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Optimising Seismic Acquisition Through Combined Ray Tracing and Structural Modelling

The combination of 3D structural modelling and 3D ray trace modelling provides an essential tool for seismic acquisition design in complex structural settings. It is important to account for the refraction effects of the overburden when calculating subsurface reflection coverage and evaluating the merits of one set of seismic acquisition parameters over another.

Issues that may arise during processing and imaging of the seismic data can be better understood by pre-survey analysis on a valid model to ensure adequate offsets are recorded and the optimum survey orientation is chosen. In compressional tectonic settings where wavefront distortion typically occurs at layer boundaries, using the correct 3D structural geometry is critically important. 3D structural models can be produced from limited geologic data such as maps and 2D cross-sections. Structural validation of the 3D model provides a method to accurately constrain the structure prior to ray trace modelling.

The quality of results from a seismic modelling exercise depends largely on the validity of the velocity-density model used. Velocity and density information for layers can be based on geophysical and petrophysical information from wells or existing seismic velocities. In compressional tectonic settings where a layer-based model is typically used it is important, therefore, to constrain the layer properties and boundaries with any available geological information.

In addition, azimuthal velocity anisotropy often needs to be taken into account when imaging seismic data in compressional tectonic settings. Seismic modelling to quantify the scale of the problem and investigate possible solutions can simulate the potential effects.