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Unraveling Crustal Deformation and Seismogenic Signatures in Eastern Taiwan

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Eastern Taiwan is situated on the transition zone where the Philippine Sea plate subducts beneath the Yangtze plate along the Ryukyu Trench, and collides with the continental margin along the Longitudinal Valley suture zone (Fig. 1). The complex tectonic interactions lead to frequent devastating earthquakes in this region. The GNSS-acoustic measurements in the southernmost Ryukyu margin characterize an eastward growing convergence rate from 92 mm/yr offshore Hualien to 123 mm/yr near the Gagua Ridge, suggesting a capability of hosting M_w 7.5-8.4 earthquakes. In the Longitudinal Valley, the east-dipping Longitudinal Valley fault and the west-dipping Central Range fault form a dual-verging conjugate suture zone with along-strike variations of their shortening rates. GNSS velocities, with respect to the Yangtze plate generally decrease northward and westward from the Coastal Range, through the Longitudinal Valley, to the Central Range. Along the Coastal Range, GNSS station velocities range from 67 to 72 mm/yr between Taitung and Fengbin. The rate dramatically decreases to ~38 mm/yr at Shoufeng and is further reduced to 24 mm/yr near Hualien. On the western side of the Longitudinal Valley, GNSS velocities are about 40 mm/yr near Taitung and decline to 20 mm/yr at Hualien. The shortening rate between the east coast and the Longitudinal Valley decreases northward from 30 mm/yr between Taitung and Guangfu to only about 10 mm/yr near Hualien. Additionally, shallow crustal earthquakes along east coast indicate a significant clockwise rotation of P and S_H axes from convergence-parallel (120˚) south of Fengbin to about (140˚) near Hualien. The orientations of GNSS velocity show a similar clockwise rotation of 10˚ from Taitung to Hualien as well. These observations suggest a spatial change in seismotectonic stress as approaching the junction between the subduction of the Ryukyu Trench and the collision of the Longitudinal Valley suture zone. A substantial portion of the accumulated strain near Hualien is likely accommodated by offshore structures as evidenced by frequent large offshore earthquakes and interseismic subsidence along the Hualien coast. Continuous investigation of GNSS interseismic velocity, seismic activity, the long-term uplift rates from marine terraces, and coseismic uplift during historic earthquakes are crucial for revealing the long-term seismic hazard in eastern Taiwan.

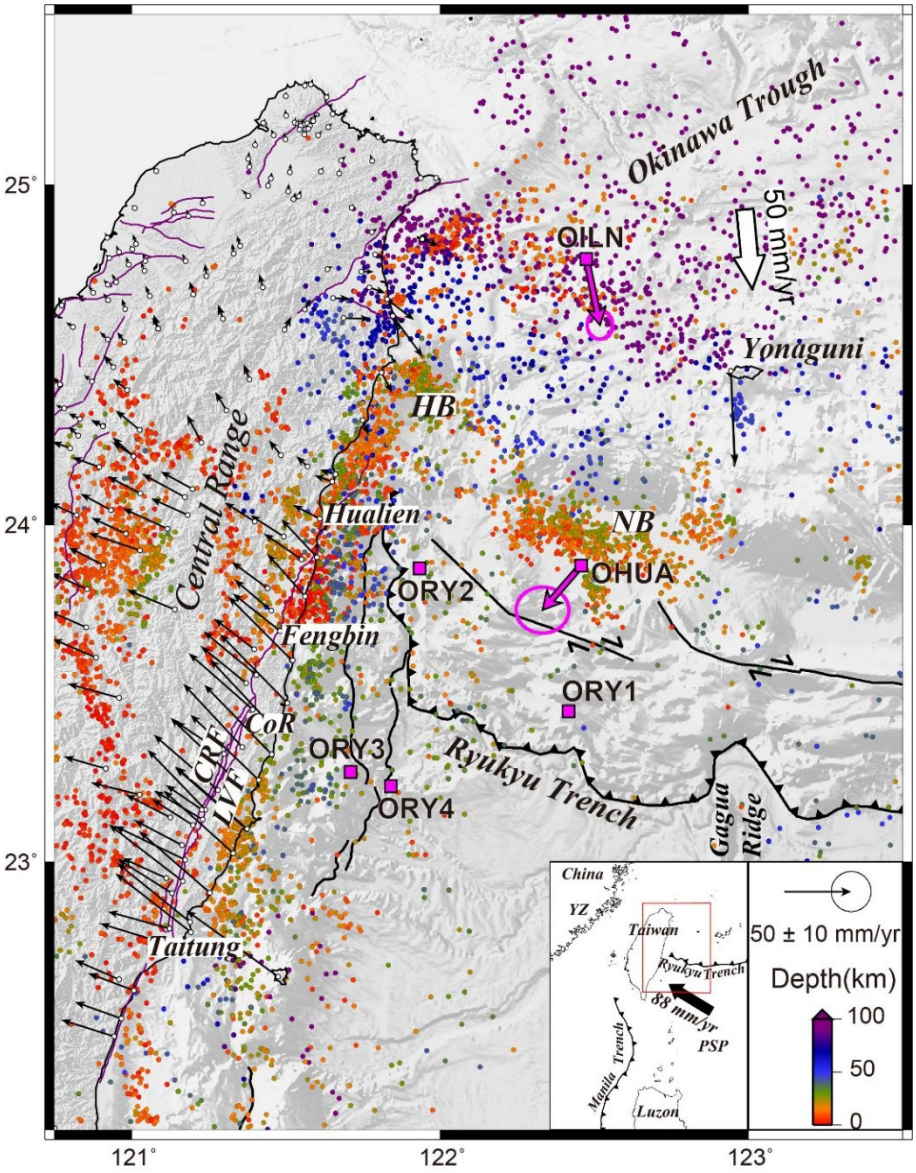

Figure 1. GNSS velocities with respect to the Yangtze plate (YZ) and earthquakes located in the Taiwan plate boundary zone. Black and magenta vectors show GNSS and seafloor station velocities, respectively. White vector represents the rifting rate of the Okinawa Trough. Dots show seismicity ($M_w \geq 4$) with color-coded hypocentral depths. Purple and black lines indicate onshore and offshore active faults. HB: Hoping Basin. NB: Nanao Basin. CoR: Coastal Range. LVF: Longitudinal Valley fault. Inset indicates regional geography and the motion of the PSP relative to the YZ.