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Structure and kinematics of the central Taiwan thrust belt: Insights from geological, seismic energy release, and earthquake focal mechanism mapping

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Despite the complicated basement and sedimentary basin architecture of the Eurasian continental margin involved in the Taiwan orogen, its faulted and folded rocks are often cited as an example par excellence of a thrust and fold belt developed above a planar, shallowly dipping basal detachment. Consequently, it has served as an important example for the model of the mechanical development of wedge-shaped thrust belts (the critical wedge model), as well as for the relationships between tectonics and climate, erosion and tectonics, or the collision of an island arc with a continental margin. Many of these ideas revolve around the structural architecture of the Taiwan mountian belt. Nevetheless, the bulk of the data for constructing its structural architecture come from surface geological observations, shallow reflection seismics, and borehole data along the western flank of the thrust belt, in what is known as the Western Foothills. Largely on a geometric basis for geological cross section construction, the shallowly dipping detachment determined for this part of the mountain belt has been extrapolated eastward beneath the more internal ranges, with the consequence that the rocks in these ranges are also structurally linked to the basal detachment to form large thrust sheets that were transported westward. Recently, selective picking and collpasing of relocated small magnitude (between ML 1 and 4) earthquake hypocenter data has been presented as a validation of the presence of this detachment, and therefore of the general characteristics and mechanics of the previous structural and mechanical models of the mountain belt. However, with a growing amount of seismicity data indicating widespread fault activity in the middle and lower crust, particularly beneath the central part of the mountain belt, it has been suggested that any model for the structural architecture of Taiwan needs to incorporate nearly the entire crust and include a number of steeply dipping faults that penetrate well into the middle crust and perhaps beyond. In order to advance the understanding of the structure and kinematics of the Taiwan mountain belt, much more surface geology data is needed from its interior. Here, we present new geological mapping in the central part of Taiwan which spans nearly the entire width of the island. These geological data are then integrated with earthquake seismic energy release and focal mechanism data to help place further constraints on the structural geometry and kinematics of this part of the mountain belt. This data corroborate the previous interpretations of a shallow detachment beneath the Western Foothills, but it also indicates that this detachment does not continue eastward beneath the more internal ranges. We suggest that a model in which the Hsuehshan Range is a zone of transpression that involves nearly the entire crust better fits the available data. In this model, the Western Foothills detachment is cut by the sinistral transpressive Shuilikeng fault, which extends into the lower crust along the western flank of the Hsuehshan Range. The Hsueshan Range is bound along its eastern flank by the crustal-scale, sinistral transpressive Lishan fault.