Sediment budget in a German upland area for the Holocene (Odenwald mountains)

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Objectives

Soil erosion, colluvial sediments and alluvial deposits are strongly associated with land use and land use history. A stratigraphic and chronological sediment budget for a mesoscale catchment will be established (as a contribution to PAGES-LUCIFS). The research area is located in the Odenwald Mountains south of Frankfurt am Main, SW-Germany (Gersprenz catchment; Fig. 1). Available digital soil data and empirical datasets are the basis for the modelling of the budget. The crucial part of this project is dominated by a sediment budget approach first recognized by Trimble (1975, 1983), the field and data modeling approach is based on methods developed in recent studies by Houben and Houben & Schmidt (in prep.).

The budget period is the Holocene. Man-environment interactions during that period are characterized by different land use patterns showing an enormous increase in land use since late medieval times. The objective is determining man-induced soil erosion, redeposition and sediment delivery by the application of quantitative methods.

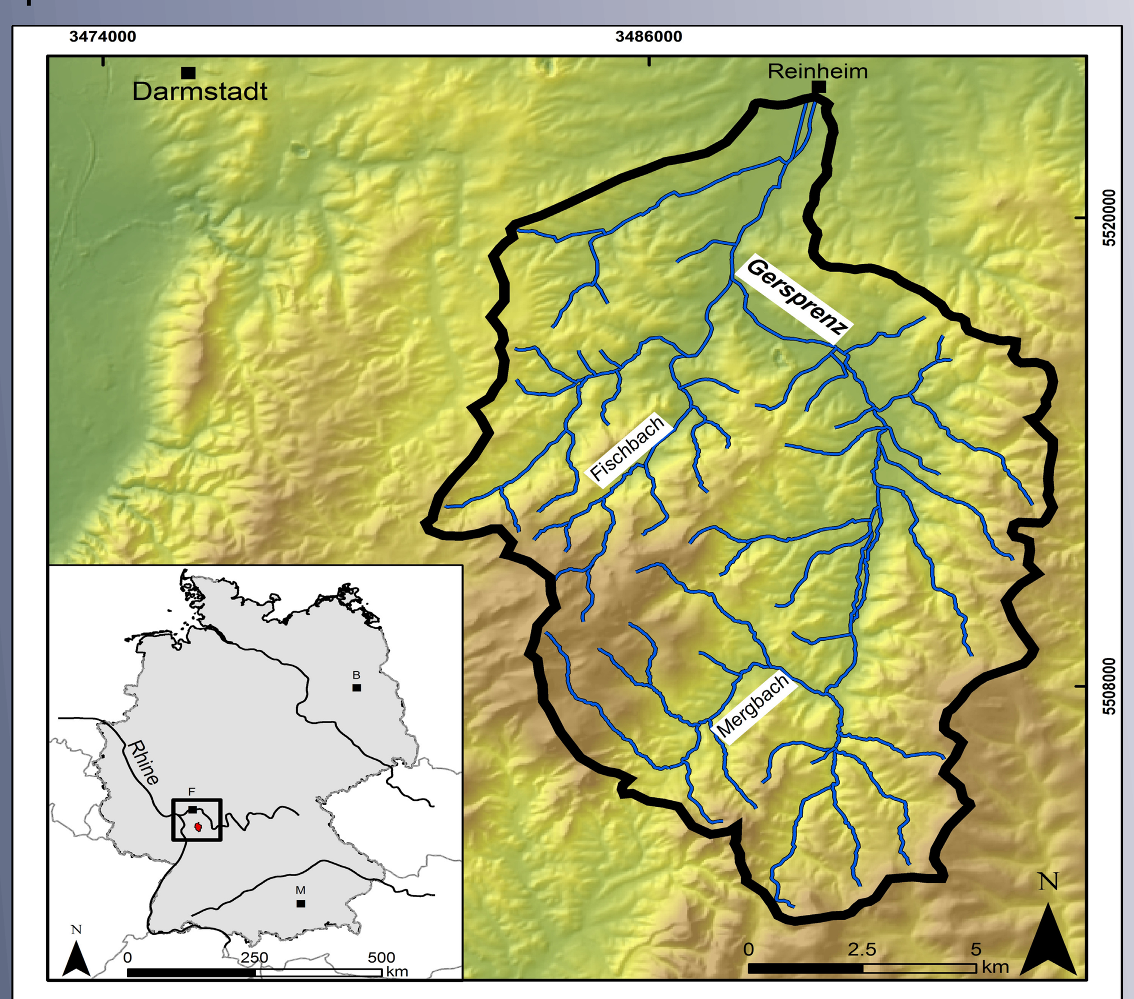

Fig. 1: Location of the research area

Research Area

The bedrock of the Gersprenz catchment (177 km²) is dominated by crystalline rocks from old Palaeozoic (Variscan Orogeny). The near subsurface material in the south of the catchment is characterized by periglacial solifluction sheets with a varying amount of loess (Mergbach catchment; Fig. 1, Fig. 2). An enormous increase in the thickness of the loess cover is evident in the north of the research area (Fischbach catchment; Fig. 1, Fig. 2).

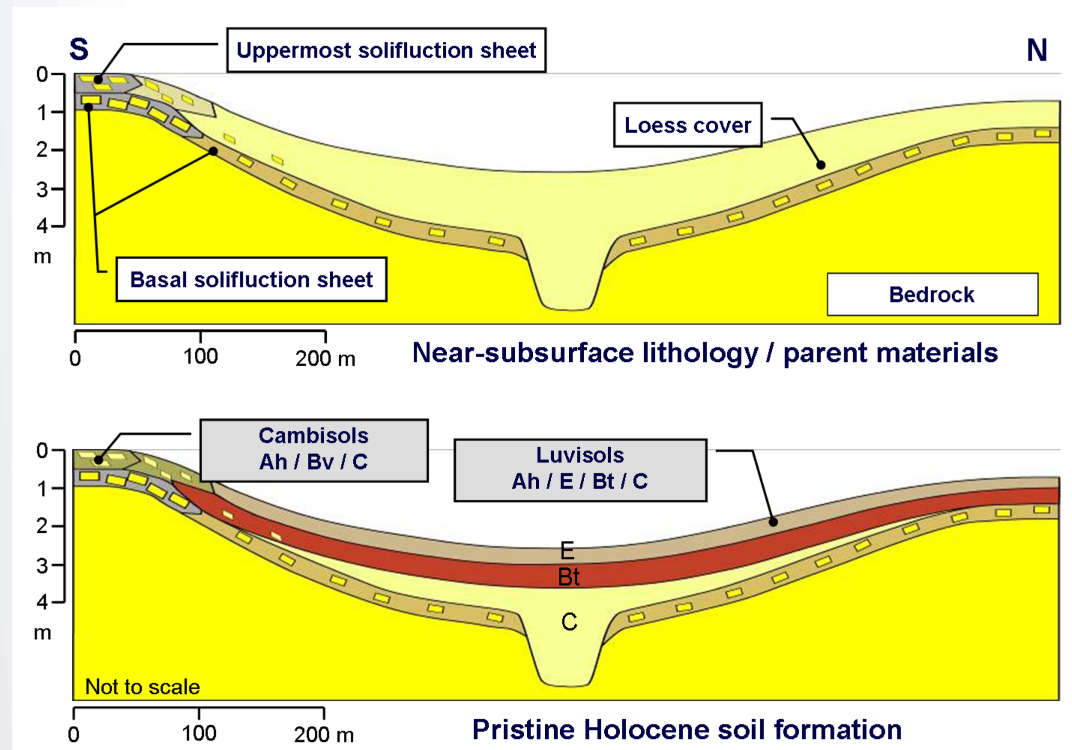

Fig. 2: Near subsurface lithology and pristine Holocene soil formation

Methodological Approach

Sediment routing in time is a non linear system with different types of sources and sinks (Fig. 3). The residence time, the temporal storage and the spatial variability of material are influenced by historic and actual land use patterns and are subjected to a time-dependent system change.

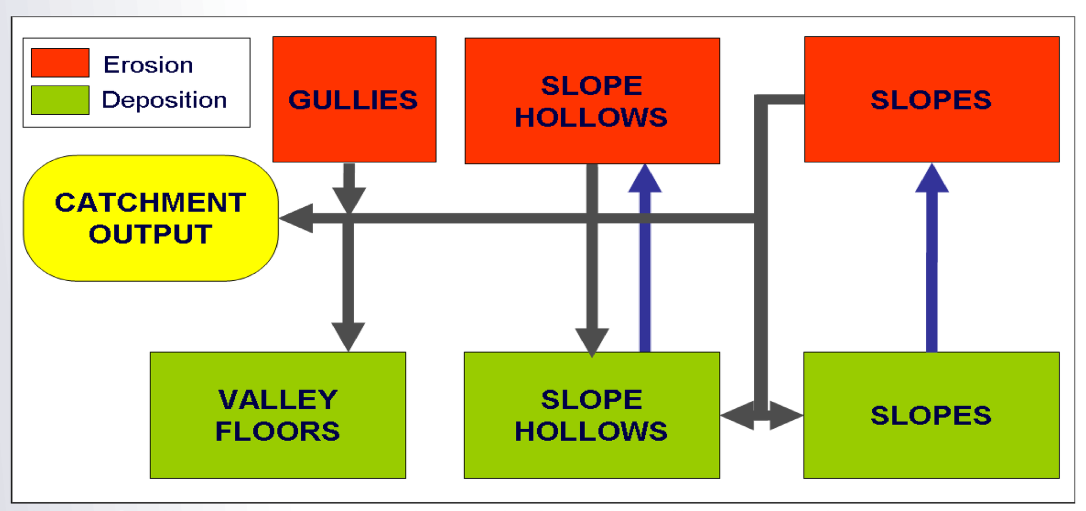

Fig. 3: Sediment cascade of man-induced sediment routing

Soilscape Model

Due to the variation of the surface structure in the research area, a soilscape model serves as a basis for calculating erosion and sedimentation. In the southern area, it is handy to work with lithological parameters like the present thickness of the main solifluction sheet (Fig. 4). In the northern part, where the loess cover is dominant for the shape of the surface, pedological approaches are more required (Fig. 5). The Holocene sedimentation is measured by the burial of soil shown in Fig. 6. Empirical spatial datasets are essential to supply the soilscape model with the correct information for soil truncation or colluvial deposition. Therefore, it is necessary to compose litological/sedimentological and pedological charts.

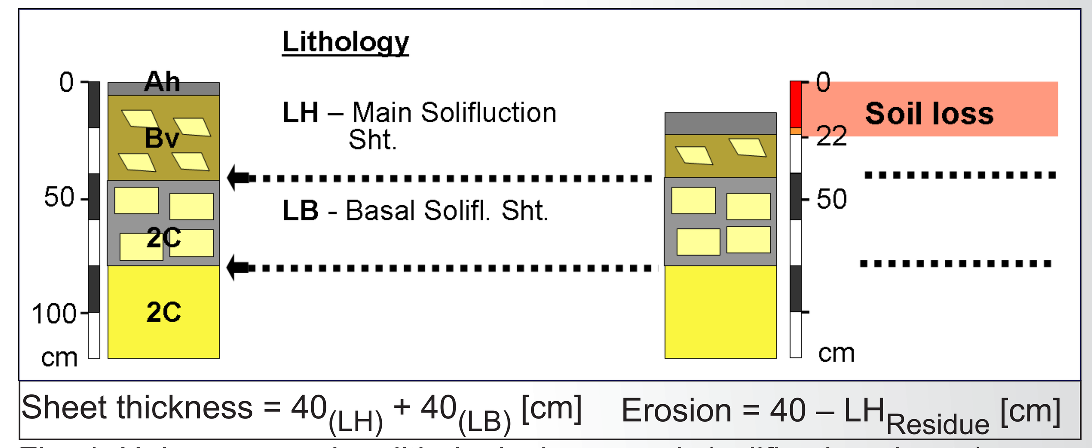

Fig. 4: Holocene erosion: lithological approach (solifluction sheets)

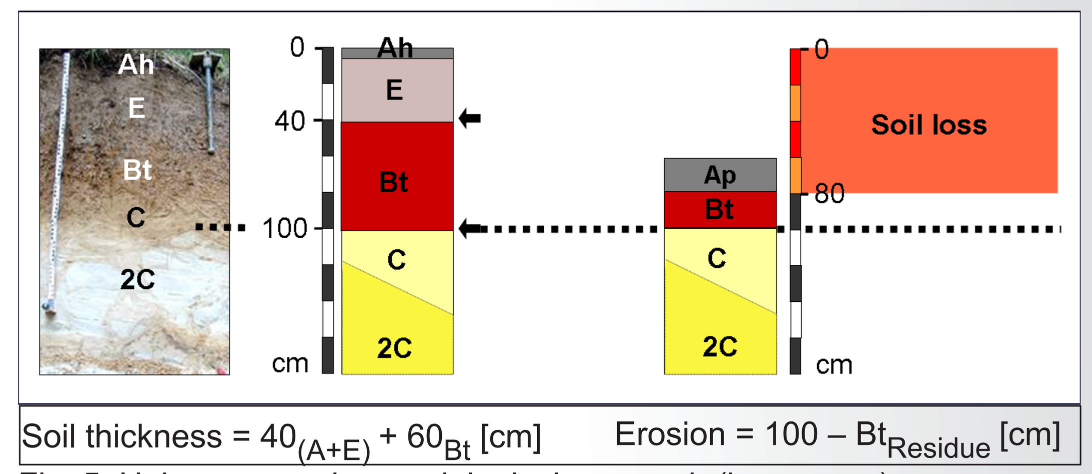

Fig. 5: Holocene erosion: pedological approach (loess area)

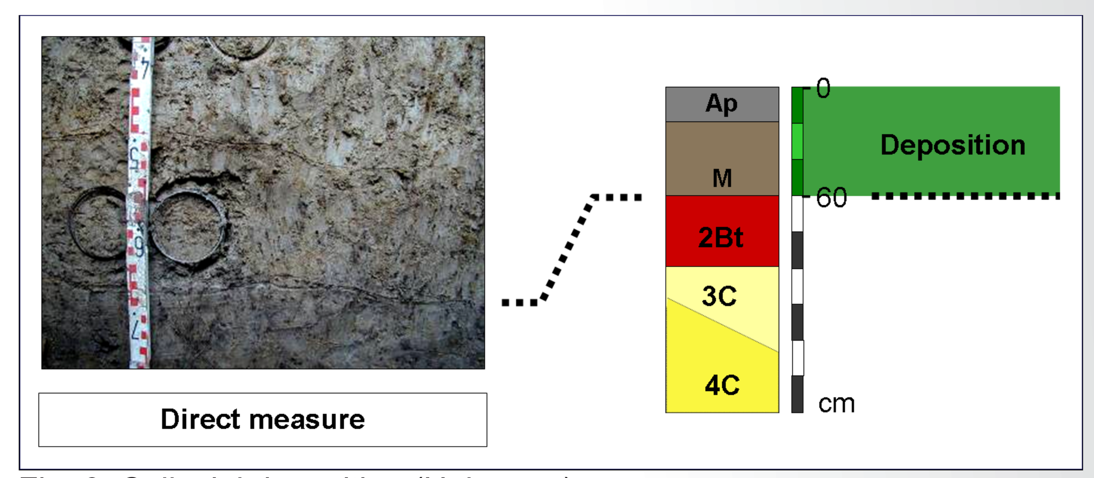

Fig. 6: Colluvial deposition (Holocene)

Fig. 7: Erosion of luvisols in the loess area

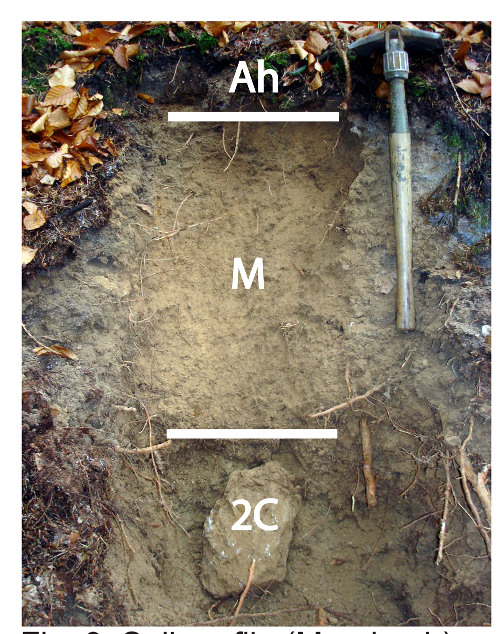

Fig. 9: Soil profile (Mergbach)

Modelling and Processing

The modelling can be done in two different ways. The first scenario is an uncritical adaptation of the dataset supplied by the state's authorities survey. This scenario is of no use as shown in previous studies by Houben (in prep.). The second scenario is a knowledge-based re-interpretation of the dataset. Recent research activities in the north of Frankfurt am Main illustrate that this way leads to reasonable values for soil erosion and sedimentation.

Sediment Flux

Another aim is to find an answer to the chronological behaviour of the transferred sediment. In addition to ^{14}C-data and OSL-sampling, different historical sources are applied to solve the task.

First Results

Previous mappings display that the northern part of the catchment is characterized by widespread erosion of the luvisols derived from loess (Fig. 7). Colluvial deposits are extremely prevalent in this area (Fig. 8).

Even in remote forest districts in the southern part of the catchment, the main solifluction sheet is very often replaced by Holocene colluvial slope deposits (Fig. 9).

By comparison with the available dataset, it is already apparent that the extent of soil erosion and colluviation is underestimated in the data.

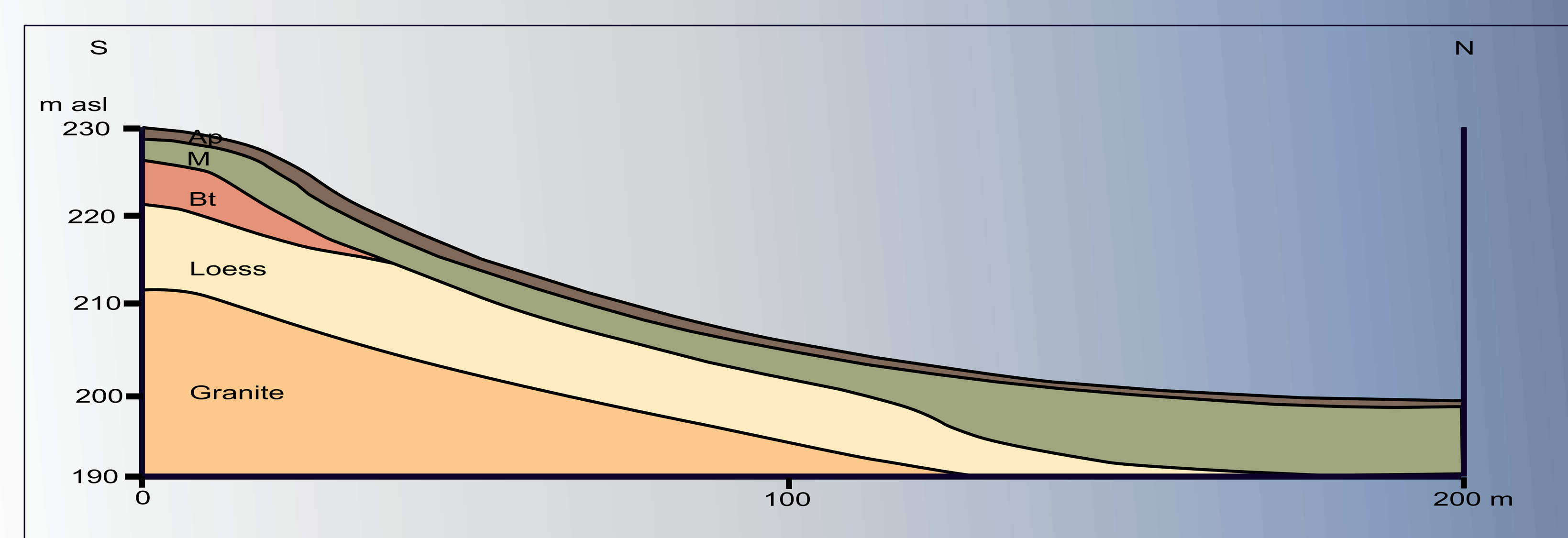

Fig. 8: Example of a typical catena with truncated luvisols and colluvial deposition (loess area)

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