



Variation of bed-material grain size along a mountain river affected by gravel extraction and channelization

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Longitudinal changes in the granulometry of bar sediments of the mountain Czarny Dunajec, southern Poland, were investigated to determine the impact of human activity in the river on depositional conditions in its channel. The grain size of surface bed material was established on 46 gravel bars along an 18 km long river reach without tributaries, in which some sections have been affected by gravel extraction and the resultant channel incision, or channelization over the few past decades. A downstream fining trend of bar sediments was determined from samples taken at the sites with close-to-average river width and a vertically stable channel, and used as reference for the other samples. Within the deeply incised section in the upper part of the reach, the bar gravels are markedly coarser than the reference grain size. Following the exploitation of large cobbles from the channel bed in the past decades, the finer grains must have been outwashed to the downstream sections, whereas the concentration of flood flows in the deeper, narrower channel has increased their competence and enabled a delivery of the coarse particles from the upstream reach. Within the narrow, regulated channel section in the middle part of the reach, the bar sediments are also coarser than the reference grain size. In the lower part of the reach, a natural, wide, multi-thalweg channel occurs that was vertically stable or slowly aggrading over recent decades and where the bar gravels are distinctly finer than the reference grain size. The middle section has been channelized to prevent sediment delivery to a downstream-located dam reservoir. However, the section actually operates as a conveyor belt, transferring downstream the bed material grains flushed out from the upstream, incising river section. In the natural, wide channel, sediment deposition is facilitated by low unit stream power and the high channel form roughness. Hence, this natural river section may function as a sediment sink and reduce bed material delivery to the dam reservoir.