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Suspended sediment transport during in-channel gravel mining: spatial and temporal dynamics

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Rivers in natural conditions tend to maintain long-term morphosedimentary equilibrium, however, natural and human induced disturbances (e.g. flooding, damming, gravel mining, etc.) may alter this equilibrium by modifying physical and ecological processes and dynamics. Gravel mining activities cause major changes in the channel mass and energy balances, that in turn affect morphology, bed sedimentology and habitat conditions. In-channel gravel extractions also increase suspended sediment concentrations, locally but with downstream associated effects. The excess of sediments can clog the interstices between substrate clasts, increasing the invertebrate drift, and reducing the available habitat for benthic organisms.

The Upper River Cinca (Southern Pyrenees, Iberian Peninsula) has experienced gravel mining activities in the active channel and floodplain since the middle of the last century, although their morpho-sedimentary impacts have never been fully investigated. Nowadays, these practices are still carried out in the upper Cinca, but mainly to prevent damages in infrastructures. One of these extractions has been experimentally monitored in the background of the research project MorphSed (www.morphsed.es). Suspended sediment transport has been monitored before, during and after the gravel extraction in order to assess the spatial and temporal dynamics and their potential impacts in the downstream reaches.

Suspended sediment samples were collected manually (Depth integrated sampler DH49) and automatically (ISCO 3700 automatic sampler) at four sampling locations, one just downstream from the mining (M1) and the other two sections (M2, M3) located 100 and 300 m downstream. Additionally, turbidity was continuously registered (every 15 minutes) in the last section (M3). Preliminary results show as during the first field day, when the channel was partially diverted, sediment concentrations increased locally and decreased downstream. Mean suspended sediment concentrations were 500, 20, 9 mg l^{-1}, respectively. The discharge was maintained low and steady (Q = 10 m^3 s^{-1}). Mean concentration in M1 was conditioned by its maximum, which was 5000 mg l^{-1}, while in M2, M3 were 70, 22 mg l^{-1}. This data suggest that sediment deposition took place in the channel in downstream reaches. Contrastingly, the second sampling day, when the channel diversion was completed and gravel extraction started, sediment transport patterns changed notably. In this case, the mean and peak concentration were higher in the downstream section M3 (170 and 1340 mg l^{-1}), followed by M1 (160 and 610 mg l^{-1}). The Lowest values were obtained at M2 (120 and 840 mg l^{-1}). These patterns are clearly influenced by the deposition observed in the preliminary day. This work supposes a first step in understanding the sediment dynamics in fluvial systems locally impacted and their influence downstream, both, in terms morpho-sedimentary and ecological impacts.