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Dynamic development of sediment infiltration in an artificial river bed

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The infiltration and accumulation of fine sediments in gravel-bed rivers leads to a reduction of the existing pore space and may lead in a worst case to a complete clogging of the river bed. To understand the highly dynamic process of sediment infiltration, measurements with high temporal and spatial resolution are required. Within this study, the development of sediment accumulations in an artificial river bed is investigated to gain further understanding on the process of colmation. The artificial river bed, implemented in a research flume, is made of spheres with two different diameters and in different packing arrangements. Three sediment mixtures with different grain size distributions are supplied to observe the dynamic infiltration process, and to get information on the distribution over depth. In addition, supply rates and supply masses are varied during the experiments.

To observe the dynamic development of sediment accumulation, the gamma-ray attenuation method is used, which provides the opportunity of non-intrusive and undisturbed continuous measurements during the experiments at a certain position. Additionally, the accumulated sediment masses are obtained right after the supply of sediments and 28 minutes later, with a high vertical resolution to detect changes as result of consolidation within the pores.

From the measured amount of infiltrated sediments can be seen that the accumulated sediment mass is strongly particle size-dependent. The measurements of the fine sediment mixture show that the filling started from the bottom until the accumulation reach the surface of the artificial river bed. The experiments with the coarse sediment mixture resulted in a clogging layer in the upper section of the river bed, and subsequently less sediments reached the flume bed. By varying the supply rate, it can be seen that a higher supply rate leads to an earlier start of the infiltration and a rapid filling, while the lower supply rate resulted in a later infiltration and slow

filling process. The measurements 28 minutes after the end of the experiments show, in addition, that dynamic changes happen mainly in the upper layers due to the washing of surface sediments by the flow, and only to a smaller extent by further settlements due to solidification within the pores. The feeding mass itself has no considerable effect on the infiltration behavior of the current setup, as once the pores are filled, almost no additional particles penetrate the bed.

The use of a high sophisticated measurement method made it possible to investigate the infiltration process of sediments in an artificial river bed with high temporal and spatial resolution. Due to the use of different sediment mixtures, and different supply conditions, further insight on the process of fine sediment infiltration could be gained within this study.