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Stream channel storage of fine particulate material

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Fine particles and stream suspended material influence the ecological and physical nature of streambeds. These clay- and silt-sized particles travel downstream with the current, but also settle to and infiltrate the stream bed. All fine particles can facilitate the transport of nutrients and contaminants within the stream and across the streambed. Excess settled particulate material can disturb streambed habitat and block the hyporheic exchange of stream water and groundwater. In order to compare the hydrologic transport of clay-sized particles with that of a conservative solute, three tracer injection experiments were performed. The conservative solute (bromide) and fine particle (titanium dioxide) tracers were added to a second-order, ungauged stream in northwestern Connecticut, USA. Water samples were collected at multiple downstream locations over a 300 m stream reach, containing both run and step-pool geomorphology and substrate ranging in size from sand to boulders. The transient storage model was applied in inverse mode to the measured breakthrough curve data in order to quantify the processes that governed solute and particle transport. Transient storage played a much larger role in solute transport than particle transport. Solutes were released more quickly than fine particles from storage areas, such as the hyporheic zone. Movement of fine particles into storage zones was not found to be readily reversible under drought and low flow conditions. Results of our analysis illustrate the mechanisms and relative timescale of suspended particle transport under different seasonal flow regimes. In particular, these experiments highlight the differences in solute and particle exchange between the active stream channel and adjacent storage areas. This work has further implications for the transport and hyporheic exchange of particle-bound nutrients and contaminants.