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Reconstruction of reflection data with dense spatial sampling by deconvolution interferometry using backscattered waves

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Deep seismic reflection profiling across the area of land-marine transition zones in Japan has been imposed serious restrictions and compromises on both data processing and acquisition. In addition to complex subsurface structure, rugged acquisition topography, crookedness of seismic lines, irregular distribution of shot points, and large noise level often result in deterioration of the data quality and poor reflection image in seismic profile. The combination of telemetry and independent recording system provides the deployment of 100-200km long survey line across the area of land-marine transition zones with dense seismic array. However, the layout of shot distribution has been constrained by irregular acquisition geometries and environmental disturbance.

In our study, acquisition footprint anomalies associated with irregular shot distribution were evaluated by the reconstruction of reflection data with dense spatial sampling. Comparing to model-based wavefield extrapolation, the fully data-driven deconvolution interferometry can kinematically predict pseudo-shot records extracted by the free-surface backscattered waves,. In recent years, many case studies have demonstrated that the Common-Reflection-Surface (CRS) stack based on paraxial ray theory produces an efficient alternative profile to conventional CMP stack with a pronounced signal-to-noise ratio. The CRS-driven velocity attribute with the short-wavelength structural heterogeneity can be utilized for the velocity model for improved prestack depth migration. In our study, multi-dip reflection surfaces method is adopted for the imaging of free-surface backscattered waves.

Synthetic seismograms simulated by the elastic pseudospectral method for a simple 2-D/3-D crustal model are given to extract multi-mode free-surface backscattered waves for active and passive data. The numerical modeling results demonstrate the potential imaging capabilities of detailed imaging for crustal structure using deconvolution interferometry.

Keywords: Crustal structure, Backscattered wave, Deconvolution interfeorometry