Practical Depth Conversion with Petrel

Place:	**Buenos Aires, Argentina**
Date:	**22 to 26 August 2016 (from 9.00 to 17:00 hs.)**
Cost:	**U$S 3,700**
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Depth conversion (domain conversion) of seismic time interpretations and data is a basic skill set for interpreters. However, there is no single methodology that is optimal for all cases since the available seismic and geologic control varies in quantity and quality within each project. To design an effective approach to depth conversion, the first part of this course prioritizes understanding the nature of velocity fields and practical approaches to velocity representation. Next, appropriate depth-conversion methods are presented in case history and exercise form. Single-layer and more sophisticated multilayer approaches are reviewed, along with depth-error analysis and the impact on formation top prognoses and volumetrics.

Depth conversion must also embrace the process of database validation. Poorly positioned wells, miscorrelated horizons, and inconsistent formation tops can introduce distortions in the implied velocity field and result in false structuring. Database validation is addressed via the formation of synthetic seismograms to confirm horizons correlation and the formation of basic Seismic Time vs. Formation Top QCs

Prestack depth migration is now commonplace, and there is always the need to calibrate the depth volumes with well control. The basic QCs and methods used for depth conversion will also be applied to validating the ties between the formation tops and the surfaces used for calibration. This is particularly important during anisotropic depth migration where inconsistencies between well control and the seismic interpretation impact the estimation of anisotropic parameters, resulting in a compromised depth image.

This course emphasizes the formation of velocity models consistent with the well control. This is in context to creating Petrel Models suitable for reservoir simulation employing depthcalibrated inversion and other attribute cubes precisely integrated with the well information.

Agenda

Day 1

Module 1: Overview of Depth Conversion

* Learning Objectives and Importance:
• Discuss the motivation for vertical timetodepth conversion
* Topics:
• Why do we depth convert time interpretations?
• Accuracies needed for relative structure, well prognoses, volumetric estimates, and reservoir models
• Database validation
• Indicators for prestack depth migration (PSDM)
* Exercises: Discussions on student goals and experiences with time-to-depth conversion

Module 2: Sources of Velocity

* Learning Objectives and Importance:
• Review common sources of velocity information
* Topics:
• Sonic logs, check shots, and VSPs
• Seismic (refraction, reflection)
* Exercises: Analysis of various velocity data types

Module 3: Defining Velocity Types

* Learning Objectives and Importance:
• Review definitions and characteristics of velocities
* Topics:
• Types of velocities
• Conversion of velocity types
• Compactional and layered geologies
• Velocity gradients
* Exercises: Various problems on relating velocity types and conversions. Petrel exercises. Module

4A: Functional Representation of Velocities

* Learning Objectives and Importance:
• Define velocities fields using vertical functions
* Topics:
• Velocity as a function of time
• Velocity as a function of depth
• Implicit velocity representation via TD functions
• Petrel Velocity Models with time and depth functions
* Exercises: Various problems defining velocity fields in various domains

Day 2

Module 4B: Gridded Representation of Velocities

* Learning Objectives and Importance:
• Define velocities fields using grids
* Topics:
• Spatial velocity variations (lateral gradients)

• Creating an edited PSTM velocity field in Petrel
* Exercises: Import SEG Y velocities to Petrel and forming a gridded model

Module 5: Well and Seismic Data Integration
* Learning Objectives and Importance:
• Understand methods for linking well and seismic information
* Topics:
• Establishing data polarity and phase
• Initial database validation
• Creating synthetic ties
• Dispersion and other considerations
* Exercises: Problem sets and interactive work sessions

Day 3

Module 6: Vertical TimetoDepth Conversion (Basic)
* Learning Objectives and Importance:
• Implement basic depth conversion using vertical functions and spatial corrections
* Topics:
• Singlelayer (direct depth conversion) methods
• Handling spatial velocity variations (lateral gradients)
• QC methods
• Basic Petrel Velocity Models
* Exercises: Problem sets and interactive work sessions

Module 7: Vertical TimetoDepth Conversion (Advanced)
* Learning Objectives and Importance:
• Explore depth conversion with layerbased methods
* Topics:
• Geologic and datadriven modeling considerations
• Multilayer approaches
• Advanced Petrel Velocity Models
• Un
* Exercises: Problem sets and interactive work sessions

Day 4

Module 8: Pitfalls of Vertical Depth Conversion
* Learning Objectives and Importance:
• Understand accuracy of vertical timetodepth methods and when they fail
* Topics:
• Extreme geologic regimes
• Shallow velocity anomalies and overpressure
• Alternatives
* Exercises: Problem sets and interactive work sessions

Module 9: WellSeismic Database Validation
* Learning Objectives and Importance:
• Appreciate the need to review and correct the database prior to incorporating well control
* Topics:

• Confirm database settings
• Review seismic data polarity, phase, and synthetic correlations
• Using basic depthconversion QCs to encounter data discrepancies
* Exercises: Extensive exercises on detecting and correcting errors and inconsistencies in the database

Module 10: Anisotropy
* Learning Objectives and Importance:
• Appreciate the impact of anisotropy on seismic velocities and imaging
* Topics:
• Seismic anisotropy
• Parameterization (Vz, delta, epsilon, VTI/TTI)
• Problems and promise of anisotropy for velocity definition and seismic attributes
* Exercises: Discuss impact of anisotropy on depth conversion and imaging

Day 5

Module 11: Depth Migration and Well Calibration
* Learning Objectives and Importance:
• Learn basic approach for stable integration of depthdomain seismic (PSDM) with well control
* Topics:
• Working in the time domain
• Updating the time/velocity model
• Conversion of time data to calibrated depth
• Optional: Map migration for dynamic calibration and introduction to uncertainty
* Exercises: Various Petrel calibration exercises

Module 12: Petrel Models and Uncertainty Analysis
* Learning Objectives and Importance:
• Implement domain conversion and uncertainty analysis with Petrel Velocity and 3D Models
* Topics:
• Evaluating depth error on structure and well prognoses
• Impact of structural uncertainty on volumetrics in 3D Models
* Exercises: Various Petrel exercises