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Complex deformation of an exhumed basement-cover-contact: the Eiger-Jungfrau Mountains (Aar Massif, Central European Alps, Switzerland)

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The SW-NE striking mountain chain of Jungfrau, Mönch and Eiger consists of basement units and their Mesozoic sedimentary cover of the Aar massif. The sediments are wedged in-between two basement units, usually interpreted as anticline-syncline fold system affecting both basement and cover in a similar way (Burkhard 1988), which nowadays is updomed and overthrusted.
Here, we present evidence from the field and from a subsurface railway tunnel demonstrating that the tectonic architecture of the frontal Aar massif results from a complex multistage deformation history. We observe that localization of deformation and strain is strongly related to the rheological behavior of individual lithologies both on outcrop- and microscale. In detail, thrusting of relatively rigid basement slivers is accommodated by the preferentially ductile folding and shearing of the sediments into which the slivers are wedged in. Consequently, a clear brittle/semi-brittle deformation style in the basement contrasts with a ductile deformation behavior of calcareous and slaty sediments. Despite these rheological complexities, we discriminate on the base of cross-cutting and kinematic relationships at least three different deformation stages. (1) Early shearing-off and imbrication of sediment slivers from their crystalline substratum was followed by (2) reverse faulting in the basement, accommodated by disperse but very localized steep and south dipping shear zones (Wehrens et al. 2016, 2017; Herwegh et al. 2017) while the overlaying sediments reacted by ductile folding. (3) An even younger deformation stage is characterized by the shearing of basement rocks slivers that are frequently wedged-in the ductile deformed Mesozoic sediments. By unravelling the different deformation imprints we find that thrusting during the last stage accommodates a significant amount of shortening.

References

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