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Effect of sediments load on growth folds in thin-skinned fold-and-thrust belt: 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 sedimentation 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 erosion/sedimentation are challenging, due to material and scaling issues, and often only reproduce two end-member cases (no erosion vs very strong erosion, where all the material is removed), but fail to investigate the transitional cases. In contrast, the influence of sedimentation on ductile deformation has not been examined in detail. 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 or/and detachment folds. Several analogue studies have demonstrated that fold morphology can be influenced by erosion rates or preferential localization of sedimentation, and additionally, that the fold growth can be stopped by increasing the supply of sediments. Here we aim to numerically investigate the effects of sedimentation on the growth of folds in three dimensions.

In order to study the feedback between sedimentation and ductile deformation, we have developed a finite-element based landscape evolution model (both erosion and sedimentation) using PETSc, and coupled it to the 3D mechanical code LaMEM. The landscape evolution model uses a non-linear diffusion formulation (Simpson and Schlunegger, 2003), taking into account both hillslope and channel processes. We present here preliminary results of the coupling between sediment loading and folding.

Reference:

Simpson, G., and Schlunegger, F., 2003: Topographic evolution and morphology of surfaces evolving in response to coupled fluvial and hillslope sediment transport, Journal of geophysical research, 108, 7-1 – 7-16.