



Basement-involved thin-skinned and thick-skinned tectonics: case study Alps

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The deformation of continental crust during continental collision by folding and thrusting follows three types of structural styles: (1) In a true thin-skinned style only cover rocks are involved. This style necessitates a detachment horizon (typically evaporites or shales), and the detachment is accompanied by internal shortening by imbricate thrusting and associated folding of the cover rocks. (2) In case of a thin-skinned basement-involved style thin slabs of crystalline basement rocks are involved and form the main body of the ensuing nappe stack. Nappe-internal deformation was largely controlled by Late Palaeozoic graben structures and Jurassic normal faults. (3) In a true thick-skinned style most of the crust is involved in the deformation. In some cases thrust faults may reach all the way down into the lower crust while in other cases large-scale shearing and folding affects the lower crust.

In the Alps all three styles can be recognized. The Helvetic nappes and parts of the Penninic nappes formed by true thin-skinned tectonics. Basement-involved thin-skinned tectonics is typical for the Penninic nappes in the core of the orogen. In these units thrust faults are overprinted by large-scale folds, a process referred to as “post-nappe folding”. A kinematic analysis reveals that the detachment of the cover units by thin-skinned tectonics occurred first and was followed by basement-involved thin-skinned tectonics, suggesting a top-down propagation. The incipient thrusting in the basement occurred under relatively low temperatures; prograde conditions then led to the ductile overprint indicated by “post-nappe folding”. When considering the Alpine orogen as a whole it is clear that nappe formation propagated from the core towards the external part of the orogen.

The thick-skinned style observed in the lower crust evolved seemingly independent from the upper crustal deformation and was responsible for much of the observed crustal thickening.