Geophysical Research Abstracts,
Vol. 11, EGU2009-3204, 2009
EGU General Assembly 2009

The importance of river - aquifer exchange for groundwater nutrient transport and transformation in different environments

S. Krause (1), C. Tecklenburg (2), M. Munz (2), L. Heathwaite (3), A. Binley (3), and E. Naden (1)

(1) Keele University, Dep. for Earth Science and Geography, Dep. for Earth Science and Geography, Keele, Staffordshire, United Kingdom (s.krause@esci.keele.ac.uk, 0044 01782 715261), (2) Potsdam University, Geoecology Dep., Potsdam, Germany, (3) Lancaster Environment Centre, Lancaster University, Lancaster, UK

The implications of streambed physical and chemical conditions on the hyporheic exchange between groundwater and surface water as well as on the transport and transformation of redox sensitive nutrients have been investigated for two contrasting UK upland and lowland rivers. The presented research comprises experimental investigations on nested piezometer arrays in streambed and floodplain as well as model applications for the simulation of hyporheic exchange fluxes and nutrient transport.

In both rivers groundwater up-welling was dominant during the observation periods. The intensity of hyporheic exchange in the upland river was found to be mainly controlled by the temporally variable streambed permeability whereas groundwater – surface water exchange in the lowland river was primarily constrained by the spatial pattern of locally disrupted shallow peat layers in the streambed, causing semi confined conditions with groundwater-surface water exchange hot spots in areas of peat disruption. The efficiency of nutrient transformation in the streambed of the upland river depended on the spatial and temporal coincidence of (i) connectivity patterns between groundwater and surface water and the resulting exchange rates and residence times and (ii) patterns of redox reactivity and reaction efficiencies. Here the content and availability of organic matter and dissolved oxygen appeared to have the greatest impact on nutrient transformation efficiencies. In the investigated lowland river however, pattern of residence and reaction times and of constricted flow through the disrupted confining peat layer proved to have the most significant impact on reaction rates and efficiency of nutrient transformation, leading not only to exchange but also reactivity hotspots in streambed areas with long residence times.

In both, the upland as well as the lowland river, hyporheic exchange fluxes and nutrient transformation had a great impact on in stream and groundwater conditions especially during baseflow. Nitrate concentrations in the up-welling groundwater at both rivers changed by up to 300% along the passage though the uppermost 100 cm of streambed sediments. For the upland as well as for the lowland case study, the spatial extend of highly reactive streambed areas exceeded the depth of groundwater-surface water mixing.