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# Investigating nitrogen attenuation in the hyporheic zone of a lowland river: a multi-disciplinary approach

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Increasingly intensive agricultural practices in the $20^{th}$ century increased the loading of nitrogen, primarily as nitrate ($NO_3^-$) and ammonium ($NH_4^+$), to surface and groundwater bodies in the UK. The interface between these distinct water bodies, the hyporheic zone, is potentially highly biogeochemically reactive due to the physico-chemical gradients which exist across this region. A multi-disciplinary approach to the characterisation of nitrogen attenuation in the hyporheic zone of a UK lowland river (River Tern, Shropshire) is described. Twenty four sediment cores were taken in total from two contrasting reaches of the Tern and the porewater analysed for a range of important geochemical parameters including major ions, alkalinity and total inorganic/ organic carbon. Using this data, geochemical contour plots were developed for both sites using the RockWorks (2004) software. $NO_3^-$ levels across both reaches were typically 0-50mg/L but were as high as 85mg/L. Ammonium levels in contrast were low, 0-5mg/L, through the first reach and undetectable at the second reach. Datasets were analysed by multivariate statistical techniques to interpret the relationships between measured parameters and properties. These analyses suggest the hyporheic zone has variable functionality in terms of nitrogen processing, which is determined by the presence of redox dependent processes, such as nitrification and denitrification. A molecular biology study carried out on the cores identified bacterial community variability via 16S RNA terminal restriction fragment length polymor-

phism (T-RFLP) analysis. This work has shown that hyporheic bacterial communities can be highly localised spatially. Furthermore, communities show greater similarity along core length than with corresponding depths in other cores. This work supports the spatially variable potential for microbially mediated nitrogen transformation in the hyporheic zone, suggested by the geochemical study. Future work, proposing the use of microcosm and flow-through experiments to quantify the effects of predicted key determinants, carbon levels and flow conditions, on nitrogen processing, are also described. Hydrogeological characterisation of the study site is also planned, to interpret the flow system and flux of water moving through the hyporheic zone. Links can then be made between the observed nitrogen processes and their relative importance in terms of the hyporheic zone acting as an attenuation compartment for nitrogen within the catchment. This information may be useful in future assessment of catchment-scale nitrogen fluxes by environmental regulators and managers.