Geophysical Research Abstracts
Vol. 14, EGU2012-12347-1, 2012
EGU General Assembly 2012

Sediment storage quantification and postglacial evolution of an inner-alpine sedimentary basin (Gradenmoos, Schober Mountains, Austria)

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Knickpoints in longitudinal valley profiles of alpine headwater catchments can be frequently assigned to the lithological and tectonical setting, to damming effects through large (rockfall) deposits, or to the impact of Pleistocene glaciations causing overdeepened basins. As a consequence various sedimentary sinks developed, which frequently interrupt sediment flux in alpine drainage basins. Today these locations may represent landscape archives documenting a sedimentary history of great value for the understanding of alpine landscape evolution.

The glacially overdeepened Gradenmoos basin at 1920 m a.s.l. (an alpine lake mire with adjacent flood-plain deposits and surrounding slope storage landforms; approx. 4.1 km^2) is the most pronounced sink in the studied Gradenbach catchment (32.5 km^2). The basin is completely filled up with sediments delivered by mainly fluvial processes, debris flows, and rock falls, it is assumed to be deglaciated since Egesen times and it is expected to archive a continuous stratigraphy of postglacial sedimentation. As the analysis of denudation-accumulation-systems is generally based on back-calculation of stored sediment volumes to a specific sediment delivering area, most reliable results will be consequently obtained (1) if sediment output of the system can be neglected for the investigated period of time, (2) if - due to spatial scale - sediment storage can be assessed quantitatively with a high level of accuracy, and (3) if the sediment contributing area can be clearly delimited. All three aspects are considered to be fulfilled to a high degree within the Gradenmoos basin.

Sediment storage is quantified using geophysical methods, core drillings and GIS modelling whereas post-glacial reconstruction is based on radiocarbon dating and palynological analyses. Subject to variable subsurface conditions, different geophysical methods were applied to detect bedrock depth. Electrical resistivity surveying (2D/3D) was used most extensively as it delivered detailed and realistic subsurface models with low residual errors in the fine grained and water saturated central and distal part of the basin. With a lower data density, ground penetrating radar and refraction seismic supplied bedrock depths underneath adjacent debris and talus slope deposits. Additionally extracted sediment cores (up to 22 m depth) yielded a detailed stratigraphic record of the basin comprising a basal till layer underneath lake sediments (sandy-silty, partly varved), a sandy matrix with several oxidised layers in the upper sections, and layers of peat towards the surface. As bedrock was reached several times, core drilling further enabled to calibrate resistivity models. On the base of geophysical derived bedrock points, the shape of the assumed bedrock basin was modelled using a thin-plate-spline interpolation. Sediment volumes were calculated by subtracting the bedrock model from a surface DEM derived from terrestrial laser scanning. Since sediment delivering areas can be clearly assigned to single storage landform volumes, denudation rates could be calculated in detail and related to sedimentation rates obtained by radiocarbon dating results. An integrated analysis of surface, subsurface and temporal information finally yielded a model of postglacial basin evolution which will be discussed in a paraglacial context.

This presentation is supported by the EUROCORES programme TOPO-EUROPE of the European Science Foundation.