A ^{13}C DOC tracer approach to estimate the contribution of semi-labile dissolved organic carbon to stream ecosystem metabolism

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13C Tracer Method

In streams and rivers, dissolved organic carbon (DOC) supplies energy and carbon (C) to heterotrophic bacteria. The complexity of the DOC pool combined with simultaneous processes that continually produce, transform and consume DOC molecules in transport, makes *in situ* measurements of DOC uptake challenging. A tracer approach is a logical solution and we prepared a ^{13}C tracer of semi-labile DOC from soil-aged ^{13}C-labeled *Liriodendron tulipifera* tissues with a chemical composition reflective of the heterogeneity of terrestrially produced C that has been modified by sorptive fractionation onto mineral surfaces and oxidation by soil bacteria.

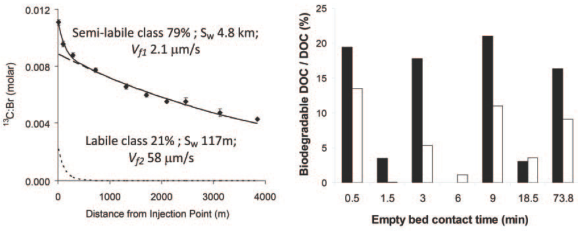

Figure 1: A. Whole-stream addition ^{13}C uptake; B. Lability profiles of stream water DOC (open) and ^{13}C tracer (solid).

Results

We used the tracer in a whole-stream injection coupled with bioreactor-based lability profiling to measure an uptake length of 4.5 km for semi-labile DOC constituents in a headwater piedmont stream and estimate support of ~10% of ecosystem metabolism.

Biogenic Fe(III) minerals lower the efficiency of iron-mineral-based commercial filter systems for arsenic removal

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Millions of people worldwide are affected by As-contaminated groundwater. Since abiogenic and biogenic Fe (III) (oxy)hydroxides sorb/co-precipitate As efficiently [1], filter systems containing Fe (III) minerals are applied to purify As-contaminated water. However, commercial filters containing abiogenic Fe (III) (oxy)hydroxides (granular ferric hydroxide, GFH) showed varying As removal efficiency depending on groundwater geochemistry and it was unclear whether Fe (II)-oxidizing bacteria influenced their efficiency. We found up to 10^7 Fe (II)-oxidizing bacteria/g dry weight in GFH-filters and determined the performance of the filters in the presence and absence of Fe (II)-oxidizing bacteria. GFH-material sorbed 1.7 mmol As (V)/g Fe. This was ~8 times more efficient than biogenic Fe (III) minerals alone that sorbed 208.3 μmol As (V)/g Fe. It was also ~5 times more efficient than a 10:1 mixture of GFH-material and biogenic Fe (III) minerals that bound 322.6 μmol As (V)/g Fe. Co-precipitation of As (V) with biogenic Fe (III) minerals in the absence of GFH-material removed 343.0 μmol As (V)/g Fe. As removal by co-precipitation with biogenic Fe (III) oxides in the presence of GFH-material bound 1.5 mmol As (V)/g Fe. This was slightly less efficient as by GFH-material alone. Since the formation of biogenic Fe (III) minerals lowers rather than increases the As removal efficiency of the filters, we recommend to exclude microorganisms from the filters (e.g. by activated carbon filters) to maintain their high As removal capacity.

[1] Hohmann *et al*. (2010) Anaerobic Fe(II)-oxidizing bacteria show As resistance & co-precipitate As during Fe(III) mineral precipitation. *Environmental Science & Technology*, **44**, 94–101.