PSP26

Orthorhombic Velocity Model Building for Microseismic Processing with Constraints of Rock Physics and Geological Setting

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SUMMARY

Seismic anisotropy of shales play a crucial role in microseismic processing, which can influence the location of microseismic event, the inversion and interpretation of source mechanism and further affect the estimates of fracture geometry and simulated volume.
The primary source of shale anisotropy are the bedding-parallel alignments of clay mineral as well as kerogen particles in organic-rich shales, which is usually known as intrinsic or fabric anisotropy and represented by TI model. Another important source of shale anisotropy are preferred-oriented fractures in macroscopic scale, which are generally induced by local stress field and result in azimuthal anisotropy. These two types of shale anisotropy can be represented by orthorhombic velocity model systematically.
As revealed in rock physics experiments, intrinsic or fabric anisotropy of shale are closely related to mineral compositions. Clay mineral and organic material with platy particles and softer elastic properties significantly increase the intrinsic anisotropy of shale, whereas quartz content with non-platy and stiffer grains largely weaken the degree of shale anisotropy. According to fracture mechanics, preferred orientations of fracture are parallel to the maximum horizontal stress. So the symmetry planes of orthorhombic model can be determined approximately by regional stress distribution.
With the constraints of rock physics studies and geological setting, reasonable initial model is built and further optimization is implemented by simultaneous inversion of microseismic data. This approach is applied to a dataset from Horn River shale gas reservoir, Northeastern British Columbia, Canada. The optimized orthorhombic velocity model is consistent with rock physics studies and remarkably reduces the time misfit compared to originally provided anisotropic velocity model. As a quality control, the locations of perforation shots are well restore with the optimized orthorhombic velocity model.

Abstract

Seismic anisotropy of shales play a crucial role in microseismic processing, which can influence the location of microseismic event, the inversion and interpretation of source mechanism and further affect the estimates of fracture geometry and simulated volume.

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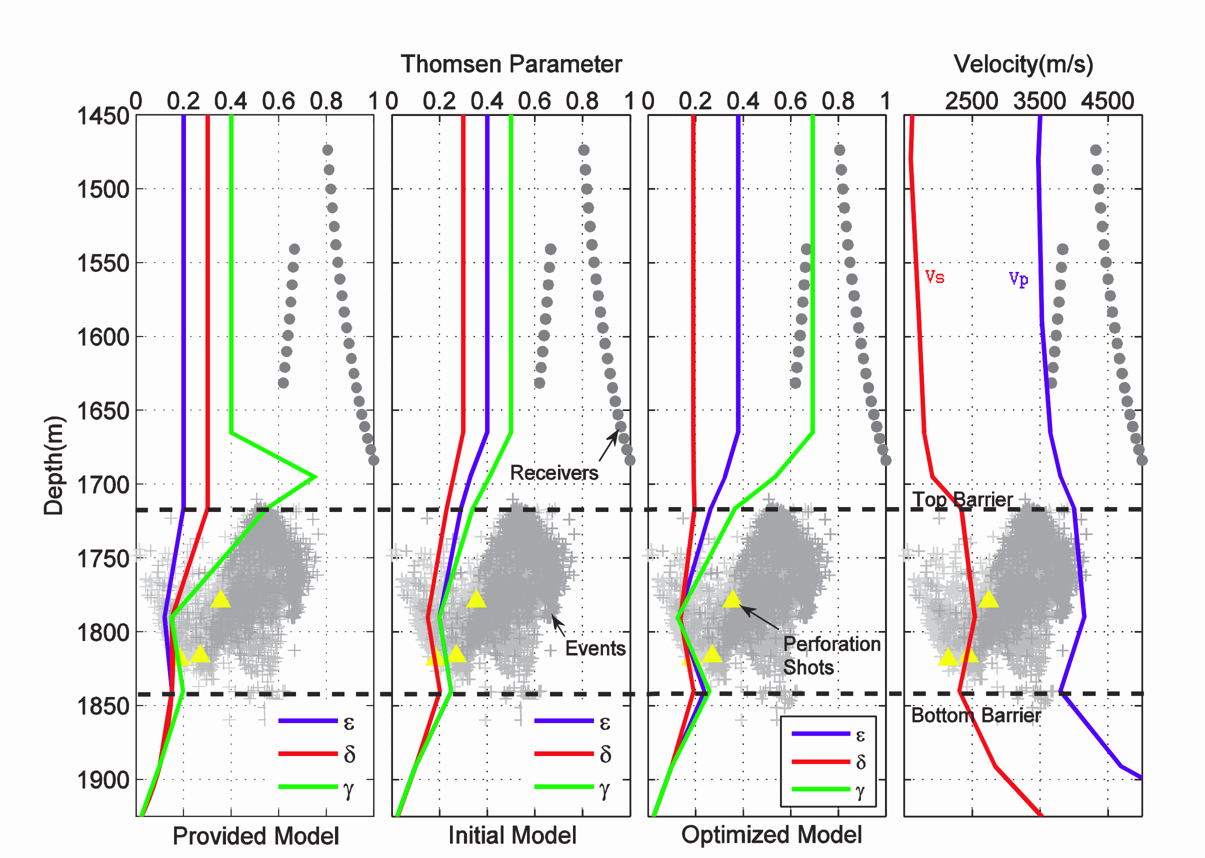

Figure 1 *Originally provided anisotropic model (left), initial anisotropic model with geological and physical constraints (middle) and optimized anisotropic model (right).*

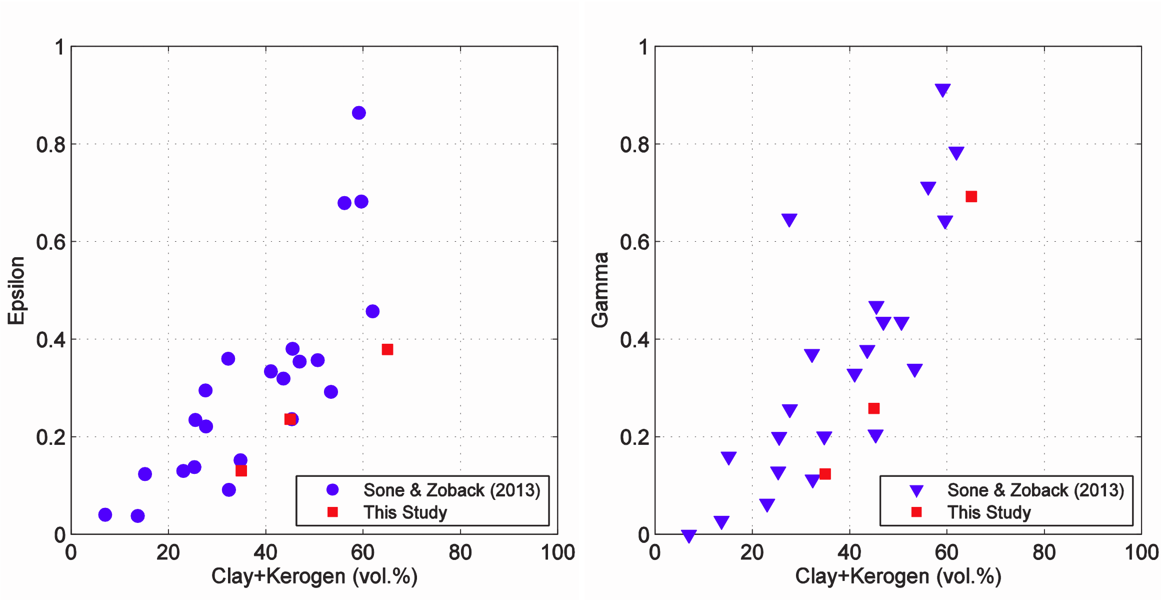

Figure 2 *Correlations of intrinsic shale anisotropy and clay+kerogen contents. Red squares are the results of this study.*

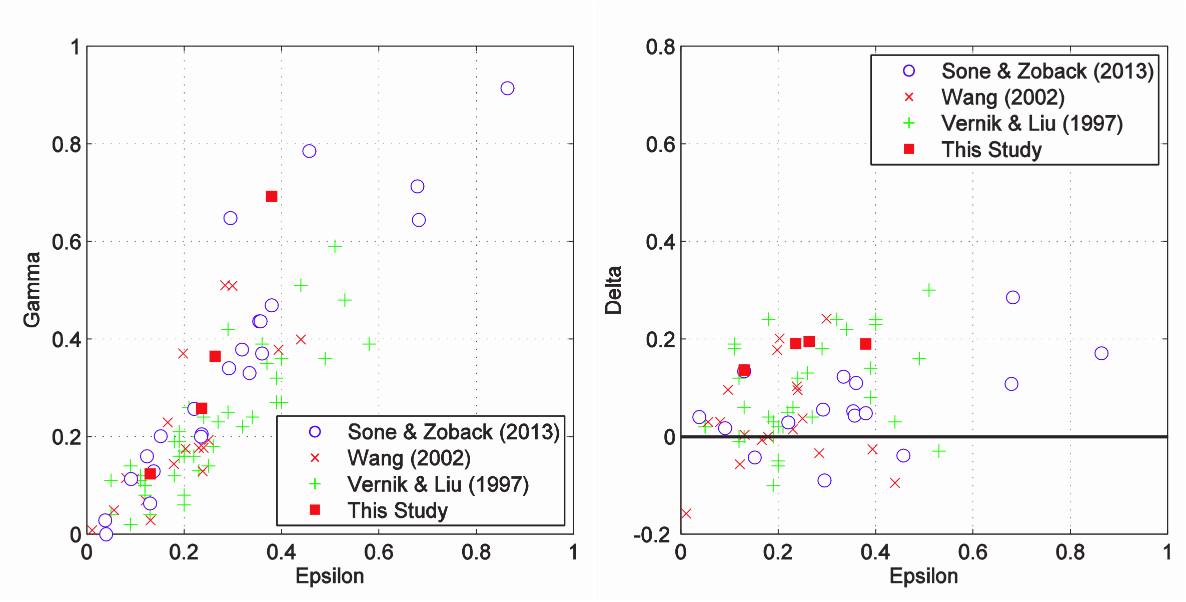

Figure 3 *Correlations between Thomsen parameters. Red squares are the results of this study.*

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