Dissolved organic matter dosing to enhance *in situ* micropollutants biodegradation in drinking water aquifers

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Motivation

In the Netherlands, approximately 65% of the drinking water is produced from groundwater [1]. A recent study reported that about 25% of 200 Dutch groundwater abstractions contain pesticides, and in 13% of the cases above the permitted limit (0.1 µg/L for a single pesticide) [2]. Pharmaceuticals and other micropollutants are also often detected in groundwater above this level. Due to the distributed nature of the source (e.g. agricultural land) and the costs associated to the removal after abstraction, an *in situ* technology for micropollutant removal is needed.

Under adequate environmental conditions, biodegradation of micropollutants can occur naturally in the environment [3]. However, in groundwater the rate of natural attenuation is impaired by the low concentration and recalcitrance of dissolved organic matter (DOM) (Fig. 1A). Previous research indicates that amendment with labile DOM can enhance the biodegradation of micropollutants.

Technological challenge

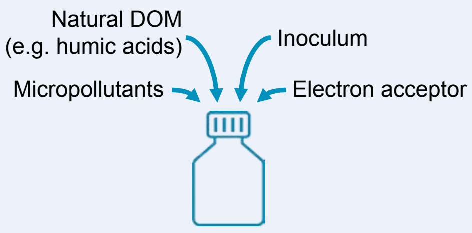
When developing the *in situ* micropollutants bioremediation technology (Fig. 1B) some challenges need to be overcome:

- Low concentrations (µg/L or lower) and heterogeinity of micropollutants
- Groundwater unfavorable environment conditions
  - Low microorganism density
  - Anaerobic environment
  - Oligotrophic conditions
  - Low temperature (≈ 10 °C)
- The in situ treatment cannot negatively affect groundwater safety and aquifer function

Research goals

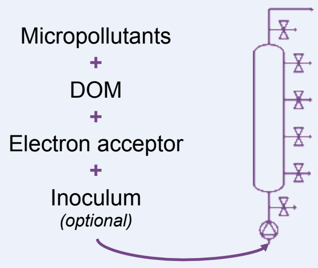
This project aims to develop an in situ bioremediation technology based on DOM amendment to treat micropollutants in groundwater systems. The research approach is divided in 4 phases:

1 Screening



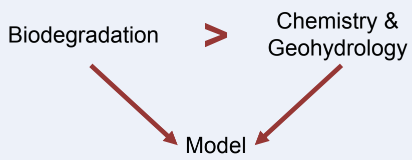
Select most promising combinations of inoculum, DOM source and redox conditions

2 Kinetics & Mechanism



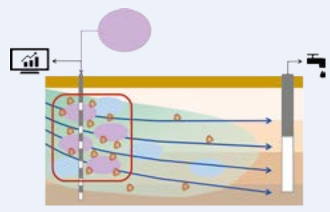
Elucidate process in columns simulating aquifer

3 Reactive transport modelling



Create model to design field experiment

4 Pilot Experiment



First step towards implementing a bioremediation-based strategy

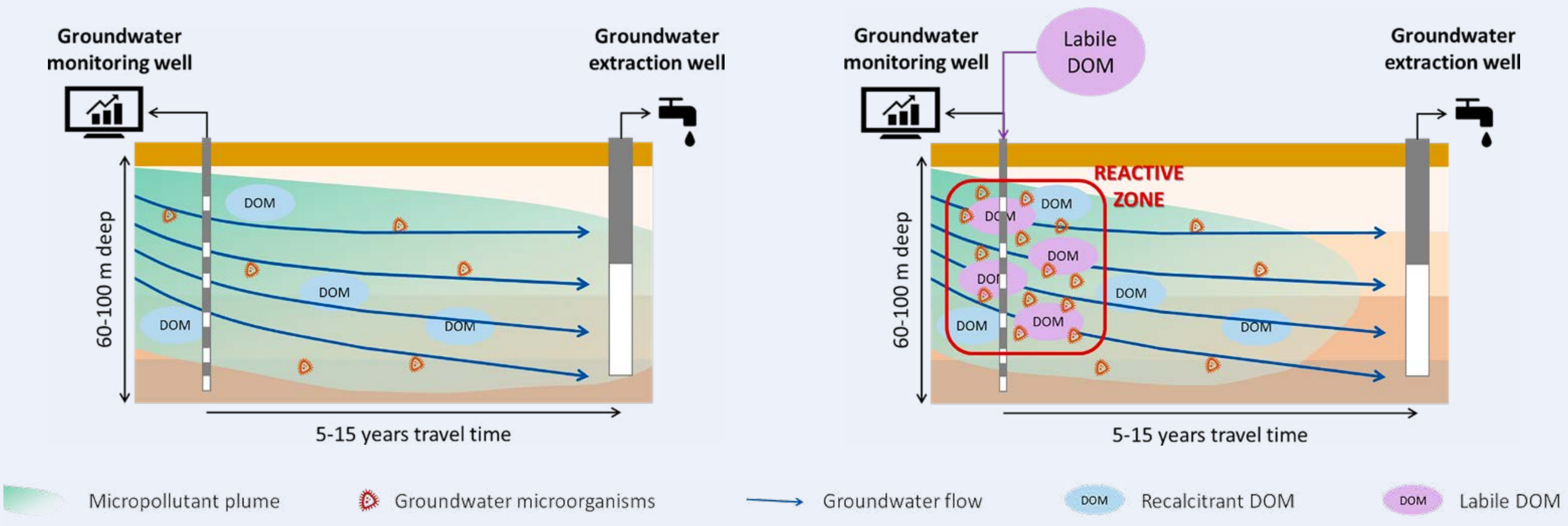


Fig 1. Micropollutant attenuation in groundwater: A – Natural attenuation; B – DOM amended attenuation

[1] Vewin, Dutch Drinking Water Statistics 2017 (2017).
[2] RIVM, Bestrijdingsmiddelen in grondwater bij drinkwaterwinningen (2016).
[3] Helbling, D. E., Curr Opin Biotechnol 33 (2015) 142-148.

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