



Borehole Seismic Modeling and Processing

Modeling

- VSP Survey Design
- Ray tracing and FD synthetic
- P, S-wave synthetics
- 3C VTI VSP synthetic
- AVO synthetic and analysis
- Anisotropic synthetic

Processing

- Checkshot, Rig VSP
- Offset, Walk Above VSP
- 2D-3C Walkaway VSP
- Wavelet extraction/matching
- Anisotropic VSP-CDP and Kirchoff migration
- Sonic calibration
- Synthetic seismogram
- 3 ways well tie
- Multiple analysis
- Q Estimation
- Look Ahead Inversion
- Shear anisotropy analysis
- Pore pressure prediction
- Microseismic QC analysis

Benefits

- Accurate inputs for seismic processing and interpretation
- Fast delivery of VSP results
- Confidence in VSP results
- Data acquisition validation
- Reprocessing recommendations

Features

- Robust and novel signal processing algorithms
- Comprehensive VSP modeling
- 3C VSP processing
- International acquisition, processing expertise
- Wireline/LWD data processing
- Comprehensive QC analysis

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ASTO Geophysical Consulting offers a wide spectrum of borehole seismic services including survey design, quality control in real time, processing and interpretation of all commercially available VSP surveys. We use the most advanced modelling and processing packages which have been developed by the major geophysical software development vendors, the experts from research organizations and Oil&Gas companies.

Modeling

Borehole seismic modeling helps to design and to optimize survey parameters before acquisition, to assist during a processing phase and to validate the interpretation results. Modeling can be carried out using ray tracing and Finite Difference code. Figure 1 shows a 1D isotropic model (left) and FD synthetic results for surface seismic, Zero Offset VSP (middle) and Offset VSP's down and upgoing ray tracing in a 3D model (right).

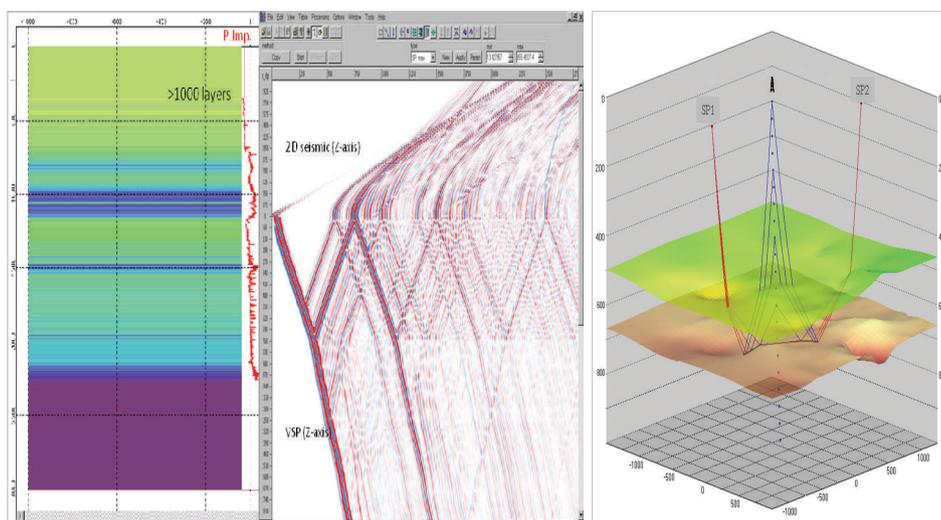


Figure 1. 1D isotropic model (left) and the modelled surface seismic and Zero offset VSP responses (middle). Offset VSP modelling for two source locations using a 3D model (right).

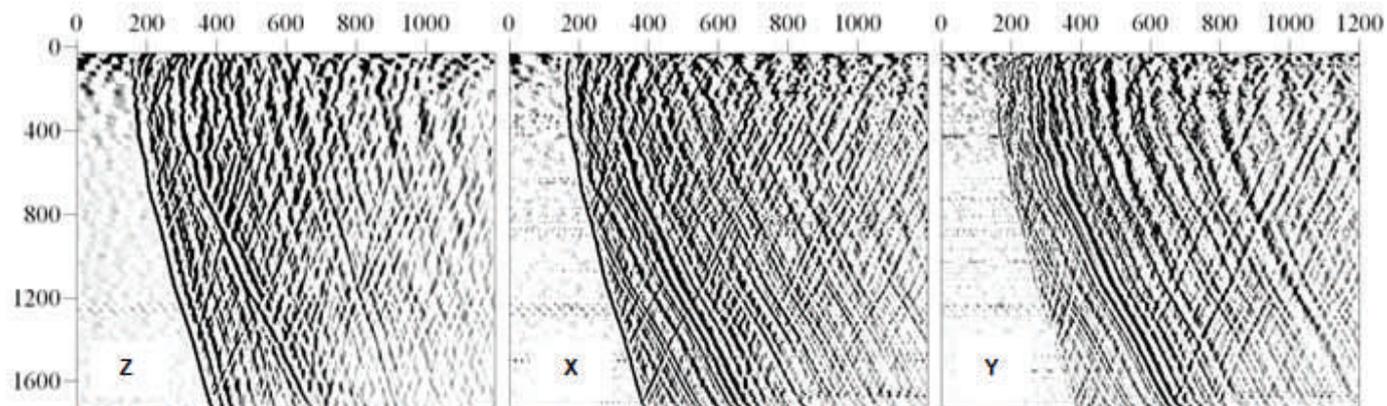
Processing

To deliver the accurate and valuable borehole seismic results a few comprehensive VSP processing packages are utilized. Those packages have all necessary functionalities for providing rapid field QC analysis of conventional VSP's and microseismic surveys, three component VSP processing, sonic calibration, synthetic seismogram, Q attenuation, multiple analysis, wavelet extraction, shear anisotropy estimation, Pp/Ps imaging, anisotropic migration and inversion below the drilling bit.

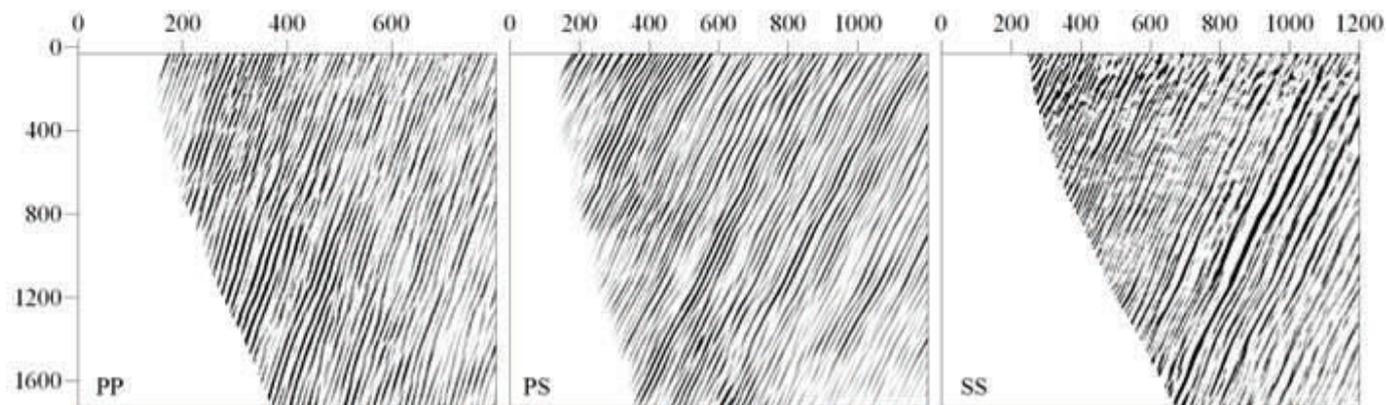
Figure 2 shows images representing the output from the VSP processing flow; the recorded Offset VSP Z,X,Y components, the deconvolved wavefield separation results, the migrated PP, PS, SS images and the inverted PP, PS and SS impedances.

Figure 3 displays the interpretation of the multi-offset VSP PP images (left) and the migrated Pp images using a 3D model (right).

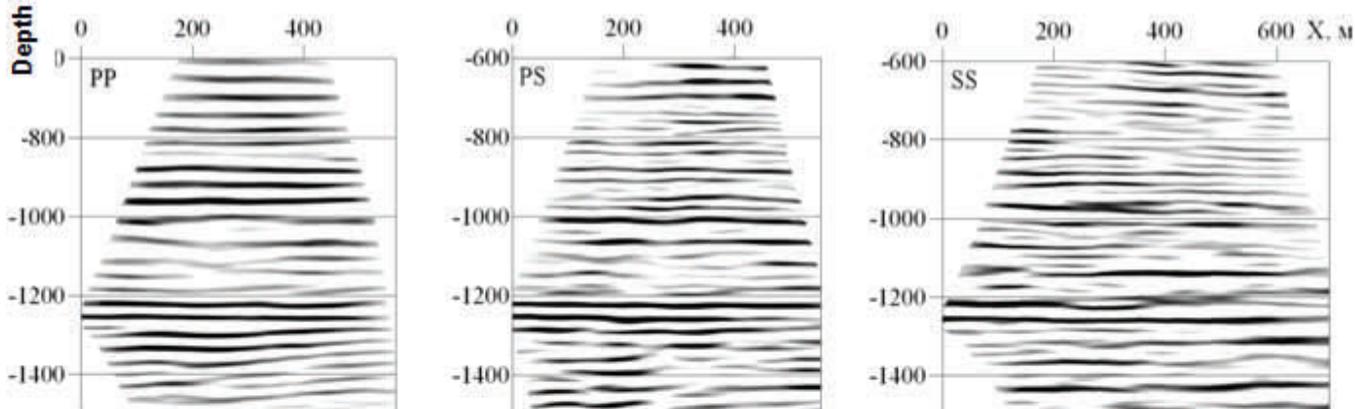
Figure 4 presents a composite display of the Offset VSP Pp depth migrated image (left), the well trajectory, the sonic log (black log) and the surface seismic cross section. The offset VSP image has the higher frequency content than surface seismic.



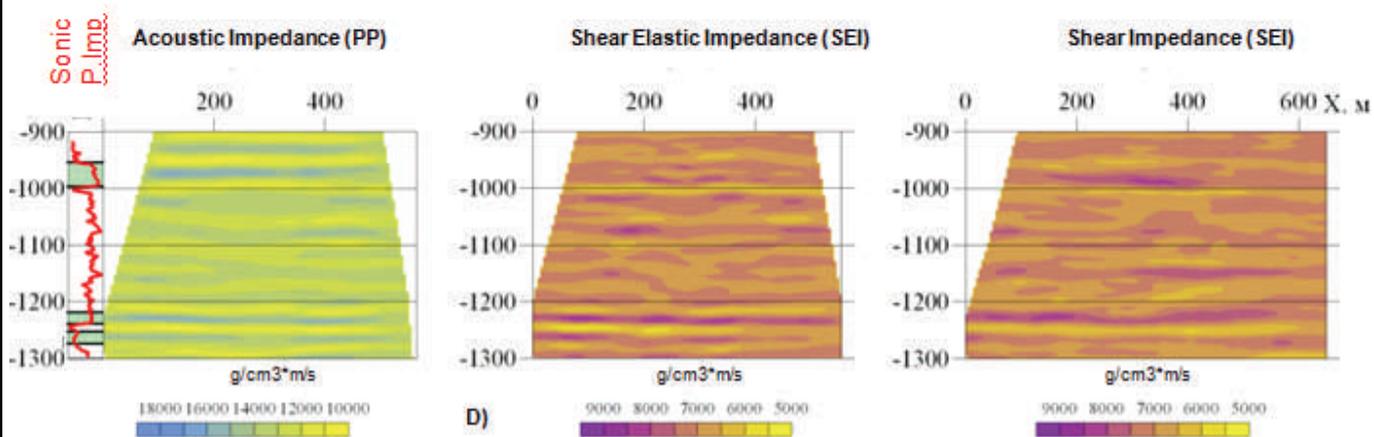
A)



B)



C)



D)

Figure 2. Shown from top to bottom are images representing the output from the VSP processing flow in order of occurrence: the recorded Offset VSP Z,X,Y components, the deconvolved wavefield separation results, the migrated PP, PS, SS images and the inverted PP, PS and SS impedances. Courtesy of VimSeis.

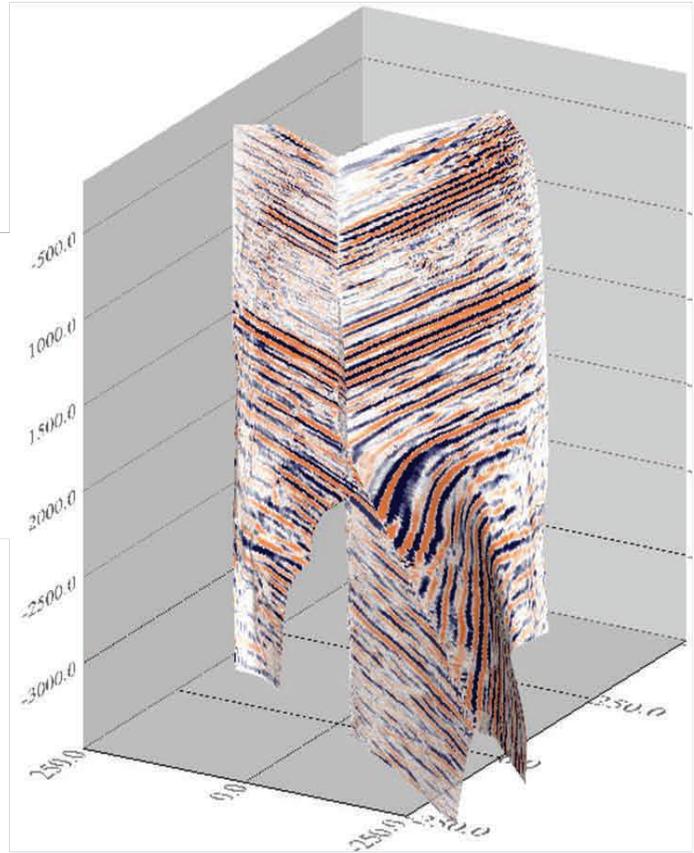
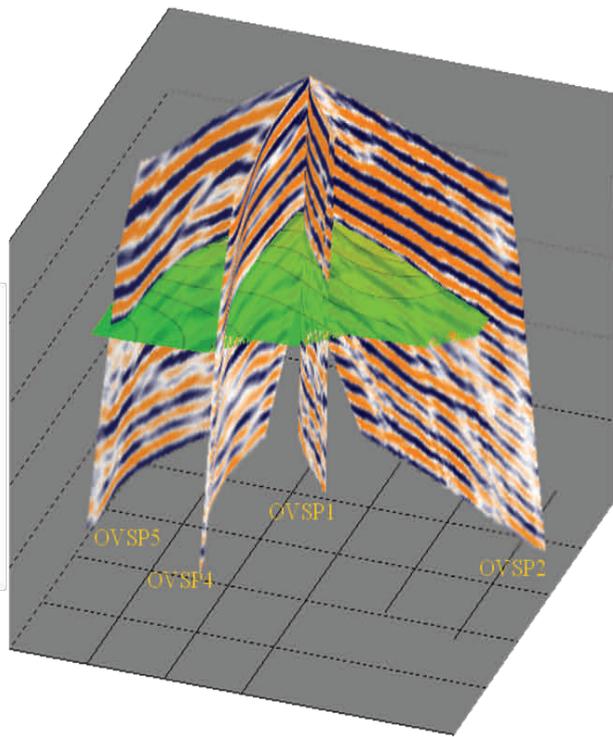


Figure 3. The interpretation of multi-offset VSP PP images (left) and the migrated Pp images using a 3D model (right). Courtesy of VimSeis.

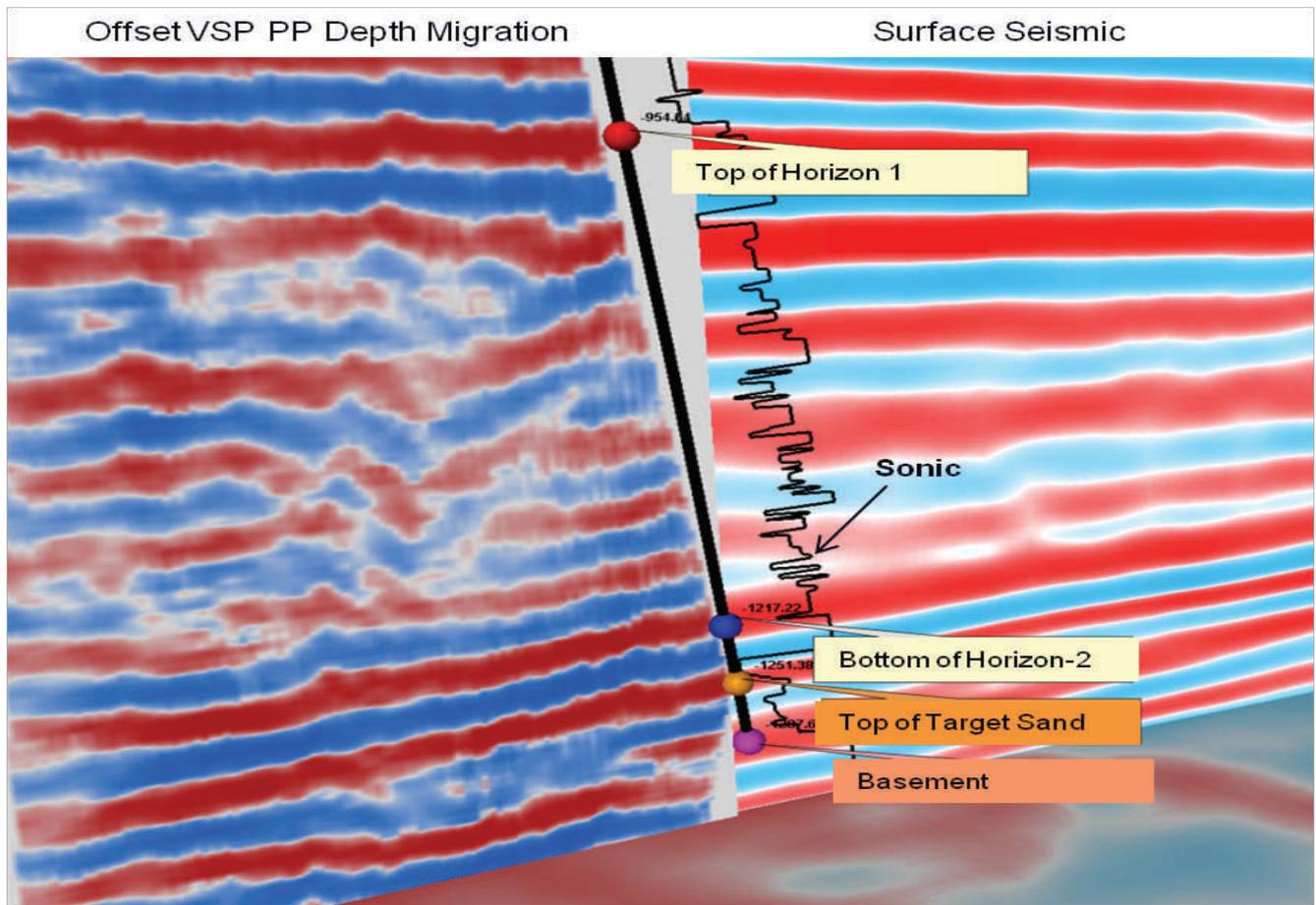


Figure 4. A composite display of the Offset VSP Pp depth migrated image (left), the well trajectory, the sonic log (black log) and the surface seismic cross section. The offset VSP image has the higher frequency content than surface seismic. Courtesy of VimSeis