

The effect of increased sedimentation on orogenic foreland basin structure – A case study from the Western Alps

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The crustal structure of collisional orogens around the world shows a wide range of deformation styles from narrow, asymmetric doubly vergent wedges like the Pyrenees to wide, plateau-like orogens such as the Zagros mountain belt in Iran. Inherited structures and surface processes are widely regarded as factors playing significant role in the evolution of such mountain belts. These parameters have been studied extensively throughout the last decades, yet questions still remain about their exact effects on the style of orogenic development.

We use lithospheric scale plane-strain thermo-mechanical model experiments to investigate the potential role of changing sedimentation rate in the development of orogenic foreland basins with a special focus on the European Western Alps where a sudden increase in sedimentation rate is well documented. Extensional inheritance is modeled explicitly by forward modeling the formation of a rift basin before reversing the velocity boundary conditions to model its inversion. Surface processes are modeled through the combination of a simple sedimentation algorithm, where all negative topography is filled up to a prescribed reference level, and an elevation-dependent erosion model.

Model results indicate that a sudden increase in sedimentation rate can temporarily impede the formation of an otherwise regular, outward propagating basement thrust-sheet sequence. The resulting foreland basin edge and thrust front advancement pattern is strikingly similar to that observed in the North Alpine Foreland Basin, where the mid-Oligocene filling of the Swiss Molasse Basin and a marked decrease in thrust front advancement rate is coeval with an increased sediment input from the Alpine orogeny.

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