Sonic-derived transversely isotropic anisotropy analysis

Advanced sonic interpretation integrated with borehole seismic data, microseismic data, or distributed acoustic sensing

Applications

- Creating seismic velocity models for depth imaging using sonic data
- Calibrating sonic data and performing a well-to-seismic tie in deviated wells where anisotropic corrections are required for overburdened shale
- Performing anisotropic amplitude variation with offset (AVO) for accurate reservoir characterization
- Determining transversely isotropic (TI) anisotropic parameters for accurate microseismic event location to map hydraulic fractures in 3D space

How it improves performance

- Reduces uncertainty in seismic interpretation and reservoir geometry with accurate well tie and appropriate velocity model
- Avoids dry wells by accounting for anisotropy when performing AVO analysis
- Calculates an accurate hydraulic fracture orientation and location during microseismic event analysis with anisotropic velocity models

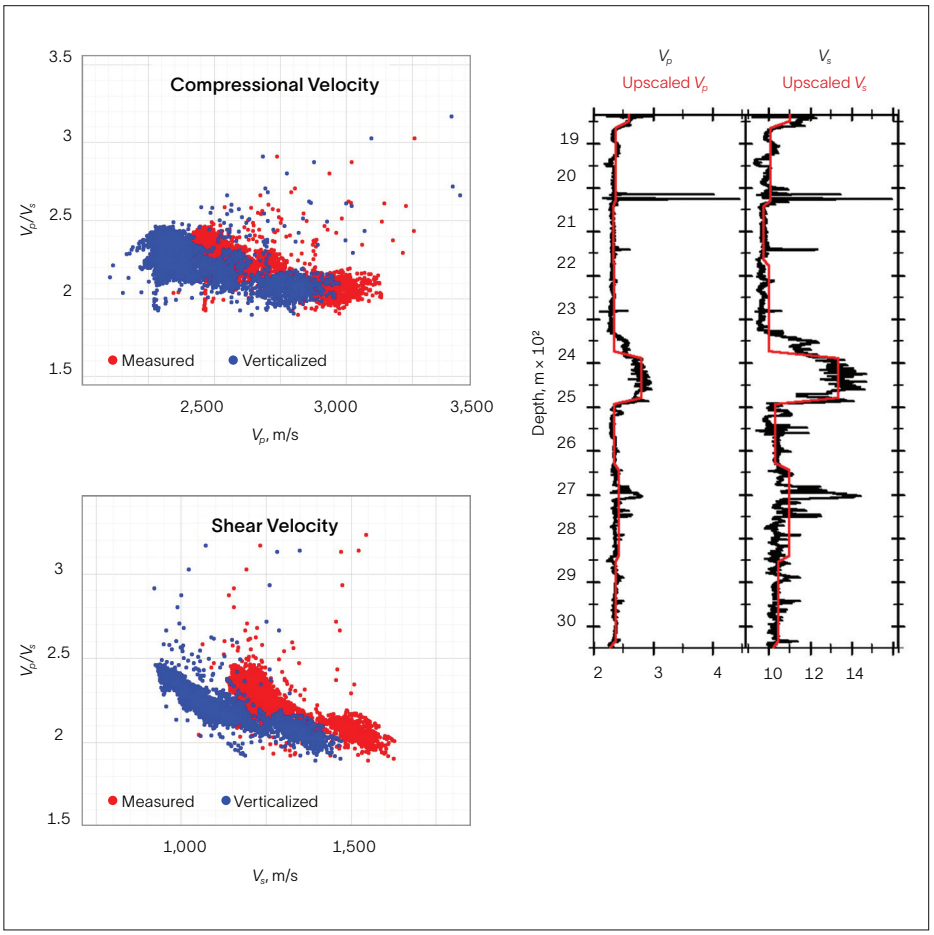
How it works

Upscaled TI anisotropy parameters at seismic frequencies are used to generate velocity model for seismic imaging, hydraulic fracture monitoring, and integration with borehole seismic anisotropy. The process combines the sonic measurement from single or multiple wells with prior information coming from cores to invert for the TI elastic properties.

Verticalized compressional slowness along with time-depth listing are taken from the vertical seismic profile (VSP) and used for sonic calibration and well-to-seismic ties. Calibrated verticalized compressional slowness combined with VSP time is used along with other TI parameters to generate synthetic anisotropic AVO gathers.

Inputs

- Compressional and shear velocity, dipole minimum horizontal stress, and vertical polarized shear wave, and Stoneley shear slowness from single or multiple wells
- Well trajectory
- Formation dip and azimuth
- VSP time depth and waveforms
- Offset well information (if available)



Left: Comparisons of measured and verticalized compressional (top, V_p) and shear (bottom, V_s) velocity, in a deviated well as V_p/V_s vs. V_p and V_s anisotropy correction.
Right: VSP velocity and sonic-derived vertical transverse isotropic (VTI) logs (black curves) and upscaled migration model (red curves).

Takeaways

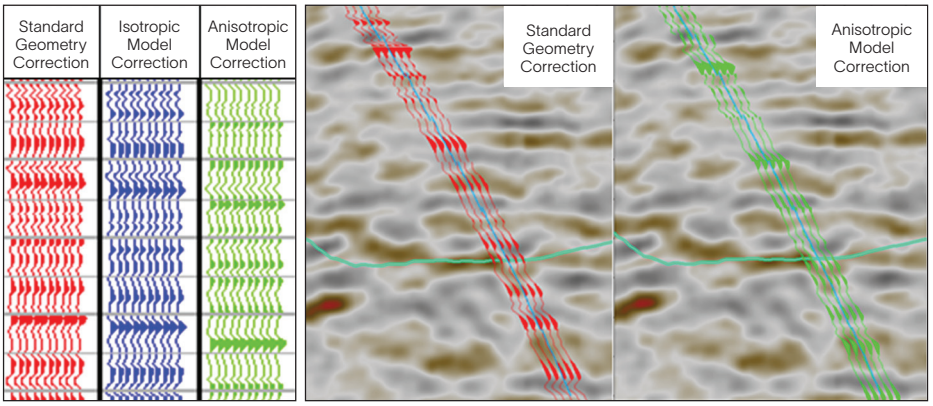
- → Continuous TI anisotropy parameters at log scale
- → Upscaled TI anisotropy parameters at seismic frequencies and integration of TI anisotropy parameter available from borehole seismic data (as seen in the compressional and shear velocity comparison figure)
- → Calibrated sonic log, synthetic seismogram, and seismic well-tie analysis anisotropic AVO synthetic gather

Learn more

Ferla, M., et al.: "Sonic-Derived TI Anisotropy as a Guide for Seismic Velocity Model Building," paper presented at the 2015 SEG Annual Meeting, New Orleans, Louisiana (October 2015) SEG-2015-5898796

How, L.H., et al.: "Verticalized Sonic Measurements in Deviated Wellbore for Accurate Velocity Modelling and Seismic Well Tie in Offshore Malaysia," paper presented at Offshore Technology Conference Asia, Kuala Lumpur, Malaysia (March 2022) OTC-31641-MS https://doi.org/10.4043/31641-MS

Leaney, S., et al.: "Anisotropic Model Building, DAS Simulation and Imaging," abstract presented at SEG Technical Program Expanded Abstracts (2019) 999-1003. SEG-2019-3215957 https://doi.org/10.1190/segam2019-3215957.1



Corridor stack comparisons between different correction methods and corridor stack positions on surface seismic data.

slb.com/SonicScanner