Geophysical Research Abstracts
Vol. 19, EGU2017-13643, 2017
EGU General Assembly 2017

Impact of water flow conditions on the fate of ammonium and nitrate at the interface of the unsaturated and saturated zone

David Glöckler, Niklas Gassen, and Christine Stumpp
Helmholtz Zentrum Muenchen GmbH, Institute of Groundwater Ecology, Neuherberg, Germany
(christine.stumpp@helmholtz-muenchen.de)

Elevated nitrate concentrations in groundwater have caused severe environmental issues in the last decades. Mitigation strategies need to be developed to reduce the amount of nitrate without reducing crop yield though. Therefore, we need to understand nitrogen turnover processes and how they are influenced by hydrogeochemical conditions in the unsaturated and saturated zone. The objective of this study was to investigate the influence of flow conditions on transport processes and the fate of ammonium and nitrate released from slurry application. Experiments were conducted under controlled conditions in an aquifer model setup (1.1 x 0.6 x 0.2 m^3). A diluted slurry mix was injected continuously. The inorganic nitrogen compounds were traced under different water regimes regarding recharge rates and water table position (steady-state, transient and stagnant flow conditions). Conservative tracers and mathematical modeling were used to identify water flow and transport. Spatiotemporal changes of dissolved oxygen, ammonium, nitrite, nitrate, dissolved organic carbon and matrix potential were identified through high resolution monitoring (0.05 m). The ecosystem immediately responded to the slurry application with enhanced microbial respiration and the first step of nitrification converting ammonium to nitrite. This process was dominating during the first ten days of the experiment. A complete nitrification was established after 20 days resulting in increasing nitrate concentrations. Less nitrate was measured below the water table during steady state flow conditions in contrast to transient conditions with a fluctuating water table which seemed to inhibit denitrification. Still denitrification was not the dominating process despite high concentration of dissolved organic carbon (4-20 mg/L). Even under stagnant flow conditions, nitrate stayed in the system and denitrification was limited. Anoxic conditions were not established due to the low bioavailability of the dissolved organic carbon. The results highlight the substantial impact of slurry application on groundwater quality for all tested hydrological scenarios.