Geophysical Research Abstracts
Vol. 20, EGU2018-2370, 2018
EGU General Assembly 2018

Insights into the Biogeochemical Cycling of Phosphorus in Reducing Aquifers of South and South East Asian Floodplain and Delta Regions

Harald Neidhardt (1), Yvonne Oelmann (1), Daniel Schoeckle (1), Elisabeth Eiche (2), Zsolt Berner (2), Pham Thi Kim Trang (3), Vi Mai Lan (3), Pham Hung Viet (3), Ashis Biswas (4), Santanu Majumder (5), Debashis Chatterjee (6), and Michael Berg (7)

(1) Geoecology, Eberhard Karls University Tübingen, Germany (harald.neidhardt@uni-tuebingen.de), (2) Institute of Applied Geosciences, Karlsruhe Institute of Technology, Germany, (3) Center for Environmental Technology and Sustainable Development, Hanoi University of Science, Vietnam, (4) Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research Bhopal, India, (5) Groundwater Research Group, Texas A&M University, United States, (6) Department of Chemistry, University of Kalyani, India, (7) Eawag, Swiss Federal Institute of Aquatic Science and Technology, Switzerland

To the present, the fate of phosphorus (P) in Asian floodplain and delta aquifers has received little attention despite the vital role that P plays in the enrichment of toxic arsenic in local groundwater. Furthermore, groundwater may act as an important source of P to surface waters, increasing the risk of eutrophication. We studied the distribution and processes underlying the enrichment of P in anoxic groundwater in two characteristic delta and floodplain regions, the Red River Delta (RRD) in Vietnam, and the Bengal Delta Plain (BDP) in West Bengal, India. To gain insight into the biogeochemical mechanisms underlying the mobilization, microbial cycling and subsurface transport of P, we combined detailed groundwater analyses and innovative in situ experiments. We focused our investigation on one field site in the RRD, and two complementary sites in the BDP. Here, total concentrations of dissolved P (TDP) in shallow groundwater between 12 to 38 m below the surface largely exceeded 1 mg/L and were typically associated with young sandy aquifer sediments of Holocene age. Dissolved inorganic P (DIP) represented the dominant species of P in groundwater. Mobilization and enrichment of P in groundwater was attributed to a microbially controlled process chain based on the degradation of organic carbon and the reductive dissolution of iron-(hydr)oxides. While we could not entirely rule out the possibility that external sources like fertilizers contributed P to groundwater, we consider increased concentrations in groundwater on a large scale to represent the geogenic background level. Furthermore, extensive extraction of groundwater in the vicinity of Hanoi currently causes migration of P-enriched groundwater into adjacent aquifer sediments of Pleistocene age at our field site in the RRD. Our data demonstrates that these sediments represent effective sinks for P due to a high adsorption capacity. However, the enduring contact with anoxic and reducing groundwater also altered the sediments P sorption capacity over time as revealed by an in situ adsorption experiment. In sum, our study areas constituted ideal model systems for porous aquifers in S and SE Asian floodplain and delta regions. The present results offered valuable insights regarding the biogeochemical cycling of P in groundwater ecosystems that are transferable to similar settings in Asia and elsewhere.