Crustal Structure Investigation in Northern Taiwan - Localized Wavefield Inversion of TAIGER T6 Wide Angle Refraction/Reflection Data

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TAIGER T6 transects is one of the four crustal-scale Wide Angle Refraction/Reflection (WARR) survey lines under **TA**iwan **I**ntegrated **GE**odynamics **R**esearch (TAIGER) project conducted in 2008 in Taiwan. The north main array consist of four shot points (N1, N2, N3, and N4) across northern Taiwan from west to east. A total of 456 geophones deployed with receiver interval of ~200m on average. However, the recorded data suffers from crooked survey line geometry, uneven shot energy, noise level and currently available poorly defined 3D reference velocity model. Near-surface static effects caused by the irregular source and receiver spacing, strong lateral velocity variations and rapid topography changes produce apparent 3D wave propagation so that the standard seismic data processing or travel-time inversion could not be fully applied. To compensate above-mentioned drawbacks, Localized Slant Stack Transformation (LSST) for data pre-processing was applied to separate signal from interfering noise that has big amplitude and minor T-X curve difference. LSST is slowness and offset range-based plane wave destruction and construction techniques. The pros and cons of LSST will be discussed for TAIGER-T6 line.
For stable wavefield inversion, sufficient spatial sampling and events enhancement is essential. Wavefield inversion utilize the complete-cycle of wavelet information without picking compared to tomography study that rely on the travel time picks with potential reading errors. Velocity estimation is performed via wavefield transformation from τ-p data domain to τ-p-z solution domain through downward continuation and the application of imaging condition ($\tau = 0$). Ray tracing is performed for quality control and to quantify the separated static effects produced from source, receiver and velocity changes. Feasibility studies of three crustal scale synthetic models containing: (1) flat layers without topographic, (2) flat layers with topographic, (3) laterally varying topographic velocity models. Synthetic data is produced from Specfem2D computations. Effects of source and/or receiver static, velocity variation, and the combination of all were studied. Wavefield inversion is stable for all test models. Inverted 1D velocity becomes less smooth when static effects are included with and without static corrections. Real data implementation for all shots were cross-checked through numerical travel-time curve with acceptable error bound. Furthermore, the bottoming point of each ray through seismic ray tracing can be mapped along with the velocity information to construct quasi-2D velocity model. Inverted velocity depth profile from wavefield inversion provide higher resolution compared to the existing tomography velocity model across northern Taiwan area.

Keywords: Localized Slant Stack, TAIGER Project, Wiechert-Herglotz Inversion, Vespagram

