ESC2016-200-2, 2016
35th General Assembly of the European Seismological Commission

35th General Assembly of the European Seismological Commission
4–10 September 2016
Trieste

Diffraction-Stack Imaging of Source and Structure – Application of TAIGER Project in Taiwan

Haw-Chun Wang and How-Wei Chen
Taiwan (k03004748549@gmail.com)

A Pre-Stack Diffraction-Stack Migration (PreSDSM) algorithm is proposed, test and implemented for deep structure imaging of seismic data. Imaging principle follows generalized imaging conditions for 3D depth migration that accommodate arbitrary source-receiver configuration and without precise velocity information. The proposed approach is designed for practical applications of currently available earthquake and exploration seismic data in Taiwan.

The PreSDSM imaging procedure involve three fundamental steps: (1) computation of imaging conditions, (2) back projection and (3) diffraction stack of discretized waveform data from actual source/receiver locations for imaging large-scale structure. A one-way-travel-time map is firstly generated from a given 1D velocity model. Delay times between source-to-scatter (τ_S) and scatter-to-receiver (τ_R) are derived and combined as total travel-time T. The waveforms recorded at each receiver station can be mapped onto a specified depth profile through migration principle for pre-stack seismic data. PreSDSM imaging principle follows the Fresnel diffraction concept for constructive interference. The migration trajectories construct “fat ellipsoid” in depth space with its foci connecting source and receiver. The resolving power of the proposed approach depends on wave velocity, frequency bandwidth and spatial aperture coverage of available data. Diffraction stack produce impedance image through true-amplitude wavefield processing strategy.

To test and verify the capability, resolving power and sensitivity of the proposed PreSDSM imaging, both synthetic and real data applications are demonstrated. TAIGER project utilized a series of active-source wide-angle surveys with vertical component Texan seismometers deployed in the field. Meanwhile, passive-source data were also recorded. Such deep-structure investigation was conducted from April, 2006 to May, 2009. Four common-shot TAIGER wide-angle seismic data gathers along south main line were processed with path-dependent 1-D velocity model modified from Kuo-Chen et al. (2012) and Huang et al. (2014). Although limited by the shot number, several important large-scale tectonic structure features can be recognized and distinguished. In addition, MGL0908 and MCS937 for gas hydrate exploration in Lower Fangliao Basin are also applied for imaging fluid/free gas migration pathway. Furthermore, the proposed algorithm holds the potential for migration of passive-source (earthquake) data and source imaging. Future development involves incorporation of more accurate 2-D or 3-D velocity information for the proposed algorithm to enhance imaging conditions and imaged depth section.