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# Sediment fining processes in a mountain stream at multiple time scales

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Downstream fining of sediment is observed in most gravel bed rivers, and is attributed to two mechanisms. The first one is an apparent fining that results from a collective effect called selective sorting: smaller grains travel further downstream while larger grains deposit preferentially upstream. The second one is generally referred to as abrasion and encompasses all the fining processes that affect each grain during its travel along the stream.

The latter type of processes is dominant in the mountainous streams of the Draix observatory and is the focus of this study. Draix catchments are characterized by hard climatic conditions with winter frost and storm-induced floods, and a very erodible lithology (marl). During the floods, at the time scale of a few minutes, sediment size is reduced by surface abrasion and fragmentation due to the collisions between grains. In between the floods, at the time scale of a few weeks to months, sediments that remain exposed on bars at low flow are affected by weathering due to frost/thaw and wetting/drying alternations, which also reduces their size.

Using field measurements, we measured the global sediment fining rate that results from both short-term (flood) and long-term (low flow) processes. The very high value obtained (51%/km) reflects the combination of the soft lithology with hard climatic conditions. We then combined various field and laboratory experiments to quantify the efficiency of each fining process (surface abrasion and fragmentation during a flood, frost/thaw weathering and wetting/drying weathering). Results indicate that short-term and long-term processes are equally efficient and that both are needed to explain the in-situ global fining rates.

We finally propose a simplified model to describe the observed fining patterns, which we use to predict the system response to changes in the hydrological or climatic regime.