



Seismic Data Acquisition and Processing

Course: 3D Survey Design, Field QC and PSDM Imaging



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Introduction:

Seismic data acquisition and processing, from 3D survey design and field QC to PSDM imaging, is a 10-day course for geophysicists, geoscientists and seismic QC staff that ends with a Seismic Survey Design and Processing QC Plan for a case field. Budgets are lost when bin size, fold or offset are set too thin, field noise goes unchecked and migrated volumes keep residual multiples and velocity errors. Nominees already specify surveys or review processed data, and work through case datasets, shot records and test panels. CoreConcept Training Center delivers this seismic data acquisition and processing course.

Course Objectives:

- Specify 2D and 3D survey geometry, including bin size, nominal fold, offset range and azimuth distribution, from target depth, dip and resolution needs
- Select land, marine and ocean-bottom source and receiver configurations and set sampling, record length and spread parameters for each environment
- Supervise field acquisition quality through daily shot record, noise, positioning and HSE reviews, and approve field data delivery in SEG-Y and positioning files
- Review a processing sequence from geometry assignment, refraction and residual statics, noise attenuation and deconvolution to velocity analysis, NMO correction and CMP stacking
- Judge multiple attenuation and pre-stack time and depth migration results with parameter tests, gathers, velocity models and QC metrics
- Produce a Seismic Survey Design and Processing QC Plan for a case field covering acquisition parameters, processing flow, test decisions and handover deliverables

Target Audience:

- Geophysicists who define acquisition parameters and survey geometry for exploration and development seismic projects
 - Geoscientists who sponsor new 2D, 3D or 4D seismic and accept the final processed volumes
 - Seismic QC representatives who supervise field crews and verify shot records, positioning and noise on site
 - Processing geophysicists who build and test processing flows and present test panels for decision
 - Geophysical project staff who manage acquisition and processing contracts, schedules and deliverable acceptance
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Course Outline:

Day 1: Seismic Wave Physics and the Reflection Method

- P-Wave and S-Wave Propagation Through Layered Elastic Rock
- Acoustic Impedance Contrast and Reflection Coefficient at Interfaces
- Spherical Divergence, Absorption and Frequency Loss With Depth
- Common Midpoint Reflection Geometry and Normal Moveout Hyperbola
- Nyquist Sampling, Aliasing and Record Length Selection

Day 2: 2D and 3D Survey Design Geometry and Parameters

- Bin Size From Target Dip and Maximum Unaliased Frequency
- Nominal Fold, Fold Taper and Signal-to-Noise Targets
- Offset Range, Mute Zone and Far Offset Requirements
- Orthogonal, Slant and Wide-Azimuth Swath Layout Comparison
- Illumination Modelling and Survey Footprint Prediction Checks

Day 3: Land Acquisition Sources, Receivers and Field Operations

- Vibroseis Sweep Design, Drive Level and Ground Force Checks
- Explosive Shot-Hole Depth, Charge Size and Weight Drop Options
- Geophone Arrays, Point Receivers and Ground Coupling Tests
- Uphole Surveys and Low-Velocity Layer Field Measurements
- Cable and Nodal Land Recording Systems and Spread Management

Day 4: Marine and Ocean-Bottom Acquisition and Field Data Formats

- Air-Gun Array Tuning, Source Signature and Bubble Ratio
- Streamer Spread Configuration, Depth Control and Feathering Limits
- Ocean-Bottom Node and Cable Layouts With Four-Component Sensors
- Hydrophone and Geophone Summation for Ghost and Receiver Response
- SEG-Y Trace Headers and Source and Receiver Position Files

Day 5: Week-One Case Study on Acquisition QC and HSE Oversight

- Daily Shot Record Review and Noise Classification on Site
 - Positioning QC, Coverage Plots and Infill Decision Rules
 - Seismic Crew HSE Management Plan and Exposure Hours Review
 - Marine Mammal Observation and Soft-Start Source Procedures
 - Case Field Acquisition QC Report and Acceptance Checklist
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Day 6: Pre-Processing, Geometry, Statics and Noise Attenuation

- Field Data Reformat, Trace Editing and Geometry Assignment
- First-Break Picking and Refraction Statics Model Building
- Surface-Consistent Residual Statics and Stack Power Optimisation
- Ground Roll, Swell and Linear Noise Attenuation Methods
- Surface-Consistent Amplitude Scaling and Spherical Divergence Gain

Day 7: Deconvolution, Velocity Analysis, NMO and Multiple Attenuation

- Spiking and Predictive Deconvolution Operator Length Testing
- Semblance Velocity Picking on CMP Gathers and Supergathers
- NMO Correction, Stretch Mute and CMP Stacking Quality
- Surface-Related Multiple Elimination for Long-Period Marine Multiples
- Radon Demultiple and Peg-Leg Short-Period Multiple Suppression

Day 8: Time and Depth Imaging With PSTM and PSDM

- Kirchhoff Pre-Stack Time Migration Aperture and Anti-Alias Settings
- Interval Velocity Model Building From RMS Velocities
- Tomographic Velocity Update Using Residual Moveout on Gathers
- Reverse Time Migration Versus Kirchhoff PSDM Selection Criteria
- Anisotropy Parameters and Depth Image Calibration Checks

Day 9: Processing QC Metrics, Parameter Testing, 4D and Broadband

- Test Panel Design and Parameter Decision Records
- Processing QC Metrics for Gathers, Stacks and Spectra
- Time-Lapse 4D Repeatability Metrics and Cross-Equalisation Steps
- Broadband Deghosting and Low-Frequency Bandwidth Extension Methods
- Amplitude-Preserving Flow Audit Before Pre-Stack Inversion Studies

Day 10: Capstone Case Study on the Survey Design and Processing QC Plan

- Case Field Target Review and Acquisition Parameter Selection
 - Case Processing Flow and Test Sequence Specification
 - Case Velocity Model and Migration Route Decision
 - Deliverables Handover Package for Interpretation Teams
 - Seismic Survey Design and Processing QC Plan Completion
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Skills You Will Gain:

- Seismic Survey Geometry Design
- Source and Receiver Parameter Selection
- Field Acquisition Quality Supervision
- Statics and Noise Diagnosis
- Velocity Model Building
- Multiple Attenuation Assessment
- Pre-Stack Migration Evaluation
- Time-Lapse Repeatability Analysis

Why Attend This Course:

- Hand the exploration or asset geophysics lead a Seismic Survey Design and Processing QC Plan for a case field, with parameters, flow, tests and handover list
- Decide bin size, fold, offset and azimuth for a new survey, and choose between PSTM and PSDM for a given velocity setting
- Avoid reshoots, infill lines and reprocessing caused by undersampled geometry, unchecked field noise and unresolved velocity errors
- Share shot record review sheets, test panel templates and processing QC checklists with field and processing colleagues

Conclusion:

Back at work, the participant gives the exploration or asset geophysics lead a Seismic Survey Design and Processing QC Plan that fixes survey geometry, source and receiver parameters, field QC criteria, the processing flow, test decisions and the handover package for interpreters. The lead uses it to approve the next acquisition scope, set acceptance criteria for contractors' field and processing work and choose the imaging route. After the first survey or reprocessing project, the team should review infill volumes, rejected shots, test outcomes, residual moveout and turnaround against the plan.

Frequently Asked Questions FAQ:

What should participants know before the seismic data acquisition and processing course?

Participants should already work with seismic data, either specifying surveys, supervising field crews or reviewing processed volumes, and understand basic wave physics and geology. Bringing a recent acquisition specification, QC report or processing test panel helps them apply the case work to their own projects.

How does the seismic data acquisition and processing course differ from a seismic interpretation course?

It ends where interpretation begins. This course designs surveys, supervises field data and judges the processing and migration that produce the volume. Interpretation courses take that finished volume to tie wells, pick horizons and faults, convert to depth and map prospects.

Why does seismic data acquisition and processing need both PSTM and PSDM?

Each suits a different velocity setting. Pre-stack time migration is faster and adequate where lateral velocity changes are mild. Pre-stack depth migration uses an interval velocity model and is needed below salt, steep dips or strong lateral velocity contrasts, at higher computing cost.

What do participants take back from the seismic data acquisition and processing course?

Participants take back a Seismic Survey Design and Processing QC Plan for a case field, with geometry and parameter worksheets, shot record and positioning QC checklists, test panel templates, processing QC metrics and a deliverables handover list for interpretation teams.
