



Transition from thin- to thick-skinned tectonics and consequences for nappe formation: numerical simulations and applications to the Helvetic nappe system, Switzerland

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We use two dimensional numerical simulations to study the deformation style and nappe formation during the compression of basement-cover systems with half-grabens. We perform mechanical simulations with only linear and power-law viscous rheology, and also thermo-mechanical simulations with viscoelastoplastic rheology and temperature-dependent viscosities. The results show that the transition from thin-skinned dominated (i.e. deformation mostly in the cover sediments) to thick-skinned dominated (i.e. similar amount of deformation in basement and sediments) deformation is controlled by two effective viscosity ratios: the ratio of viscosity at the top of basement to viscosity at the bottom of basement, and the ratio of viscosity at the top of the basement to viscosity of the sedimentary cover. A higher basement-internal ratio favors thick-skinned deformation whereas a higher basement-cover ratio favors thin-skinned deformation. The results further show that the sediments initially in the half-graben form fold nappes during a thick-skinned dominated deformation and thrust nappes during a thin-skinned dominated deformation. Simulations with only viscous rheology show the same first-order results as the thermo-mechanical simulations. The results are applied to the Morcles fold nappe (Helvetic nappe system, Switzerland), and a model for the tectonic evolution of this fold nappe is proposed.