

Estimation of seismic anisotropy with azimuth from sonic data by full waveform inversion

*Satoshi Fuse¹, Hitoshi Mikada¹, Junichi Takekawa¹

1. Kyoto University

Recently, seismic processing techniques accommodate seismic anisotropy in the wave propagation phenomena for better imaging of subsurface structure and for more precise estimation of subsurface material parameters. After 30 years of research on seismic anisotropy, it has become well known that subsurface materials are more anisotropic than the foreseen. For example, shale rocks are anisotropic in the order around 30%, for which it is necessary to take the anisotropy into account for planning hydraulic fracturing. It is, however, difficult to estimate directly all of 21 independent parameters in the general elastic medium in the 3D Cartesian coordinate system, and a method to deal with seismic anisotropy for complex anisotropic materials has been waited for.

In this research, we set model parameters as orientation and dip as well as 5 independent parameters instead of estimating 21 parameters directly under a hypothesis that the stable solution could be obtained. We attempt to estimate these parameters by full waveform strategy because azimuthal anisotropy influences the waveform. Low computational costs by efficient parameterization technique make it possible to work on 3D sonic logging model. Since one of the crucial problems of FWI is the predicted model would be possible to converge to local minimum as the number of parameters increases, the small number of unknowns in the proposed strategy could play a key role to deal with complex anisotropy. As a result, all elements come close to true values by full waveform inversion process. Our results suggest that the proposed parameterization strategy and FWI have an advantage over the conventional methods in terms of accuracy and stability.

Keywords: Seismic Anisotropy, Full Waveform Inversion