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Kinematics, crustal structure and seismotectonics of the subducting northernmost Luzon arc in eastern Taiwan

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The Coastal Range in eastern Taiwan belongs to the northernmost Luzon arc system, which sits on the western edge of the NW-moving Philippine Sea plates (PSP). As the PSP subducting and colliding with the Eurasian continental margin in Taiwan, the northern part of the Coastal Range provides a crucial key for better understand the geological structures and processes at tectonic transition from collision to subduction at plate corner. In this study, we conducted a dense network of GPS measurements at the northern tip of the Coastal Range and compiled available geological and geophysical information, including surface geomorphic features, geological structures, seismological data, seismic tomography, in order to provide insights on kinematics, crustal structure and seismotectonics of the transition from waning collision to subduction of the northern Luzon arc system and its vicinity.

Regional short-term geodetic data, including GPS and levelling, and long-term thousand-year scale geological vertical rates indicate that the Coastal Range is going down toward the north, which we interpret it as being pulling down by the north- subduction PSP. Combing with the local GPS measurements carried out at the northern tip of the Longitudinal Valley, the plate suture, which shows a significant clockwise rotation at a rate of 33° M/yr, we interpret the tectonic escape of the northernmost Longitudinal Valley as being initiated locally by the northwest indentation of the Coastal Range, which pushed the northern Longitudinal Valley to move upward and eastward to form a 2-km-wide, 8-km-long, 100-m-high Milun Tableland. No significant deformation was observed across the surface trace of the major active Milun fault on the western side of the tableland, which has been ruptured during the 1951 M=7.1 Hualien earthquake, indicating that the Milun fault is now probably locked in the near surface.

As for the crustal structure, we anticipate that there exists a fore-arc basement of the Luzon arc system with significant volume. Instead subducting toward the NW, we tend to interpret that the fore-arc basement has been squeezed beneath the plate suture whereas the arc itself, including volcanic arc and fore-arc deposits (i.e. the Coastal Range), detached and were thrust over the Central Range of the Eurasian plate. Recent studies of seismic tomography allowed us interpreting the fore-arc basement is in contact with the Eurasian crust under the northern Coastal Range, characterized by a high-angle W-dipping seismicity zone. We also argue that recent two moderate earthquakes, including the 2013 M=6.3 Ruishui earthquake and the 2014 M=5.9 Fenglin earthquake, resulted from rupturing of the interface of Eurasian plate and Luzon fore-arc basement.