Fate of the cyanotoxin cylindrospermopsin in sediments

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Motivation and Methodology

Recent studies report the occurrence of the cyanotoxin cylindrospermopsin (CYN) in surface waters [1]. Due to high persistence in aquatic systems [2] efficient elimination of CYN has to be ensured if these waters are used for drinking water production via sediment passage. The aim of our experiments was to determine a) CYN retention in two sandy sediments with different contents of fines and b) CYN degradation by considering the role of sediment preconditioning and DOC composition in the water.

We conducted a) breakthrough column experiments to determine CYN retention and b) closed-loop column experiments to quantify CYN degradation in both virgin sediments as well as degradation in the preconditioned sediment by percolating pond water with i) added aquatic DOC or ii) DOC released from lysed cells of CYN-producing cyanobacteria.

Discussion of Results

In the two sandy sediments, CYN shows almost tracer-like behaviour with R-values between 1.0 and 1.1. An increased fraction of fines has no impact on CYN retardation.

In a non-preconditioned sediment, the lag-phase amounted to approx. 20 days. After 40 days, > 92 % of the initial CYN concentration (10 µg/l) was degraded. Added aquatic DOC showed the highest degradation rates of CYN in the sediment ($k = 0.46$ day $^{-1}$). The presence of DOC released from lysed cells yielded slow CYN degradation rates during the initial 8 days ($k = 0.03$ day $^{-1}$), suggesting degradation competition between substrates, i. e. CYN and easily degradable organic substances, as already hypothesized by Smith *et al.* [3]. We conclude the different types of DOC affect CYN degradation rates. Additional experiments are being conducted to further clarify the role of sediment preconditioning.

[1] Rücker *et al*. (2007) *Toxicon* **50**, 800-809. [2] Chiswell *et al.* (1999) *Env. Toxicol.* **14**, 155-161. [3] Smith *et al.* (2008) *Env. Toxicol.* **23**, 413-421.

Effect of wastewater irrigation on plants: Boron uptake investigated through boron isotopes

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Irrigation with reclaimed wastewater is a major option for coping with droughts induced by global or regional climate changes in arid regions. However, treated wastewater from both urban and rural sources usually contains high levels of soluble organic molecules (SOM), boron (B) and salts. In soil, interactions between wastewater compounds, soil-microorganisms and plants are complex. To investigate boron uptake by plants, growth experiments using wild type (WT) tomatoes and transgenic (TR) tomato lines were conducted under various conditions of B and pH. Boron isotope fractionation between water, roots and leaves was investigated.

Two series of experiments were conducted: Tomato plants were grown at 5 different pHs (5-9 for the first series, 5 to 10 for the second series) in 5 L flask (3 replicates). The initial B was 0.2 ppm (δ^{11}B around -10 ‰ vs. NBS951) for the first and 2 ppm (δ^{11}B +31.3 to +35.5 ‰) for the second series. Blanks contained B at low ppb level. Tomato leaves from the first experiment showed at low pH (undissociated boric acid dominating) a slight constant isotopic fractionation between growth water and leaves. At high pH, this fractionation grows to up to 10 ‰.

In the second experiment, at low pH, the fractionation between the growth solution and the leaves is negligible. From pH 8 to 10 the leaves are enriched in ^{11}B compared to the solution by 1.3 to 9 ‰. At high pH, the borate ion is largely predominant in the solution but the observed δ^{11}B values in the leaves at pH 10 correspond to the isotopic composition of undissociated boric acid which is the minor species at this pH. It can be concluded that the tomato plats assimilated mainly undissociated boric acid in the high pH range and borate only to a lesser degree.

These first results on environmental B isotope signatures in plant tissues (not isotopically spiked B) are promising as indicators of the plant's assimilation mode of the principal B species in irrigation water.