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MultiPAC: A novel approach to quantify the clogging degree of a riverbed

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Riverbed clogging, also referred to as colmation, describes the infiltration of fine sediment in gravel bed rivers. The infiltrated fine sediment leads to a reduction of the pore space and, in the worst case, to a sealing of the riverbed. As a result of severe colmation, negative effects on the environment may occur, such as a limited oxygen supply for fish eggs or for macrozoobenthos.

The quantification of the degree of colmation and its impact on the ecological status of a river is often based on an expert assessment or only on a single parameter, such as the amount of fine sediment. However, depending on the sediment matrix of the riverbed, the packing arrangement of particles, or the organic material in the riverbed, a single parameter may not be sufficient to evaluate the degree of colmation. In addition, most expert-based assessments, such as mapping of inner and outer colmation, are on the one hand biased due to subjectiveness and on the other hand, only investigate the surface layer of the riverbed. Knowledge on possible occurring colmation layers in deeper regions of the interstitial will not be gained by using these methods.

In this study, a novel **MultiParameter Approach** to assess **Colmation** (MultiPAC), is presented, which measures several physical parameters, and provides insights into the status of colmation conditions in the interstitial. These are:

- measurements of the sediment composition for identifying surface and subsurface grain size distributions and for assessing fine sediment fractions,
- measurements of porosity by using Structure-from-Motion in combination with freeze-core sampling, and
- measurements of oxygen concentration and hydraulic conductivity by using a newly developed double-packer system, called VertiCo.

The VertiCo (**V**ertical profiles of hydraulic **C**onductivity and dissolved **O**xygen) enables measurements with a high spatial resolution over the vertical axis of the riverbed to enable the quantification of possible colmation layers or changes of the conditions in the interstitial over depth.

With the MultiPAC it is feasible for the first time to holistically assess the influence of oxygen and hydraulic conductivity in the interstitial. By taking also into account the properties of the sediment matrix and the porosity, the degree of colmation of a riverbed can be identified. In addition, these findings may provide important information to support the classification of the ecological state of river sections.