N085: Introduction to Seismic Interpretation

Instructor(s): Rachel Newrick

Format and Duration

Classroom - 5 Days
Virtual - 10 Sessions

Summary

Business Impact: This course will add value for petrotechnical professionals and support staff by providing a practical knowledge and a working understanding of the techniques and concepts used in the seismic interpretation process.

This course provides a thorough introduction to all aspects of seismic data, from the fundamentals of the seismic method to mapping and the use of seismic attributes. This long-standing foundational seismic course has added value for new hires and those switching to a seismic-based role, as well as for geo-techs and petroleum engineers. The course makes use of "real-world" examples of producing fields and basins around the world.

Learning Outcomes

Participants will learn to:

1. Explain fundamental aspects of seismic wave propagation, diffractions, and reflection criteria.
2. Compare 2D and 3D seismic acquisition techniques; evaluate key survey requirements necessary to achieve project objectives.
3. Assess the importance of key seismic data processing steps including datum and statics corrections, velocity analyses, migration, and depth imaging.
4. Contrast 2D and 3D seismic data benefits, recognize common imaging pitfalls.
5. Explain how prospect risk factors can influence project objectives and interpretation workflows.
6. Demonstrate practical interpretation skills; construct and use synthetic seismograms, perform well-seismic ties, 2D line correlation, horizon and fault identification, seismic picking and basic mapping.
7. Compare seismic time-to-depth conversion techniques and recognize the advantages and disadvantages of different methods.
8. Determine factors affecting seismic resolution at the reservoir scale.
9. Differentiate the various types of seismic attributes available and select appropriate attributes for a given project.
10. Demonstrate the relationship between mapping exercises on paper and modern workstation practices.
11. Apply basic stratigraphic seismic interpretation skills including identification of major sequence boundaries, and also 3D stratigraphic slicing to map channel reservoirs.

Training Method

This is a classroom or virtual classroom with exercise and lecture materials derived from "real-world" examples of producing fields and basins around the world.

Who Should Attend

Geoscientists who are new to the petroleum industry and who require tools and techniques for the practical use and interpretation of seismic data; Geotechnical assisstants who are involved in seismic

interpretation projects; Petrophysicists, Engineers and Project Managers who would like to learn more about the utilization of seismic data in various project settings.

Prerequisites and Linking Courses

A general geological background and some familiarity with oil and gas industry terms and practice are assumed. N085 also provides the foundation necessary for other geophysics courses such as N004 (The Essentials of Rock Physics for Seismic Amplitude Interpretation), N049 (Seismic Attributes for Exploration and Reservoir Characterization), and N485 (Advanced Seismic Interpretation).

Course Content

Seismic data, in particular 3D seismic data, is a mainstay of the petroleum industry. Seismic data are used by geophysicists, geologists and engineers alike to image subsurface structure and stratigraphy, identify hydrocarbons, and thereby generate drilling prospects and effectively drain oil and gas reservoirs. Achieving an understanding of all of the methods and concepts used during the interpretation process can be a daunting task. A partial list of disciplines incorporated into a complete interpretation workflow includes rock physics, signal processing, wireline log analysis, computer visualization, structural geology, stratigraphy and petroleum engineering. Few, if any, new hires have mastered, or perhaps even been exposed to, all of these disciplines during their university education. Other, more experienced, petroleum professionals may have become specialists in one of these or other fields, and lack the “big-picture” view necessary for maximizing the value of a seismic interpretation.

The approximate schedule of content for this course is shown below but may vary according to the pace and experience of the group.

Introduction

Prospect risk factors influencing interpretation workflows

- Exercise: prospect analysis and risk assessment

The seismic method

- Rock properties
- Wave propagation, reflectivity, impedance
- Data acquisition
- Exercises: reflection coefficients, time/depth domains, mapping

Seismic data processing overview

- Conventional pre-stack processing and CMP gathers
- Post-stack processing
- Seismic migration
- Exercises: datum statics, migration

Calibration methods (well-tie)

- Velocity surveys
- Sonic logs
- Synthetic seismograms
- Exercise: seismic well tie

Vertical Seismic Profiles

Structural interpretation

- Structural styles
- Fault interpretation
- Exercise: fault plane interpretation
- Horizon interpretation techniques
- Horizon attributes
- Exercise: structure mapping
- Validation methods
- Interpretation pitfalls
- Exercises: compressional tectonics

Attributes for lithology, fluids, and rock mechanics

- Acoustic impedance and inversion
- AVO and elastic seismic response
- Pore pressure effects on velocity
- Interpretation tools for unconventional reservoirs

Modelling and depth conversion tools

- Types of velocity information
- Depth conversion methods
- Exercise: velocity model building
- Workflow: depth conversion using 2-layer model
- Image ray map migration
- PreStack depth migration

Validation using 2D modeling, ray tracing and full waveform modeling

Stratigraphic interpretation of seismic data

- Sequence stratigraphy
- Seismic facies identification
- Exercise: seismic stratigraphy
- Seismic tuning amplitudes and isochron mapping

- Exercise: mapping reservoirs using stratigraphic slices
- Spectral decomposition
- Visualization tools