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Quantification and temporal evolution of sediment storage in a Lateglacial inner-alpine basin (Gradenmoos, Schober Mountains, Austria)

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On continental spatial scales and geological timescales, high mountain systems can be considered in a simplistic approach as source areas with high rates of sediment production and huge amounts of sediments available for transport. However, large areas shift to intermediate sediment storages when studying smaller spatio-temporal scales. These sediment storages frequently interrupt sediment fluxes and therefore decouple alpine cascading systems. Impediments due to large rockfall deposits or glacial oversteepening effects are possible causes for decoupled sedimentary systems. As a consequence characteristic knick points in longitudinal valley profiles with increased sediment storage above and reduced sediment storage below develop. This study quantifies sediment storage in a small inner-alpine sedimentary basin using geophysical methods, coring and GIS modelling. Temporal evolution of the basin is reconstructed based on radiocarbon dating.

Barriers along the longitudinal valley profile of the Gradenbach catchment (32.5 km^2, Schober Mountains, Austria) can be attributed to the lithological and tectonical setting, with mainly NW-SE-oriented faults and strikes, and to climatic conditions, in particular to the impact of Pleistocene glaciations causing overdeepened basins. As a consequence major sediment sinks developed in the course of the Gradenbach creek (several lakes named Gradenseen, the lake mire Gradenmoos). These sinks largely prevent coarse grained sediment throughput and show different states of infilling. They represent important landscape archives documenting the Postglacial sedimentation history of this inner-alpine catchment. The ancient lake mire Gradenmoos with adjacent floodplain sediments and slope storage landforms is the most pronounced and largest sedimentary basin in the catchment. This Lateglacial, tongue-like basin – today completely filled up with sediments delivered by various processes (mainly fluvial, debris flow, rock fall) – is assumed to be deglaciated since Egesen times. Thus, we expect an uninterrupted stratigraphy of Postglacial sedimentation.

As a first important step, a detailed landform inventory was established and visualised in a geomorphological map. Subject to variable subsurface conditions, different geophysical methods delivered volumetric information of sediment storage. Electrical resistivity tomography (ERT, 2D and 3D) was applied in the fine grained and water saturated mire. In terms of measurement density, speed of data acquisition and the given subsurface characteristics (water saturated, fine grained deposits above bedrock), ERT proved to be a suitable technique delivering detailed and realistic subsurface models with only low residual errors. Ground penetrating radar (GPR) was used to survey bedrock depths underneath adjacent coarse grained debris and talus cone deposits. Additionally, sediment cores (up to 22 m depth) have been taken in the basin. They delivered the composition of the basin fill showing (1) the depth of the basin floor, (2) a basal till layer underneath proglacial lake sediments (sandy-silty, partly varved), (3) several intermediary oxidised layers and (4) overlying layers of peat towards the surface. Furthermore, coring allowed for inferring bedrock resistivity of approximately 2000 ohmm. The shape of the basin was modelled by Spline interpolation of surface and subsurface bedrock areas. Sediment thickness was calculated by subtracting the basin floor model from a LIDAR surface DEM. Radiocarbon dating results will finally enable to differentiate mean sedimentation rates and variable phases of geomorphologic activity.

Summarized, this study focuses (1) on the analyses of sediment storage patterns in the Gradenmoos basin and its volumetric quantification, (2) on the reconstruction of the Postglacial Gradenmoos evolution (rates of infill) and (3) on the validation of the paraglacial concept describing alpine landscape transformation from glacial to nonglacial conditions.

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