

Lithology- versus base level-dependent morphogenesis of the Hausruck – Kobernauberwald range

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The Hausruck - Kobernauberwald range has the highest relief in the Northern Molasse Basin in front of the Eastern Alps. The highest peaks of the range exceed an elevation of 800 m and are characterized by a local relief of about 400 m relative to the adjacent lowlands. The Hausruck - Kobernauberwald range has never been glaciated and erosion is solely driven by fluvial incision and corresponding hillslope processes since the inversion of the Molasse Basin. Landslides are frequently observed at hillslopes in the Hausruck domain in the west but are completely missing in the Kobernauberwald domain in the east. Recent tectonic activity like faulting has not been reported for that region and the stratigraphic record shows no evidence for tectonically induced discontinuities. The morphological expression of the western Kobernauberwald and the eastern Hausruck apparently differ in their degree of erosional landscape decay with a gently incised western and deeply incised eastern domain. These domains correspond with two different lithological units of the Upper Freshwater Molasse: The simultaneously deposited western Kobernauberwald Formation (Kobernauberwald domain) and the eastern Ampfelwang Formation (Hausruck domain) are interpreted as sedimentary deposits of a fluvial fan in proximal and distal position, respectively, and show fining of the sedimentary record from west to east. The stratigraphic highest unit of the study region, the Hausruck Fm., consists of well consolidated fluvial gravels uniformly covering the hill tops of both domains.

We used a high resolution LiDAR digital elevation model and performed a series of morphometric analyses to investigate the effects of different base levels and contrasting lithology on the topographic evolution of the Hausruck – Kobernauberwald range. The analysis of longitudinal river profiles reveals that all channels independent from base level, bed rock and overall morphological expression are well graded with steep headwaters and a decrease of channel gradient with increasing contributing drainage area. This suggests that the drainage system of the range already reached a high level of fluvial equilibration. Migrating knickpoints that may arise from base level changes and even stationary knickpoints caused by erodibility contrasts of different lithological units are missing. The drainage area and slope relationship reveals that the transition zone between hillslope and fluvial processes range between 0.01 and 0.1 km² which is at the lower reported limit. Based on the hypsometric analysis we found no evidence for base level effects causing the morphological differences obviously observed between the Kobernauberwald and the Hausruck domain. However, the analysis reveals that differences in the hypsometric curves correlate with the sedimentological differences of the Kobernauberwald Fm. (Kobernauberwald domain) and the Ampfelwang Fm. (Hausruck domain). This may be due to variable erodibility influencing bed rock incision in channels, but also due to a variable peculiarity and pace of hillslope processes as response to fluvial landscape dissection.

While the slope distributions of the Kobernauberwald- and Ampfelwang Formations show frequency maxima in the range of 0.1 to 0.2, the Ampfelwang Formation features fewer areas with slopes in the range of 0.25 to 0.4. This implies that hillslopes of the Ampfelwang Fm. respond faster on river incision and increased topographic gradients than those of the Kobernauberwald Fm. and resulting in different levels of landscape dissection. Both domains are armored by the erosional resistant Hausruck Fm. resulting in low gradient hilltops at similar surface elevation. However, the mean elevation of the Hausruck domain in the east is significantly lowered compared to the Kobernauberwald domain in the west. We therefore conclude that lithology and associated hillslope processes have a paramount significance on the pace of topographic adjustment and evolution of the landscape following the inversion of the Molasse basin.