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3D thrusting in frictional wedges : comparison between experimental observations and numerical predictions by limit analysis

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The objective is to capture 3D failure mechanisms, i.e., thrust surfaces in compressive accretionary wedges by the sole knowledge of the material and interface strengths. A 3D simple prototype composed by a flat sand layer topped with a wedge on one side and maintained between two lateral rigid walls is shortened by the relative movement of the two end walls. We consider laboratory data that demonstrate the important influence of the side wall friction on the position of thrust faults and on spurious departures from plane strain conditions, by comparing outcomes using the two possibles configurations of sand boxes (fixed or mobile base) (Souloumiac et al., J. Struc. Geol., 2012). The proposed method to reproduce these observations is the limit analysis. The 3D virtual velocity field is constructed by spatial discretisation. The numerical tool based on the limit analysis allows us to take into account the influence of the side wall friction and to find the 3D failure modes observed in the laboratory at the onset of thrusting. The comparison with the analogue experiments shows the connection between the virtual 3D velocity field and the actual deformation, and validates the numerical method. It is further applied to cases with lateral variations of surface slopes and basal friction to illustrate respectively the lateral transition from super to sub-critical conditions and the surface effect of patches of low friction on the décollement.