N172: Depth Conversion Methods and Pitfalls

Instructor(s): Alan Atkinson

Format and Duration
Classroom - 5 Days

Summary

The course is equally appropriate for those with sophisticated depth conversion tools who must understand the 'black box', and for those who have to depth convert using only mapping software and a spreadsheet. Attendees will learn how to maximise use of their velocity data, see how greater control on the velocity model can be achieved by incorporating geological understanding, and recognise the importance of appropriate well tying. A wide range of experience will be catered for in the course, which is biased towards worked examples. The course provides attendees with a geophysics refresher, mapping and interpretation tips, and several efficiency enhancing spreadsheets to take away.

Business Impact: Participants will learn to approach depth conversion as part of the geological-geophysical interpretation process, starting during seismic time interpretation and ultimately producing more accurate maps for hydrocarbons in place calculations and well planning. Tips and techniques in data QC, practical velocity modelling methods, and recognition of geological and geophysical pitfalls are emphasised.

Learning Outcomes

Participants will learn to:

1. Assess and verify the integrity of the different sources of data providing a measure of velocity.
2. Review and evaluate velocity data to determine the best approach to depth conversion.
3. Construct geologically reasonable velocity models from the data with which to perform depth conversion.
4. Prepare seismic horizon picks, well formation picks and seismic velocity to facilitate depth conversion.
5. Set up depth conversion work flows appropriate for the data availability and technical challenges.
6. Create depth maps which honour well depths using geologically reasonable well tie techniques.
7. Evaluate the impact of the velocity model and velocity model updates through sophisticated quality control techniques.
8. Judge when the geophysical method means that vertical ray depth conversion is inappropriate or provides velocities which are inaccurate for depth conversion.
9. Revise depth conversion techniques when geological factors mean that the standard approaches will give incorrect results.
10. Develop well tying techniques for maps derived from interpretation of depth-domain seismic data based on good time-domain depth conversion techniques.

Training Method

A classroom course where a variety of exercises using Excel and easy-to-use mapping software are interspersed with lecture material including case-studies, recommended workflows, and tips on dealing with problems. A final comprehensive depth conversion exercise consolidates understanding of the workflow.

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Who Should Attend

Geologists, geophysicists, and technical support staff engaged in producing depth maps from seismic interpretations, as well as technical management and other subsurface professionals involved in evaluating and using depth mapping results.

Those with less experience will benefit from the practical lectures and worked examples, while those with greater experience will treat the classroom exercises as a workshop for exploring new techniques.

Course Content

Introduction

- Understand the relevance of depth conversion in the era of Pre Stack Depth Migration
- Know the defining characteristic of a good depth conversion

Geological factors influencing velocity

- Understand the intrinsic properties of rocks that influence velocity
- Understand how geological processes control macro velocity variations in the subsurface

Sources of velocity data and their problems

- Be aware of the different sources of data providing a measure of velocity
- Understand the limitations of the data and know checks to help ensure data integrity
- Be familiar with velocity terminology

Synthetic seismograms and time-depth relationships

- Understand how interpretation systems use time-depth data and how this influences calculated velocities
- Learn how to optimally calibrate synthetic seismograms for use in depth conversion

Analysing velocity data

- Learn the importance of looking at all of the data, including logs and seismic velocities
- Learn data analysis techniques which help determine the best approach to velocity modelling and depth conversion
- Understand the importance of scale in displaying quantitative data

Velocity model building methods

- Understand when simple functions (e.g. t-d polynomials) and average velocity are poor velocity models
- Appreciate benefits of layering even with simple velocity models
- Be comfortable implementing the common velocity modelling methods, including linear velocity

functions ('Vok'), and understand their limitations
- Know techniques to condition seismic velocity products

The process of depth conversion

- Be aware of generic workflows for depth conversion
- Understand the influence of data availability and geological complexity on choice of workflow
- Be aware of potential pitfalls in implementing the processes

Tying to wells

- Know mapping techniques that make depth conversion easier by minimising misties
- Be aware of pitfalls in the use of check-shots and well picks
- Learn the importance of QC for assessing the effects of tying
- Understand when it is best to tie in depth, velocity or time domains
- Appreciate the implications and value of mapping Vo, and learn how to do it
- Know when it is best not to tie

Depth domain seismic techniques

- Understand the benefits and limitations of tomographic velocity models
- Understand how anisotropic PSDM results are matched to well depths
- Recognise the importance of being aware of/involved in seismic processing of your dataset
- Learn how to adapt good depth conversion practice to depth domain seismic horizon corrections

Quality control: tips and techniques

- Know techniques to QC the time model – time grids and correction surfaces
- Learn techniques to QC the velocity model through 'time conversion'
- Learn workflows to assess the impact of adding sophistication to velocity modelling
- Be aware of quick and effective technique for QC'ing others' work

Dealing with geophysical pitfalls

- Be aware of the reasons why the seismic image is not a vertical scaled version of the real earth
- Understand the impact of channels and other shallow anomalies on seismic reflection times and how they limit the accuracy of seismic velocities
- Learn what solutions can be implemented in vertical depth conversion, and which require another approach

Dealing with geological pitfalls

- Understand that, even when properly implemented, there are times when some velocity modelling methods will not work (presence of hydrocarbons, deep sea floor channels etc)
- Learn solutions or work-arounds for use when the recommended techniques need modification (variable water depth, discontinuities, overpressure etc)

Quantifying uncertainty

- Learn the fundamentals of combining uncertainty measurements
- Be aware of the techniques available to quantify mapping uncertainty