fundamental concepts of Petroleum Geology and Seismic Exploration.

Learning Objective: Trainees will have an introductory understanding of Petroleum Geology and the imaging of its associated structure using surface seismic geophysical methods . **Topics:**

- Basic Petroleum Geology – Defining an Oil and Gas Trap
- Wave Propagation and Reflection at an Interface
- Wavelet Theory Fundamentals and Seismic Resolution
- Overview of Surface Seismic Acquisition Methodology
- Basics of Move Out and Migration (ATC 4 only)
- Wavelet Inversion

Relevant ATC Courses

ATC 3   ATC 4   ATC 7
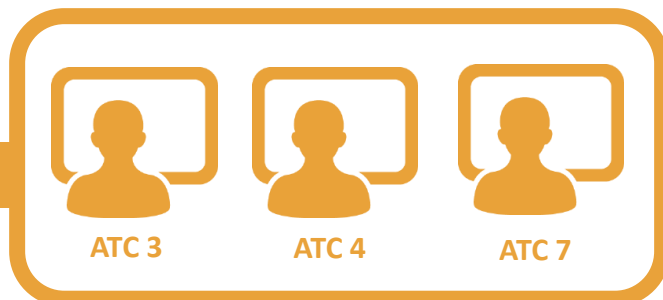
M1.2 Key Concepts of Borehole Seismic Surveying and Monitoring

Learning Objective: Trainees will gain an understanding of the key concepts and applications of both VSP and microseismic monitoring.

Topics:

- What are VSPs and their Applications?
  - What is a VSP?
  - What are the advantages of a VSP?
  - Signal vs Noise
  - Check Shots
  - VSP Geometries (Zero Offset to 4D)
- Hydraulic Fracturing – Induced Seismicity and Monitoring.
  - Why Frack?
  - Borehole Seismic Monitoring
  - Regulation Case Studies
  - Other Microseismic Applications

M1.3 Examples of Downhole Seismic Hardware

Learning Objective: Opportunity to look at various borehole seismic tools.

Topics:

- Acquisition System Overview – Using 'Geochain' as example -
  - Analogue vs Digital Operation
  - Geophone/Sensor Pack Variants – Omni Fixed vs Gimbal
  - Coupling and Vector Fidelity
- Ancillaries and Logging Tools
  - Gamma Logging Tools
  - Tension Heads and Wireline Properties
- Overview of how to QC a Tool System prior to Seismic Survey.
  - Demonstration of a surface set up with interface to recorder
  - Tap and Telemetry QC Tests.

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M6 ACQ Acquisition Software

LEADERS IN BOREHOLE SEISMIC TECHNOLOGY

Module Overview

This module is aimed a Geoscientists and Engineers who wish to gain an understanding of ACQ acquisition software. They will be able to configure a tool system and perform diagnostics checks (ATC 1 + 2 Only). The trainees may wish to go beyond this and learn to use ACQ to set up a VSP survey, configuring receivers and well site geometry. Trainees will be able to simulate a ZVSP acquisition exercise using ACQ (ATC 2-4).

Difficulty: Foundation-Intermediate

M6.1 Introduction to ACQ

Learning Objective: Trainees will be introduced to the software and will be able to use ACQ to configure a seismic survey job.

Topics:
- Software Installation
  - Install ACQ
  - Default folder used by ACQ
- Job Manager
  - Creating a new job in ACQ
  - Selecting recorder and downhole tool type
  - Specifying a non-default Rcd folder
  - Entering general survey information
- Configuration of source, surface channel and downhole tools
  - Configuration parameters for airgun sources
  - Configuration parameters for explosion sources
  - Setting up GSP control
  - Setting auto pick parameters
  - Setting up automatic source location acquisition from a navigation system
  - Configuring surface channels
  - Configuring downhole tools
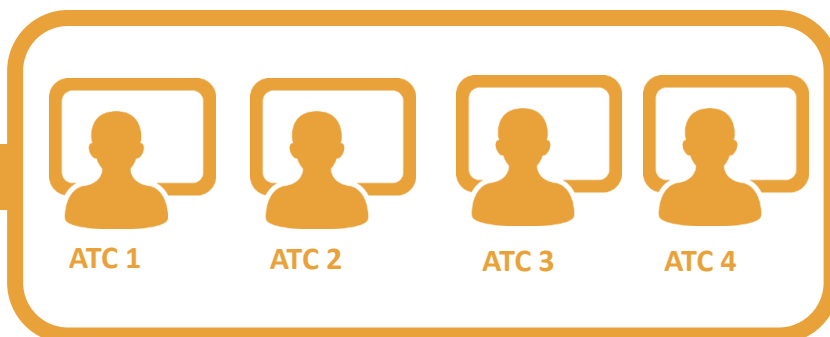
M6.2 Internal System Test

Learning Objective: Trainees will be able to perform an instrument test and diagnostics in the ACQ software.

Topics:
- Instrument Test and System Diagnostics
- Spectral Analysis
- Using the Journal

M6.3 Acquiring Data

Learning Objective: Trainees will know how to acquire data within the ACQ software, and will be able to do a basic interpretation of the data.

Topics:
- Monitor mode and Tool Control
- Recording, Stacking, and Displaying Data
- Plot Mode
- Profile Mode

M6.4 Simulate ZVSP

Learning Objective: Trainees will be able to simulate a ZVSP, and interpret the VSP plot components.

Topics:
- Configuring the Survey Simulator
  - Types of survey which can be simulated
  - Configuring Elevations and Depths
  - Choosing the downhole tool type
  - Configuring source
  - Configuring downhole tools
- Recording Simulation Data
  - How data is simulated
  - Recording data
  - Simulating telemetry errors
  - Features of VSP dataset

M6.5 Advanced ACQ

Learning Objective: Trainees will be able to use the advanced features within ACQ (for complex VSP surveys), and the supplementary MIRFCOPY and WELLTRAK software.

Topics:
- Logs
- Vibroseis
  - Configuration for Vibroseis sources
  - Moving versus static sources
  - Walkaway sources
- Complex Geometries
  - Simulate Spiral 3D Survey
- MIRF Copy
  - Configuring MIRFCOPY
  - Using MIRFCOPY with DVD-RAM
  - Using MIRFCOPY with ACQ simulator
- WELLTRAK
  - Configuring WELLTRAK
  - Importing deviation data into WELLTRAK
  - Editing WELLTRAK data
  - Interaction between ACQ and the WELLTRAK database

ATC Course

ATC 1   ATC 2   ATC 3   ATC 4

BSI
ISO 9001
FM 555054

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M7 Well Operations

Module Overview

This module is aimed at Field Engineers and Geoscientists who wish to acquire introductory practical experience deploying ASL borehole seismic equipment within a well. Trainees will acquire a simple shallow well rig source VSP and learn safe deployment/rig out procedures.

Difficulty: Intermediate

M7.1 Configuration of Geochain /Geochain Slim

Learning Objective: Trainees will be able to configure the Geochain and Geochain Slim on the surface, and prepare the tools for downhole operation.

Topics:

- Connection for Workshop Testing
    - Correct orientation of TAS and ASR/GSR
    - Use of link cables
    - Use of the wireline simulator
- Connecting a System to a Wireline
    - Wireline requirement
    - Wireline testing
    - Correct installation of GSP and GPP
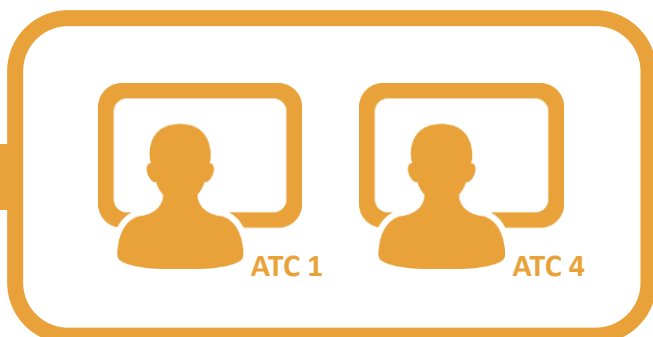
M7.2 Configuration of Sources

Learning Objective: Trainees will be able to configure the sources using the GSP and RSS-2 surface panels (optional).

Topics:

- Interfacing to Sources and Source Controllers
    - Single airgun operation
    - GSPIO card capabilities and functionality
    - Interfacing to vibrator controllers
    - Interfacing to explosive blaster
    - Interfacing to multiple airgun controllers
- Configuration of Remote Multiple Sources Using RSS-2 (optional module)
    - Modes of operation
    - GSP synchronisation
    - RSS-2 (Master/Slave)
    - Analogue hydrophone adaptor (AHA)
    - Source interface unit

M7.3 Acquiring a Real ZVSP at Avalon Test Well

Learning Objective: Trainees will carry out practical exercise were they assemble the receivers and surface panels, and carry out a ZVSP survey of the Avalon Testing Well.

Topics:

- Surface Set Up
    - Assembly of receivers on surface
    - Connect to ITCs and Winch Unit wireline
    - Surface panel set up and interface
    - Interface of land spot Sleeve Gun to GSP (either local or using RSS-2)
- Downhole Acquisition
    - System diagnostics using ACQ software
    - Lower tools and acquire common depth stack ZVSP from TD surface
    - Safe rig out procedures
    - Perform routine maintenance checks and service

There may be opportunity to deliver this module at the new Avalon Borehole Test Facility based at Avalon Cornwall.

This would allow a more complex deeper well survey to take place along with facilitating the use of offset vibroseis sources. This would add +0.5 days to the course time to allow for travel plus 1 nights accommodation at a hotel close to test site. Please let us know if you would like this module delivered at this facility.

ATC Course

ATC 1   ATC 4

M8 Introduction to VSP Processing Using VSProwess

Module Overview

This module is aimed at Engineers and Geoscientists who wish to have a foundation appraisal of VSP dataset characteristics and basic processing steps, and have a comprehensive understanding of how to use VSProwess to QC, pre-process and present VSP data.

- **Difficulty: Intermediate**
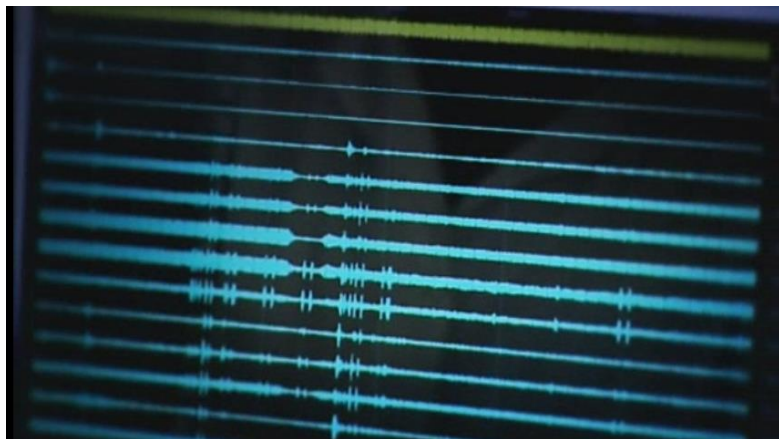
M8.1 Introducing/Refreshing Basic VSP Processing Theory

Learning Objective: Refresher - Trainees will have an introductory understanding of Borehole Seismic applications and will be able to identify the key features and processing steps of a VSP dataset.

Topics:

- Introduction to check shot surveys and VSP
- Application of borehole seismic surveys
- Understanding elevations and times
- VSP processing route theory
- Identification of VSP events
- Primary waves
- Multiples
- Other VSP events/Noise

- Preparation of data – General Overview
- Separation of upgoing and downgoing wavefields
- Collapsing multiple energy
- Overview of Corridor Stack and simple inversion steps for final composite display.

ATC Course

ATC 4
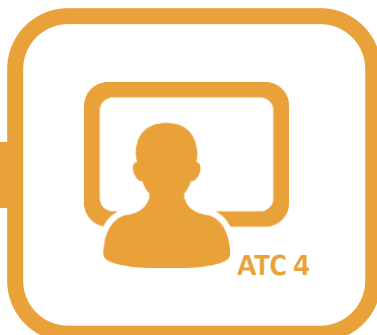
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M8.2 VSProwess – A Rig Side Data QC Tool

Learning Objective: Trainees will be able to use industry standard VSProwess to import, configure, manipulate and display VSP plots to aid rig source QC and provide efficient data presentation.

Topics:

- Introduction to Data Processing using VSProwess
- Software installation
- Creating and editing processing routes
- Standard routes vs custom routes
- Display results
- Exploring display options
- Display Zoom

- Acquisition Repair
    - Selecting and Sorting Traces
    - Time Corrections
    - Error Corrections
- Simple QC – tools
    - Spectral Analysis
    - Hodogram tools
    - Frequency domain data (FX and FK) & Filtering

M8.4 Further Data Processing - an example

Learning Objective: Trainees will have fully processed a simple vertical incidence VSP example dataset demonstrating a detailed understanding of the operators and parameters involved within the pre-processing steps.

Topics:

- Preparation of SEG-Y data (client example?)
- Recover, Select and sort data
- Apply Filters
- Frist Arrival Picking/Stacking
- Introduction to Velocity Analysis
- Recover amplitude attenuation by spherical divergence
- Separation of upgoing and downgoing wavefields
- Blank operators
- Remove upwave multiples
- Deconvolve operator

- Presentation of data
- Minimum phase VSP
- Inversion and prediction ahead of the bit
- Enhancement of data
- Well View Displays
- Composite Displays

This is a condensed short course module introducing fundamental concepts of simple VSP processing. For advanced data QC and Pre-processing we recommend ATC-8 "Advanced In-field QC and Analysis of Borehole Seismic Data".

For instruction on advanced processing of 3D VSP datasets please contact VSProwess Ltd.