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Effects of surface processes on multi-layer detachment folding: a numerical approach.

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Over the past decades, the interaction between surface processes and development of mountain belts has been extensively studied. While syntectonic sedimentation appears to control the external development of the fold-and-thrust belts, erosion strongly influences the evolution of internal regions within mountain belts.

The effects of surface processes on brittle deformation have been thoroughly studied using analogue and numerical models of accretionary wedges, however, most of the numerical studies used a 2D model of deformation and/or a simple formulation for the surface processes, where both sedimentation and erosion are rarely present together. Coupled analogue models of deformation and surface processes are challenging, due to material and scaling issues, and they often only represent the two end-member cases (e.g. no erosion vs infinite strong erosion). Thus they fail to explore the transitional cases.

In contrast, interactions between surface processes and folding have been poorly investigated. Thin-skinned fold and thrust belts are seen as the result of compressional deformation of a sediment pile over a weak layer acting as a décollement level. The resulting surface expression has often been interpreted, based on geometrical criteria in terms of fault bend folds, propagation folds and/or detachment folds. A few analogue models have demonstrated that sedimentation could influence the shape and the growth of folds, as well as the development of faults on one or two side of a growing fold.

Here we aim to numerically investigate how sedimentation and erosion can influence the folds pattern in multi-layer systems employing either purely viscous or visco-plastic rheologies.

For this purpose we will use a 3D finite element mechanical code with a von Mises and Druker-Prager rheology, which has been coupled to a landscape evolution model. The landscape evolution model allows for both erosion and sedimentation and accounts hillslope and fluvial processes.