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Structural analysis in the actively deforming Western Foothills at the latitude of Erhjen River in southwestern Taiwan

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In the southwestern Taiwan fold-and-thrust belt, the footwall of east-dipping reverse faults, particularly the Gutingkeng Fault, exhibits active deformation and uplift, as observed through levelling and InSAR data. Moving westward into the Coastal Plain, geophysical data reveals prominent folds, such as the Chungchou Anticline. The geological setting is defined by the dominance of the Late Miocene to Early Pleistocene Gutingkeng Mudstone (Pgtk) in the foreland basin, deposited on a former passive continental margin. This thick mudstone layer is associated with mobile shale features, including high overpressure in boreholes, mud volcanoes, and possible mud diapirs/shale diapirs. This intriguing geological context led us to delve into the structural geology of the region, aiming to enhance our understanding of mobile shale mechanisms in relation to fault-related folding. Our investigation involved radiocarbon dating of the Erhjen River terraces in the deforming footwall, field structural measurements, and the construction of a regional geological cross-section. Our findings indicate rapid uplift rates, with incision rates of approximately 19 mm/yr and 32 mm/yr. In the field, a prominent southeast-dipping reverse fault oriented at 080°/51°S was identified, possibly the Gutingkeng Fault or one of its branches. Notably, the bedding in the deforming footwall remains consistent and preserved. The geological cross-section suggests that footwall deformation may be attributed to folding of the thick mudstone unit in response to compression. Despite the absence of any disturbed bedding as a surface expression of mobile shale deformation, we propose the possibility of active subsurface mobile shale structures underneath the footwall region. Additionally, our interpretation includes detachments at two depth levels: at the base of the Gutingkeng Mudstone and a reactivated continental margin fault. The thicker Late Miocene Gutingkeng Mudstone unit on the hanging wall of the Gutingkeng Fault is linked to the normal fault basin referred to as the "Gutingkeng Basin." Furthermore, we interpret the Chungchou Anticline as a fault-propagation fold detaching at a depth of approximately 5 km.

Keywords: Footwall uplift, high Incision rates, southeast dipping reverse fault, geological cross-section, shale tectonics, basement structure