Seismic Processing Workflows (G072)

Tutor(s)

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Overview

This course will provide participants with the skills needed to liaise with specialists and implement workflows for seismic data acquisition and processing. Using modern case histories and basic theory, the course covers fundamentals, established workflows and advanced technology. Participants will use interactive processing tools to improve their understanding of the latest techniques and learn how to apply them effectively and efficiently to meet their objectives.

Duration and Logistics

Classroom version: A 3-day in-person course, comprising a mix of lectures with examples (90%), laptop-based exercises and discussion (10%). The manual will be provided in digital format and participants will be required to bring a laptop or tablet computer to follow the lectures and exercises.

Virtual version: Six 3-hour interactive online sessions presented over 6 days, comprising a mix of lectures, discussion and interactive exercises using case histories to illustrate the basic theory and impact of the techniques discussed. The participants will use a series of web-based software modules to experience the processing options available and learn how to combine the basic tools together to build a flow which meets objectives. A digital manual and exercise materials will be distributed to participants before the course. Some reading and several exercises are to be completed by participants off-line.

Level and Audience

Intermediate. This course is aimed at geoscientists seeking an overview of seismic acquisition techniques and processing methods, and those who wish to liaise effectively with specialists to improve their decision making and deliver objectives. A geophysics refresher is provided but it is helpful if participants have a basic knowledge of seismic acquisition and processing terminology and are actively working with seismic data.

Objectives

You will learn to:

1. Compare the most common seismic acquisition and processing techniques used in seismic exploration and production, and become more proficient in the terminology used to describe them.
2. Establish how survey design, earth model building and selection of migration algorithm can affect accuracy of interpretation in depth.
3. Optimize the impact of seismic processing parameter selection for specific objectives such as amplitude interpretation for exploration and reservoir characterization.
4. Demonstrate a typical seismic processing workflow covering data preparation, parameterization, noise and multiple suppression, velocity model building, and the imaging process, discussing likely issues at each step.

5. Compare newer acquisition and processing techniques alongside their potential benefits and pitfalls.
6. Liaise effectively with specialists, develop workflows and optimize decisions based on quality and cost.

Course Content

Session 1: Workstation based workflow – objective setting

- Seismic refresher, including a brief overview of basic wave theory, noise suppression, velocity model building, stacking, imaging and factors affecting resolution
- Basic techniques, such as convolution, sampling, aliasing and interpolation
  Simple data conditioning techniques, including trace scaling, automatic gain control and frequency and dip filtering

Session 2: Survey design and signal processing workflow

- Technical aspects of survey design, featuring a basic survey design workflow and rules of thumb for orientation and azimuthal coverage, and designing surveys for both shallow and deeper targets
- Amplitudes, frequency and wavelet processing, featuring case histories of designature, attenuation compensation and combining acquisition and processing solutions to obtain broadband data and improved resolution

Session 3: Noise and multiple suppression workflow

- Noise: types, suppression and quality control in marine and land seismic data
  FK, radon, tau-p analysis, machine learning techniques and quality control
- Multiple suppression, quality control and interpretation, including predictive methods (deconvolution, shallow water demultiple), moveout methods (radon) and free surface multiple removal (2-D and 3-D SRME)
- Modern case histories from land, shallow and deepwater environments

Session 4: Imaging workflow

- Basic migration, prestack time migration and gather generation
- Correcting for velocity variation and complex sub-surface: prestack depth migration
- Algorithm choice: Kirchhoff single/multi arrival, Beam vs wavefield methods (including reverse time migration), least-squares migration
- Anisotropy, including VTI, TTI, orthorhombic cases
- Imaging with multiples, elastic imaging and future developments

Session 5: Velocity model building techniques for depth imaging and quality control

- Statics: elevation, refraction, tomographic based statics are compared using a series of synthetic and recent real case histories
- Full waveform inversion toolkit, quality control and recent case histories
- Tomography techniques and role of interpreter in velocity model building and quality control, featuring recent case histories from North Sea and Atlantic margins

Session 6: Case histories and introduction to specialized processing

- ase histories: complex topography, amplitude extraction and data conditioning workflow for reservoir characterization
- Specialized processing: single sensor, OBC, elastic and 4-D methodologies
- Meeting objectives, acquisition and processing methods for the future

Additional topics and material

The following additional sections are included online:

- Seismic data formats: seismic and navigation formats
- Workstation data loading: including common pitfalls
- Processing tenders overview

The following optional resources can be made available:

- Customization of training modules and exercises based on client data
- Self-paced learning modules provided online in advance of in-person workshop-based sessions