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A conjugated structure discloses interaction between two fault systems in eastern Taiwan during 2022 Guangfu earthquake

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The Longitudinal Valley (LV) in the eastern Taiwan is located at the convergent boundary between the Philippine Sea Plate and the Eurasian Plate. Within the LV, two significant fault systems, the Longitudinal Valley Fault (LVF) in the eastern part and the Central Range Fault (CeRF) in the western part, have been recognized. However, understanding the precise mechanisms and spatial relationships of the two fault systems in the middle segment of the LV has remained a challenge. In this study, we integrate various data sources, including geodetic measurements, seismic data, field investigations, and simulation results, all obtained during the Guangfu earthquake event. Our goal is to shed light on the complex structural interactions between the two fault systems. We introduce a coupled structures model consisting of a main fault plane and a coupled ramp plane. The deep-seated fault plane is constrained using seismic data, while the shallow ramp plane is determined through field investigations. Geodetic measurements are utilized to constrain the surface deformation resulting from dislocation model. The simulation outcomes reveal that the Guangfu earthquake was primarily triggered by the activity along the CeRF. The CeRF experienced an eastward reverse slip of approximately 58 cm along the fault plane. This fault not only intersects the LVF beneath the Coastal Range but also initiates the development of a ramp plane along pre-existing fault planes of the LVF. This intricate interplay results in approximately 20 cm of vertical surface deformation within the Coastal Range. The linear connection observed in the simulation residuals is associated with pre-existing faults within the LVF system. This alignment corresponds to the ground distribution of ramp plane, suggesting that older fault systems within this area exhibit characteristics of reactivation in response to earthquake-induced processes. Our study not only pinpoints the potential location of the CeRF intersecting with the LVF in the middle segment of the LV but also provides insight into one of the interaction mechanisms between the CeRF and the LVF. These findings hold significant implications for assessing seismogenic structural activity and enhancing the mitigation of regional earthquake hazards in the future.

Keywords: InSAR, GNSS, dislocation model, conjugated structure, Guangfu earthquake