Elastic imaging of subsurface Structure with Equivalent Offset Migration for multicomponent seismic data

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Seismic reflection survey is one of the most efficient techniques for exploring subsurface natural resources, such as oil or natural gas. Although conventional reflection imaging methods using poststack time migration work well for horizontal multi-layered structure, it is difficult to apply the conventional techniques to image complex subsurface structure. Prestack depth migration could be used to image such complex structure, but requires precise seismic velocity models with enough accuracy. Partial prestack migration is therefore used to estimate velocities as a trial-and-error method with the conventional post-stack processing methods. On the other hand, Equivalent Offset Migration (EOM) was proposed to exploit both advantages of the conventional post-stack processing and velocity analysis even for complex subsurface structure (Bancroft et al., 1998) as an alternative method to partial prestack migration, and draw attention in exploration geophysics for its computational efficiency and imaging accuracy.
In the conventional EOM, it is mainly to use the vertical component of received waveforms, not horizontal components. However, it is necessary to obtain S-wave velocity structure in order to establish the sub-surface model including petrophysical properties. We would like not to employ EOM to take the advantages of the processing efficiency but to extend it to use the horizontal components of waveforms for petrophysical analysis. We conduct numerical experiments to verify the possibility of extracting information about S-wave velocity structure using EOM with the horizontal components. Our numerical results show that EOM based on the horizontal components can increase the amount of information of S-wave velocity whereas some unique difficulties to the horizontal components should be addressed.

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