Impact of land use change on the migration of historical radionuclide and heavy metal contamination in riparian soils of the Grote Nete Valley

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Background

A legacy mixed contaminated Belgian soil that will be flooded to prevent climate change impacts. A case for which **no geochemical model exists yet**.

The SigmaPlan aims to deploy new controlled flooding areas along the Grote Nete Valley (Flanders, Belgium) to avoid downstream impacts of increasing water surges coming from the tributaries of the Scheldt river. Some of the affected soils, classified as NORM, contain heavy metals and radionuclides as a result of former phosphate industries and SCK CEN releases.

There is still no geochemical model able to predict the fate and further mobility of those combined contaminants in the expected, future anaerobic conditions.

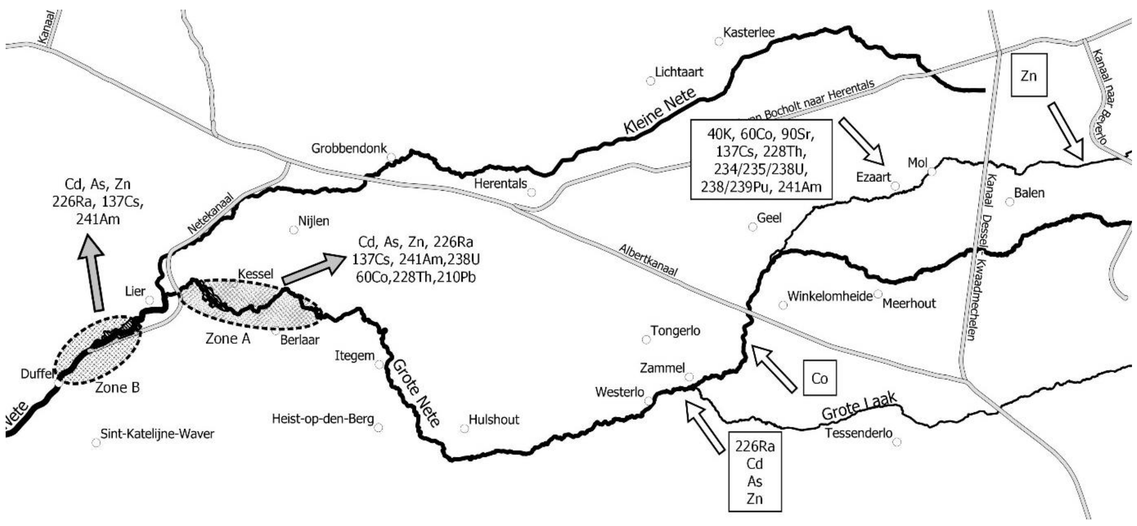


Figure 1. Contamination map along the Grote Nete Valley until the two areas of interest in Lier (Zones A and B, circled).

Objectives

Analyse the dissolved and reversibly sorbed (**labile fractions**) of the elements of concern

Understand the **colloidal behavior** of mixed contaminants and their interactions in ad-hoc and anaerobic conditions

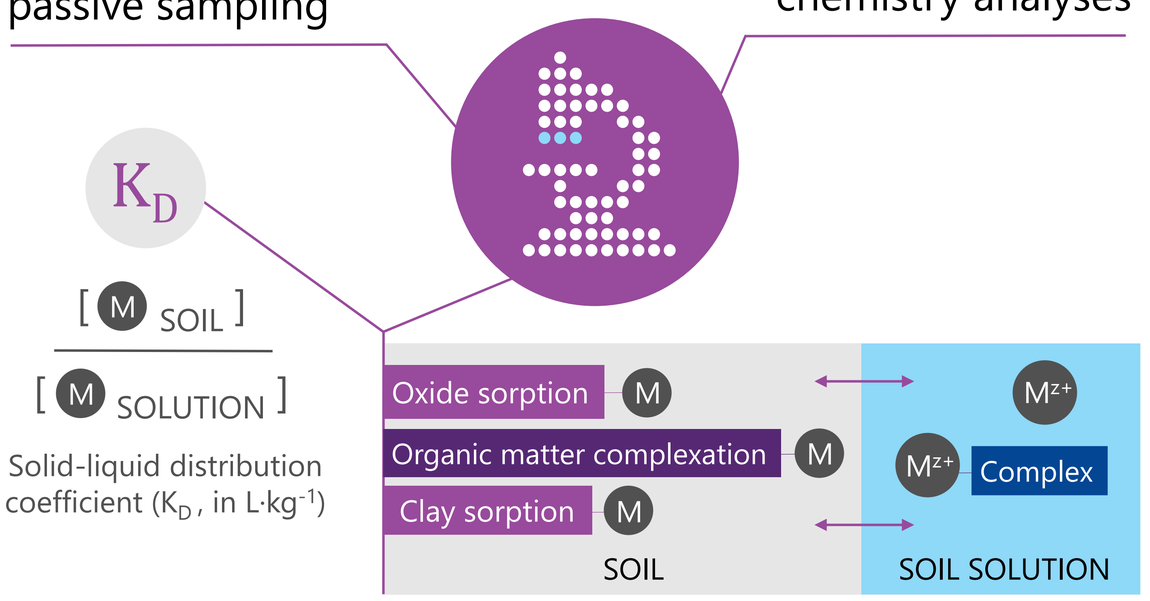
Strategy

1. Baseline

Sampling, physicochemical analyses, soil incubations, passive sampling

2. Waterlogging

Simulation of ex situ floodings: column and batch experiments, wet chemistry analyses



3. Modelling

Conceptual model of geochemistry, numerical model with subcomponents to estimate anaerobic K_Ds

Results

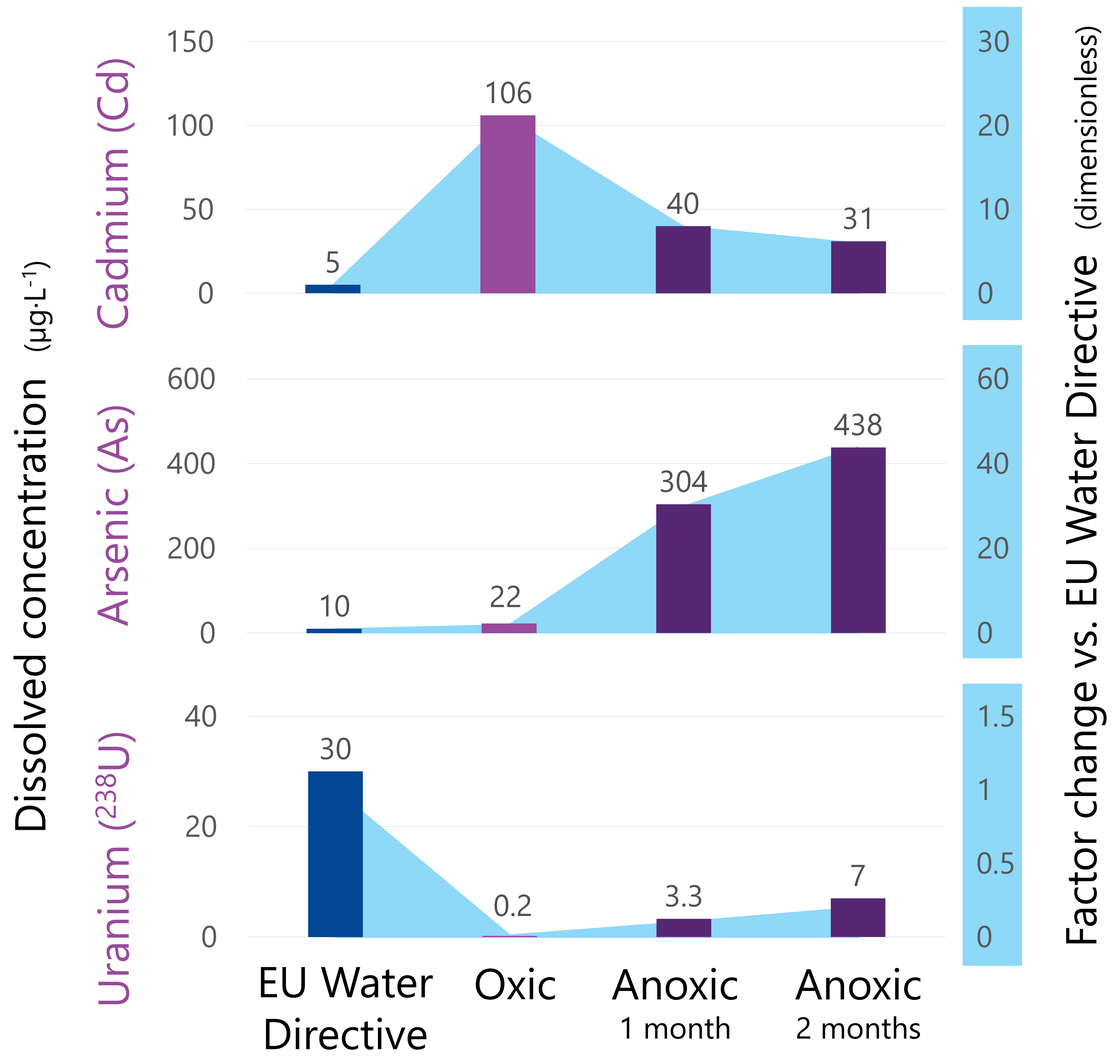


Figure 2. Comparison of soil solution concentrations of a Grote Nete soil sample from Zone A with the legal limits established by the revised EU Water Directive 2020/2184 for drinking waters. Soils were incubated in a 1:2 solid-liquid ratio.

Methods

Incubations

Time-dependent and different solid-liquid ratios to determine the dissolved species

Centrifugation or (ultra)filtration + ICP-MS or gamma spectrometry

Digestions

Total concentration analysis from the solid phase in heavy metals

Aqua regia + ICP-MS

Diffusive gradients in thin films (DGT)

Piston samplers with a selective sorption resin for in situ soil or solution analysis of labile fractions

Testing of commercial vs "homemade" resins + LA-ICP-MS (laser ablation) or gamma spectrometry

Refine and improve the methodology

Challenges

Although projected as a radioecological showcase, the Grote Nete concentrations of **radium (^{226}Ra)** and **americium (^{241}Am)** in solution appear to be very low.

It is resulting very challenging to obtain reliable experimental K_Ds for the radioisotopes of interest.

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