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Modelling the Deformation Front of Fold-Thrust Belts Containing Multiple Weak Horizons

Fold-thrust belts shortened above a weak horizon (e.g. salt) possess a low taper, a wide deformation zone and contain structures with no preferred vergence. Fold-thrust belts containing multiple weak layers (e.g. Zagros and Pyrenees) undergo a complex deformation history. Here, we use sand-box models where a pack of layers of loose sand containing ductile layers, simulating salt, was shortened above a viscous layer. Model results show that the viscous layers embedded within the sand layers govern the propagation style of the deformation front entirely. The deformation front jumps forward ahead as it climbs from deeper to a shallower detachment. Often transference from deeper to shallower detachments is in a back verging structure, giving a triangle-zone geometry to the deformation front. Applied to nature, this suggests that triangle zones form throughout the history of a fold-thrust belt. Preservation of the triangle-zone geometry, as in the Southern Pyrenees, is related to the small total shortening in the frontal areas. The surface expression of a deformation front in a fold-thrust belt containing weak layers may not represent the active deformation zone in the deeper levels. Based on model results, we suggest that the deformation front in the Zagros fold-thrust belt may only represent the extent of deformation in the shallow units and that the deformation front at deeper levels may be located further towards the Northeast relative to surface expression of the deformation front. Model results also show that strain distribution is heterogeneous in fold-thrust belts with multiple weak zones.

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