AVO + Seismic Inversion

Course Price

£3050

Course Description

In addition to kinematic attributes, traveltimes, that historically have received the most popular use of the seismic data, nowadays seismic data is also used for dynamic attributes, amplitudes. Examples of the application of AVO attributes are as independent supporting evidence of the occurrence of hydrocarbons in addition to structural evidence, as hydrocarbon discriminator and as a lithology indicator. This course gives an overview of the factors that affect seismic amplitudes and of ways to extract the relevant factor, i.e. the angle dependent reflection coefficient followed by its interpretation. Therefore the course will deal with wave propagation, boundary conditions, rock physics, fluid substitution algorithms, amplitude preserving seismic data processing, including true-amplitude migration, derivation of AVO attributes and the interpretation of these attributes. An AVO workshop will be part of the course.

Course Objectives

Participants will be able to conduct AVO studies including the pre-processing of the data prior to such a study. They have the tools to assess the results for a proper interpretation.

The course also deals with auxiliary topics, such as seismic-to-well matching, inversion and studies with synthetic data; this enables the participants to enhance the scope of AVO for further applicability, e.g. liase with geologists, petrophysicists and reservoir engineers.

Who Should Attend

This course is designed for those earth scientists who in addition to knowledge about the structural behaviour of the underground (referred to a structural interpretation) also want to extract layer attributes, elastic and rockphysical, together with an assessment of the quality of those attributes. This course learns how to reconcile a variety of inputs from different disciplines with the information that can be derived from the seismic data; this is also called quantitative interpretation.

Course Content
Elastic constants

1. The stress tensor, the strain tensor, Hooke’s law: stress-strain relationships
2. Definition of elastic constants
3. Relationships between elastic constants
4. Wave propagation and wave phenomena
5. P-waves and S-waves

AVO : Amplitude Versus Offset and AVA : Amplitude Versus Angle

1. Factors affecting amplitudes
2. The boundary conditions
3. Example of normal incidence reflection and transmission
4. Reflection and transmission for isotropic elastic media – the Zoeppritz equations
5. Approximate expressions for reflection coefficients
6. Rock properties; fluid substitution algorithms and Vp-Vs relationships
7. Processing for AVO
8. Estimation of AVO parameters and AVO inversion
9. AVO attributes, crossplotting of AVO attributes and AVO classification
10. Reflectivity from logs and AVO modeling
11. Angle stacks and elastic impedance
12. Auxiliary topics:
    – deconvolution
    – detuning
    – least-squares estimation and inversion techniques

Seismic amplitude modeling

Workshop seismic amplitude modeling

True-amplitude migration

1. Discussion of different approaches
2. Imaging conditions and amplitude recovery
3. The Beylkin determinant

Seismic-to-Well Matching

1. Model based wavelet estimation; merging different seismic surveys
2. Seismic-to-well matching: amplitude calibration
3. Reflectivity estimation; the O’Doherty Anstey model
4. Seismic-to-well matching: quantitative measures
5. Seismic wavelet determination with well data
6. Seismic attributes: classification and derivation
7. Coherency measurement and applications
8. Seismic data inversion

Seismic data inversion
1. From reflectivity to acoustic impedance to reservoir properties
2. Least-squares filtering and estimation
3. Singular value decomposition (SVD)
4. Resolution matrix and covariance matrix
5. Probability theory and Bayesian approach to inversion
6. Determinist inversion and stochastic inversion
7. Full waveform inversion (FWI)
8. Kriging, cokriging and sequential Gaussian simulation (SGS)

CPD Unit

Continuing Professional Development

35 HOURS CPD