



Advanced Seismic Imaging of Subsurface Geology

Course Duration : 5 days

Date : 11-Nov-2024 to 15-Nov-2024

Location : Abu Dhabi

Type of Participant : Seismic interpreters, geophysicists, geologists, and exploration team members who use seismic data and need to understand the purpose and implications of the data acquisition and processing steps that lead to the final seismic images and derivative attributes. Also, the course is appropriate to early-career processing geophysicists seeking a rigorous foundation of the principles of data processing and seismic imaging.

Summary:

This course is designed for those working with reflection seismic data to understand and appreciate the underlying principles and processes leading to final images and associated attributes. Basic seismic imaging principles and techniques are introduced at the outset of the class to establish the purpose, underlying principles, parameterization, and limitations of the various processing steps leading to final seismic images provided by current state-of-the-art imaging techniques. The course focuses on 3D seismic data.

By the end of the course, the participant will understand and appreciate the many steps leading to final interpretable images and will be able to recognize possible problems introduced or not mitigated by the processing flow. Moreover, the participant will understand how seismic acquisition and data processing steps affect seismic amplitudes to assess their validity as input to various post-imaging seismic attribute and inversion processes. The lectures are complemented by many case-history examples, hands-on exercises and real-time data processing examples. Although mathematics is kept to a minimum, some understanding of 1D and 2D filtering is helpful.



Objective:

Participants will learn how to:

- Assess and determine data processing flows for a variety of acquisition and reservoir scenarios
- Determine the most cost-effective imaging or migration technique given acquisition and structural scenarios
- Recognize various noises and how best to mitigate them
- Assess and appreciate the sensitivity of data processing parameters on final images
- Estimate the vertical and lateral resolution of the processing and attribute products
- Understand and examine data acquisition and processing quality control displays
- Ask appropriate questions during data processing steps
- Communicate effectively with specialists in seismic data acquisition, processing, and interpretation
- Appreciate and evaluate the trade-offs between costs, turn-around time, and sophistication of processing and imaging steps

Contents:

1. Introduction to Seismic Imaging

- **Basics of Reflection Seismology**
 - Wave Propagation and Seismic Amplitudes
- **Introduction to 3D Seismic Imaging**
 - Overview and key concepts
- **Commonly Used Data-Acquisition Geometries**
 - Impact on imaging and data quality

2. Seismic Imaging Techniques

- **Seismic Imaging as a Data Focusing Process**



- Kirchhoff Migration Methods
- **Principles of Wavefield-Continuation Equation Migration**
 - Time vs. Depth Migration
 - Kirchhoff Depth Migration
- **Depth Migration by Wavefield-Continuation**
 - Anisotropic Migration
 - Current Trends: Reverse Time Migration (RTM)

3. Velocity Estimation and Analysis

- **The Relationship Between Seismic Velocity and Migration**
- **Basic Methods for Velocity Estimation**
 - Velocity Spectra, Dix Equation
- **Velocity Estimation in Complex Structures**
- **Migration Velocity Analysis (MVA)**
 - Introducing Geological Knowledge into MVA

4. Advanced Migration Techniques

- **Waveform Inversion Process**
 - Principles and Techniques
 - Linearized Waveform Inversion and Least-Squares Reverse Time Migration (LSRTM)
 - Full Waveform Inversion
- **Wave-Equation Migration Velocity Analysis (WEMVA)**
- **Time-Lapse Imaging by Waveform Inversion**

5. Imaging Artifacts and Aliasing

- **Imaging, Aliasing, and Incomplete Subsurface Illumination**
 - Spatial Aliasing and Imaging Artifacts
 - Avoiding Aliasing in Kirchhoff and Wavefield-Continuation Migration
 - Imaging Artifacts from Irregular Data Geometry
- **Illumination Maps**



- Proper Use and Common Pitfalls

6. Application of Approximate Regularized Inversion

- **Data-Domain Methods**
 - Data Geometry Regularization
- **Model-Domain Methods**
 - Imaging by Least-Squares Migration

7. User Guides and Tools

- **Migration Toolbox User Guide**
- **Principles of Reflection Traveltime Tomography**