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Estimation of seismic anisotropy parameters in the presence of lateral heterogeneity using WAVSP

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ABSTRACT

Estimation of anisotropic parameters is one of the most important problems in seismic imaging. Lateral heterogeneity in the seismic velocity on the scale smaller than a spreadlength, often associated with velocity lenses in the overburden, can significantly distort anisotropic parameters estimation (Takanashi, 2011).

The presence of lateral heterogeneity is analyzed here using the phase slowness method on synthetic walkaway VSP (WAVSP) data. The synthetic data was generated using a velocity model with known Thompsen Thomsen anisotropic parameters. This approach obtains the estimates of phase slowness from a receiver array situated in the target zone and lines of shot points on the surface. The vertical and horizontal components of slowness are described by a phase dispersion relation derived from the equation of Kelvin-Christoffel (Helbig, 1994). The seismic anisotropic parameters are estimated by fitting the slowness data to the dispersion relation.

The presence of lateral heterogeneities affects the estimation of anisotropic parameters. For small lateral homogeneities close to the well, we propose an approach that includes tomography in addition to the phase slowness method to detect the lateral heterogeneities and to identify which shot offsets are affected by them. These offsets are removed before applying the phase slowness method. By using this approach, we show that anisotropic parameters were correctly estimated on the synthetic WAVSP.