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Unraveling crustal deformation and seismogenic signatures in eastern Taiwan

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Eastern Taiwan is located in 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. These complex tectonic interactions have led to frequent and devastating earthquakes. 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. Along the Longitudinal Valley, the east-dipping Longitudinal Valley fault and the west-dipping Central Range fault form a dual-verging conjugate suture zone. The GNSS velocities relative to the Yangtze plate generally decrease northwestward from the Coastal Range, through the Longitudinal Valley, to the Central Range. Along the Coastal Range, GNSS velocities range from 67 to 72 mm/yr between Taitung and Fengbin. This rate then drops significantly to approximately 38 mm/yr at Shoufeng and further decreases to 24 mm/yr near Hualien. The shortening rate between the east coast and the Longitudinal Valley decreases northward, from 30 mm/yr between Taitung and Guangfu to approximately 10 mm/yr near Hualien. Additionally, shallow crustal earthquakes along the east coast indicate a significant clockwise rotation of P and S_H axes from convergence-parallel (N120˚) south of Fengbin to about (N140˚) near Hualien. The orientations of GNSS velocity exhibit 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 significant portion of the accumulated strain is likely accommodated by offshore faults near Hualien, 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 of marine terraces, and coseismic uplift during historic earthquakes are crucial for revealing the long-term seismic hazard of eastern Taiwan.