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Subvertical crustal motion and boundary faults across the central Taiwan orogenic belt: insights from local-focused seismic tomography

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The Taiwan orogenic belt is often simplified as fault-and-thrust belts and accretionary wedges which slide along its shallow basal detachment; however, several noticeable seismicity occurred below the supposed depth and have been illuminated as crustal-involved motions in the mountain area. It thus motivates us to revisit the crustal structures with local-focused seismic tomography. Based on a previously published 3-D initial model, we conduct a P- and S-wave joint tomographic inversion with more local earthquake data and finer model parameterization. The derived images reveal upper-to-middle crust structures on a ca. 100 km profile perpendicular to the regional range trend. By comparing with the neighboring foreland basin, the upward-bended velocity under the hinterland could be enveloped as a crustal wedge and initiated from a middle-crustal detachment with a gentle dip to the east. Three distinguishable uplifted high-velocity bulges, representing for the crystalline basements, indicate the exhumation processes by upraising of middle crust and removal of the upper crust. Discrete exhumed bodies are considered to be separated by the inversion of preexisted rifting basin or oceanic trench. Comprehensively, the high-resolution tomography has substantial linkages with surface geology, such as the discrete crustal motions result in the exposing of the different grade of metamorphic rocks, and the near-surface faults could be inherited from the crustal deformation boundaries. Moreover, three sequences with main shocks of ML>6.0 in 2013 occurred at both flank of the depicted crustal wedge and revealed the activities of earthquake-prone areas. Such findings and detailed subsurface delineation could play an important role in the seismic hazard mitigation and the understanding of the orogenic tectonics in central Taiwan.