Geophysical Research Abstracts, Vol. 9, 02789, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02789

Effects of a drying and rewetting cycle on arsenic dynamics in a minerotrophic fen – a laboratory study

B. Fulda, K.H. Knorr, M. Bauer, C. Blodau

Limnological Research Station, Dept. of Hydrology, University of Bayreuth, 95440 Bayreuth, Germany (christian.blodau@uni-bayreuth.de / Fax: +49-921-552366 / Phone: +49-921-552223)

Being characterized by upwelling groundwater and steep gradients in geochemical conditions, wetlands and minerotrophic fens may selectively enrich redox sensitive pollutants, such as arsenic. Understanding the fate and remobilization potential of arsenic in such systems is of particular interest. Thus, several studies already address arsenic mobility and dynamics under changing redox conditions. However, most studies were conducted either under non natural conditions or they are lacking detailed measurements of solid phase and solutes on a short time resolution scale.

Here we evaluated the effect of changing redox conditions on arsenic mobility in three intact peat cores (60 cm diameter, 60 cm depth) from a minerotrophic fen (Fichtelgebirge, northeast Bavaria) on a very detailed spatial and temporal scale. The cores were incubated in a climate chamber (15° C; 12h/12h day/night cycle) for 9 months and subjected to a pronounced drying and rewetting cycle.

Solid phase contents of arsenic in the fen soil under study ranged from 5 to 25 mg kg^{-1} and peaked at 7.5 cm depth. Arsenic concentrations in the pore water ranged from 10 up to 300 $\mu g\, L^{-1}$ (primarily As(III)). As(V) and dimethylarsinic acid (DMA) had only low concentrations (10 and 5 % of the total concentration, respectively). A sequential extraction procedure revealed that arsenic was mostly associated with amorphous iron oxides (1 M HCl dissolvable). Not surprising, arsenic was concurrently released (as As(III)) under iron reducing conditions at high water level. While the cores were dried out, the water table dropped from 10 cm to about 45 cm below soil surface. Coinciding with Fe^{2+}-dynamics dissolved total arsenic concentrations decreased, values of pH dropped and As(V) dominated in the upper profile. After the rewetting ($>$30 mm d^{-1}),

the water table was back up at 10 cm below surface within 2 days, followed by a rapid remobilization of arsenic with As(III) dominating again after $<$5 days. This again agreed with the dynamics of dissolved ferrous iron. Arsenic and iron release rates were highest during the water table rise ($\sim$0.02 nmol As cm^{-3} d^{-1}, $\sim$20 nmol Fe cm^{-3} d^{-1}) and the following 25 days. Methylation of arsenic seemed to be negatively affected by the drying/rewetting cycle, as DMA was not measurable again after the rewetting.

Our study clearly demonstrated that arsenic and iron dynamics in iron rich minerotrophic fens are closely related. In our case, the ratio of iron to arsenic net turnover was always around 1:1000. Understanding iron turnover in such systems will thus help to elucidate mobility and fate of arsenic. It was also shown, that after rapid rewetting events a remobilization of arsenic is likely to occur.