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Regulation of bioavailable nutrients in the hyporheic zone of a Chalk stream in South East England

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In this study we have used tangential flow fractionation (TFF) to investigate P-colloid associations in the hyporheic zone of a groundwater dominated chalk stream, as well as the association of phosphate (PO4) with laboratory-generated chalk and clay colloids. Phosphorus (P) speciation is similar for the River Lambourn and the deeper Chalk aquifer beneath the hyporheic zone, with 'dissolved' P (<10 kDa) accounting for ∼90% of the P in the River and >90% in the deep groundwaters. Within the hyporheic zone the proportion of 'colloidal' (<0.45 um>10 kDa) and 'particulate' (>0.45 um) P is high, accounting for ∼30% of total P. Our results suggest that zones of interaction within the sand and gravel deposits directly beneath and adjacent to the river system generate colloidal and particulate forms of fulvic-like organic material and regulate bioavailable forms of P, perhaps through co-precipitation with CaCO3. Organic matter decomposition and nitrification in the hyporheic zone could be the source of both fulvic-like dissolved organic matter and NO3-N. While the aquifer provides some degree of protection to the sensitive surface water ecosystems through physiochemical processes of P removal, where flow is maintained by groundwater, ecologically significant P concentrations (20-30 ug/L) are still present in the Chalk groundwater and may be an important source of bioavailable P during baseflow conditions. Synthetic colloidal suspensions of chalk and clay were found to be very effective at removing PO4 (100 ug-P/L) from solution (>90% for chalk and >80% for clay after 1hour) and may be an important sink for bioavailable P within streambed sediments. The nutrient storage capacity of the hyporheic zone and the water residence times of this dynamic system are largely unknown and warrant further investigation.