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3D numerical modeling of basement-cover deformation during accretionary wedge formation

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The Helvetic nappe system of the Western Swiss Alps formed during the Alpine collision by the deformation of half-grabens in the European passive margin. This system exhibits both thin- and thick-skinned tectonics. Several studies on the mechanics of fold and thrust belts agree that the rheology of the basement-cover sequence and the lithospheric layering has a major impact on the deformation style of thin- and thick-skinned systems. Two-dimensional numerical models have shown that the deformation behavior is strongly controlled by the viscosity ratio between the basement and the sedimentary cover. However, to understand the deformation and interaction between basement and cover, and consequently the deformation behavior, we need to take into account the three-dimensional (3D) geometry of the half-graben system. We employ 3D thermo-mechanical numerical modeling with a viscoelastoplastic rheology to constrain the impact of (I) lateral variation of half-graben depth and (II) temperature-gradient on the deformation style during continental collision. The formation of a 3D accretionary wedge is initiated by the application of velocity boundary conditions with a velocity discontinuity, which provides a bulk deformation similar to typical sandbox models of wedge formation.