



Sediment budgets of mountain catchments: Scale dependence and the influence of land-use

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Long-term sediment budgets of forested mountain catchments are scarcely investigated today. This is because they are traditionally expected to show few erosion features and low sediment delivery. This opinion originates from process-based hydrological studies proving the runoff preventing properties of trees and forest soils. In addition mountain areas have been colonized later and only sporadically compared to the fruitful loess-covered lowlands. On the other hand steep hillslopes, narrow valleys and the availability of regolith cause a high erosion potential. And there is evidence that historical floods and yearly occurring storms initiate intensive but local and sporadic erosion events.

Sediment budgets from zero-order catchments of the Palatinate Forest in the south-western sandstone escarpment in Rhineland-Palatinate show spatially varying intensities of land use impact and relief conditions. The budgets are based on field data and a soilscape model of an upper periglacial cover bed with a homogenous thickness. OSL- and ¹⁴C-dates of colluvial deposits allow relating erosion events to land-use changes derived from historical maps and written archives.

The presented case studies from the Palatinate Forest are of special interest as the high proximity to the loess-covered and intensively cultivated Rhine Graben effected settlement and land-use intensity in the mountain catchments. Clear cuts for settlements were joined by deforestation for agriculture and stretched mainly along the Haardtrand and high order valleys. Off these areas the strength of interference in the forest ecosystem depended on transport possibilities and distance to the Rhine Graben. In the vicinity strong devastation and clear cutting occurred. With increasing distance the felling intensity decreased and some parts seem to be nearly undisturbed until the 18th century. The needs for wood were controlled by the economical development as well as political decisions on local to European scale.

The results from Palatinate Forest show that some of the cultural phases, which have been determined as main Holocene erosion phases in the Rhine Graben, did not extend to the mountain areas. The colluvial documentation of settlement history in small catchments directly connected to the Rhine Graben starts in the Neolithic Period but is not continual, while in those within the mountains colluvial layers older than modern times are missing. An inquiry of historical and modern storm events supports the requirements of local differentiation of sediment dynamics.

On the meso-scale the sediment budget of the Speyerbach shows, that the output of the catchment is higher than the sedimentation within the catchment area. A diverse pattern occurs on the local scale: while the loess-covered subcatchments show a dominance of sedimentation, the steeper ones with narrow valleys shows an exceeding delivery to the output. As the latter ones are dominant in the Speyerbach catchment, the meso-scale catchment budget seems to be determined by the majority. Micro-scale diversity of land-use history therefore determines the sediment delivery rate of small mountain catchments and underlines the need for systematic archaeological research activities in mountain areas in Germany.