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Passive vs. active hanging wall strain accommodation to sharp (flat-ramp-flat) and smooth (concave-convex) fault-ramp geometries: new insights from sandbox analogue models

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New analogue modelling results of crustal thrust-systems are presented, in which a deformable (brittle) hanging wall is assumed to endure passive internal deformation during thrusting (i.e. exclusively as a consequence of having to adapt its shape to the variable geometry of a rigid footwall). Two main (so far overlooked) critical variables are investigated: a) presence vs. absence of a basal velocity discontinuity (VD); and b) concave-convex (CC) vs. flat-ramp-flat (FRF) thrust ramp geometry. Obtained analogue modelling results show: a) Simulation of true passive hanging wall strain accommodation is only achieved if the model basal VDs are experimentally set to be absent, otherwise, active shortening accommodation always occurs above the lower (concave) fault bend; b) Sharp vs. smooth thrust-ramp geometry variation originates critical differences in local stress distribution along the deformable hanging wall, specifically above lower and upper fault bends, wherein different strain accommodation is quantitatively monitored by measured morpho-structural parameters. Additionally, the morphostructural configuration of experimentally obtained model thrust-wedges, under VD absence conditions, conforms well to natural examples of major overthrusts, wherein tectonic allochthonous transport is assisted by frictionless basal thrust-plane conditions.