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Seismotectonics at the junction of the Philippine Sea plate and the Eurasian plate, in light of the 1990 Hualien earthquake and the near-field waveform inversion

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In eastern Taiwan, the Longitudinal Valley (LV) is the suture zone separating the Eurasian plate (EUP) to the West from the Philippine Sea plate (PSP) to the East. The northern tip of the LV (near Hualien city) is the junction point where the collision evolve northward to a subduction of the PSP under the EUP. As a result, a high seismic activity is observed. Based on the CWB (Central Weather Bureau, Taiwan) earthquake catalog, four distinct seismic clusters can be observed in this area since 1990. We restrict our effort to the cluster caused by a doublet events of 1990 with two moderate-large earthquakes.

The first shock of these doublet occurred on 13^{rd} December with M_L 6.5. Seventeen hours later and 15 km to the southeast occurred the second shock of M_L 6.7. A campaign seismic network of 15 short-period stations – the Hualien Temporary Seismic Network (HTSN) was deployed during 2 months to detect the aftershocks of the doublet. By applying the near-field waveform inversion to the HTSN records, we can retrieve the focal mechanism solutions (FMS) from 50 aftershocks of local magnitude ranging from 2.5 to 5.0. A modified version of the program "FMNEAR" is adopted in this study, which has been proven to be efficient to retrieve FMS for small-to-moderate earthquakes with a limited number of stations. In practice, the near-field waveforms, were processed by band-pass filter between 0.52 and 1.2 Hz. Synthetic waveforms are built from the discrete wave number method of Bouchon (1981). The inversion is done by grid searches on the FMS parameters while the rake is inverted, the best result gives the lowest waveform misfit. The waveform adjustment are improved by depth optimization and a specific 1D velocity model for each station.

Focal depths of events are in average 10km deeper than the depth determined by the island-wide seismic stations that suffered from the lack of stations to the east due to the ocean. The FMS of the 50 aftershocks can be classified into three groups according to their mechanisms and the P- and T-axes. The 3 groups distribute from north to south. The northern one is the largest one and is located along the northern and middle part of the northern segment of the LVF (NLVF). It is mainly reverse in type and display homogeneous FMS. Our hypothesis is that the fault generated the doublet is related to the structure activated by this first group. In the middle part, the second group is dominantly normal while the last group spreads in the southern portion of the NLVF with more strike-slip events.