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Infiltration of silt-sized sediment in a gravel-bed channel

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In mountain and piedmont hydro-systems, gravel-bed rivers often transport large amounts of fine (silt-sized) sediments. The dynamics of such a sediment mixture is usually described as a simple superposition of two independent modes of sediment transport: a suspension of fine sediments over a bed load of gravels. However, the interaction between the two classes of sediment may be strong. This study is mainly focused on one of the aspects of this interaction, which is the development of a clogged layer through the infiltration of fine sediment into a coarser bed. Clogging affects the spawning process of many fluvial fish species and has different socio-economic consequences concerning to water supply and river dam management operations. Previous studies highlight the influence of flow velocity and fine sediment concentration on the total amount of fine sediments infiltrated within the gravel bed and their depth distribution. Moreover, the ratio of fine to coarse sediment size has proved to be determinant concerning to the mechanism of infiltration and the formation or not of a sealing layer at the surface of the channel bed that prevents from deeper infiltration of fine material.
This study is based on laboratory experiments performed in a 18-meter long and 1-meter wide channel. It focused on the analysis of the infiltration processes of silt-sized suspended sediment within a gravel channel bed (mean diameters of 30μm and 8mm, respectively). Such experiment with a ratio over 200 between the two grain sizes is poorly described in the literature. The influence of flow velocity and suspended sediment concentration on the amount of sediment infiltrated is analysed. Determination of velocity profiles is carried out in order to quantify bottom shear stress and its effect on the infiltration process. On the other hand, results on depth distribution of the infiltrated sediment are provided and interpreted, discussing the mechanisms of infiltration and the physical processes involved from a pore scale point of view. The present study casts light into geomorphological aspects of river behaviour that have important environmental and socioeconomic impacts.