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The preferential transport of sediment and its implications for sediment fingerprinting: A flume simulation

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The sediment source fingerprinting technique is based on the assumption that the potential sources of sediment can be linked to in-stream sediment by using natural sediment properties as tracers. However, many of the sediment properties used as fingerprints are dependent on both the particle size distribution and organic matter content. The preferential erosion, delivery and transport of sediment within a drainage basin can result in down-stream changes in particle size and organic matter content. Both particle size and organic matter correction factors are commonly used to account for these changes between sources and sediment so that a direct comparison can be made but little is known about the potential errors associated with these correction factors. A large outdoor recirculating flume (2 m*2 m*36 m) was used to assess the changes in the physical and biogeochemical properties of fluvially transported sediment under three different channel bed conditions: no gravel (smooth), 5 cm of gravel and 40 cm of gravel. Fine-grained agricultural soil was added to the flume and suspended sediment samples were collected over a 30 hr period. The suspended sediment samples were analyzed for: 1) concentration; 2) particle size distribution; 3) organic matter content; and 4) geochemical composition (51 elements). There was a decrease in both the concentration and median particle size along with an increase in organic matter content over time (distance travelled). The channel bed conditions had an effect on the preferential transport of sediment. Increasing the depth of gravel in the flume resulted in a more rapid and pronounced change in concentration, particle size and organic matter content. The geochemical composition of the sediment changed as a result of fluvial transport but the relation with particle size and organic matter, in terms of the magnitude and direction of the changes, were element specific. This suggests that the use of correction factors needs to be given careful consideration.