

STABILISATION OF PFAS IN SOIL USING ACTIVATED CARBON AND MODIFIED BENTONITE CLAY

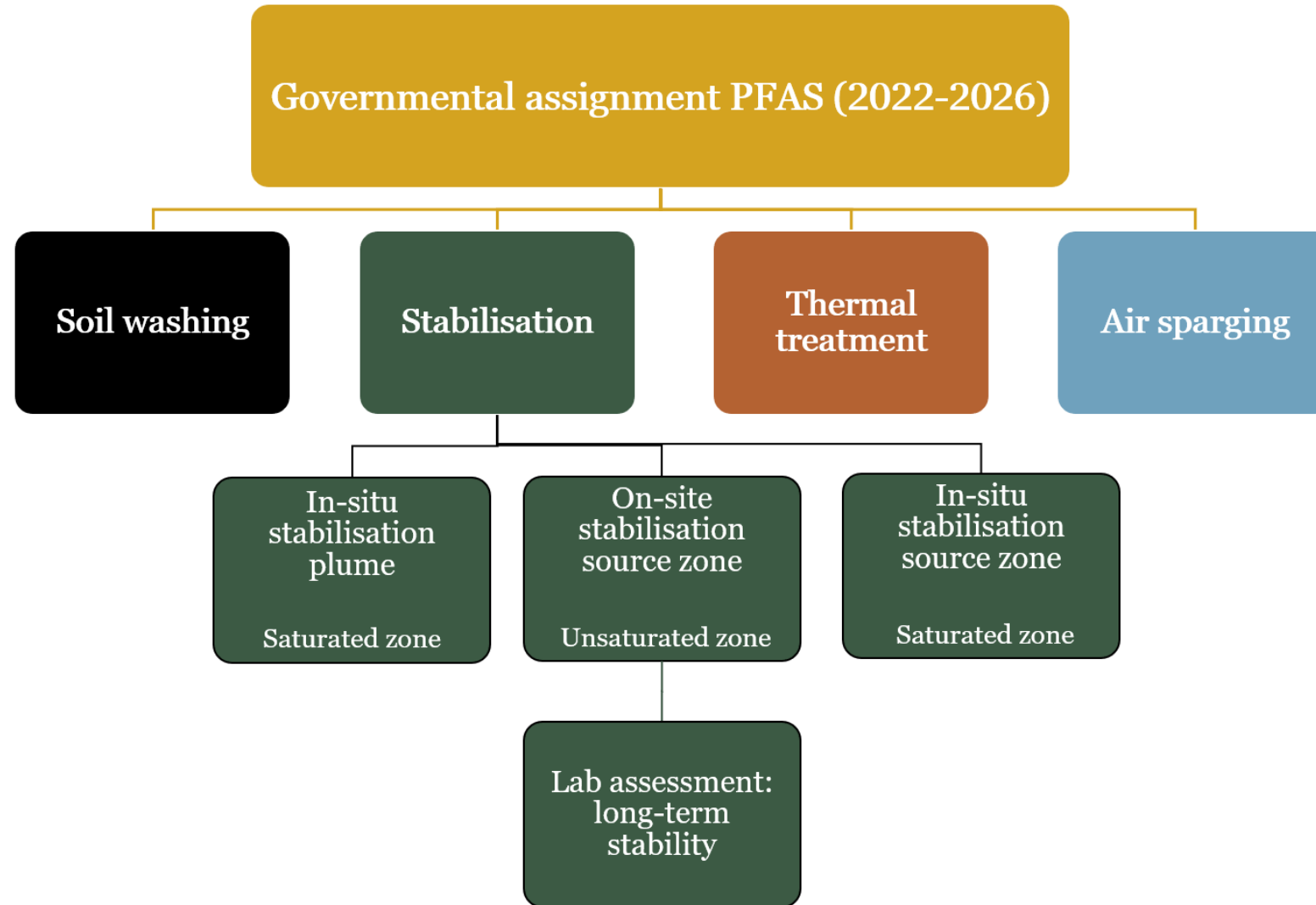
LAB ASSESSMENT OF STABILITY AND EFFECTS OF DISSOLVED ORGANIC MATTER

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PART OF A GOVERNMENTAL ASSIGNMENT



BACKGROUND AND AIM

Pilot-project - During installation



Photo: Michael Pettersson, SGI



Photo: Malin Ellbrant, SGI

Results after two years:

- Two PAC variants: Organosorb och Rembind efficiently sorbed PFAS
- Concentrations reduced by >99.99 % in the porewater

Aim of lab the assessment:

- Evaluate the long-term stability of stabilisation of PFAS-contaminated soil



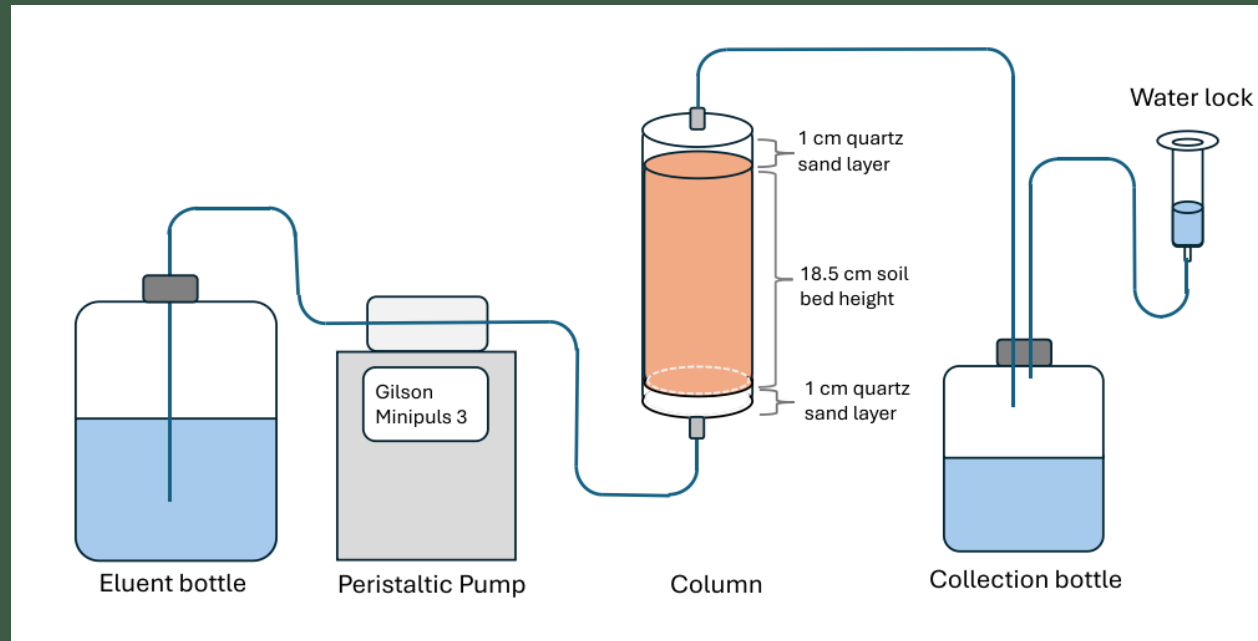
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HYPOTHESES

- Activated carbon is stable over a period of time i.e. it does not undergo mineralisation.
- Natural Organic Matter (NOM) competition for sorption sites may decrease PFAS sorption capacity over time.



Up-flow percolation test

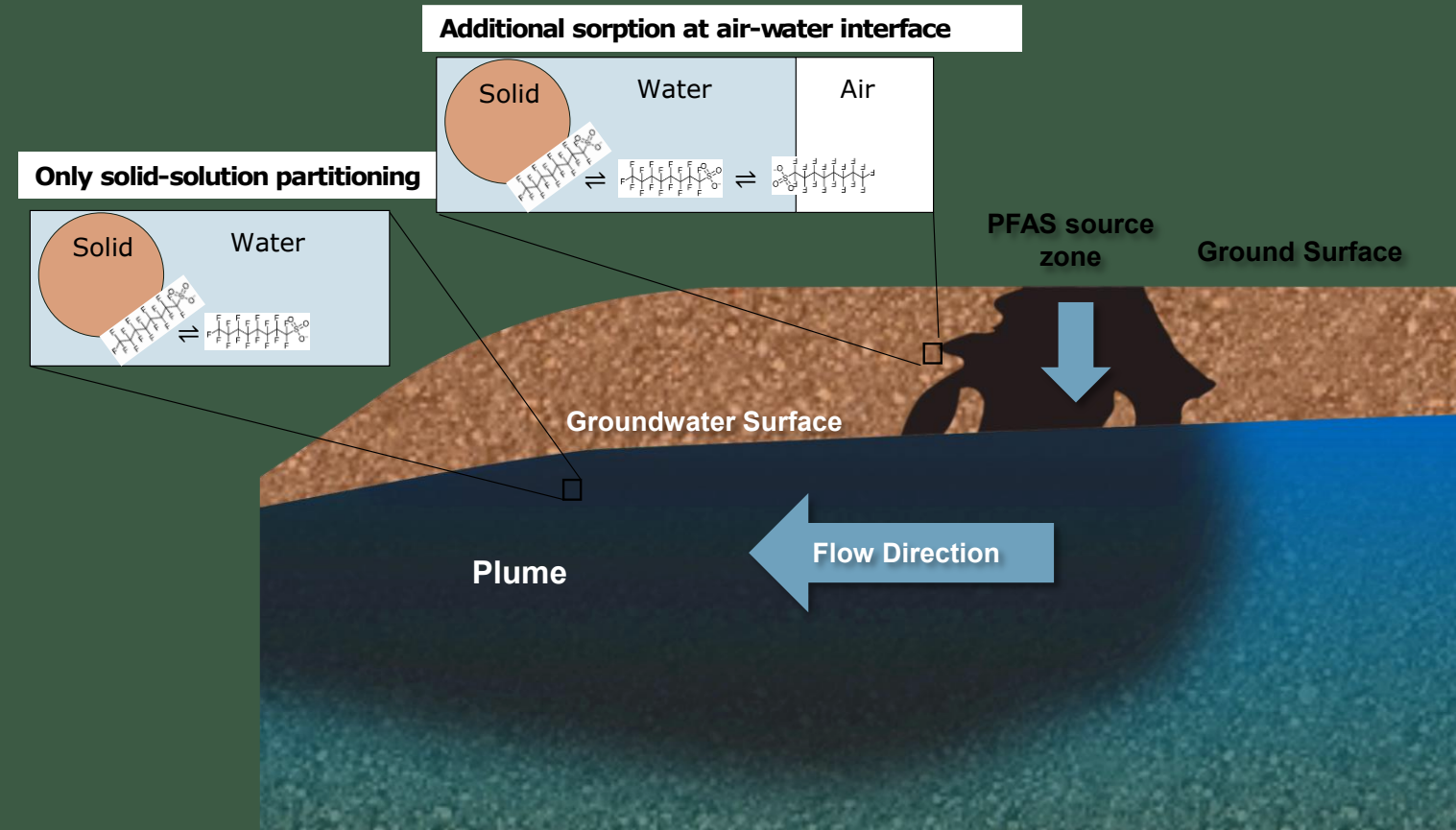


Time:

- Flow rate: 1 pore volume per day
- Duration of experiment: approximately 7 months
- Hydraulic loading corresponding to ~50 to 100 years

Up-flow percolation test

- Saturated conditions
- A longer contact time under natural settings
- “worst case”



EXPERIMENTAL DESIGN

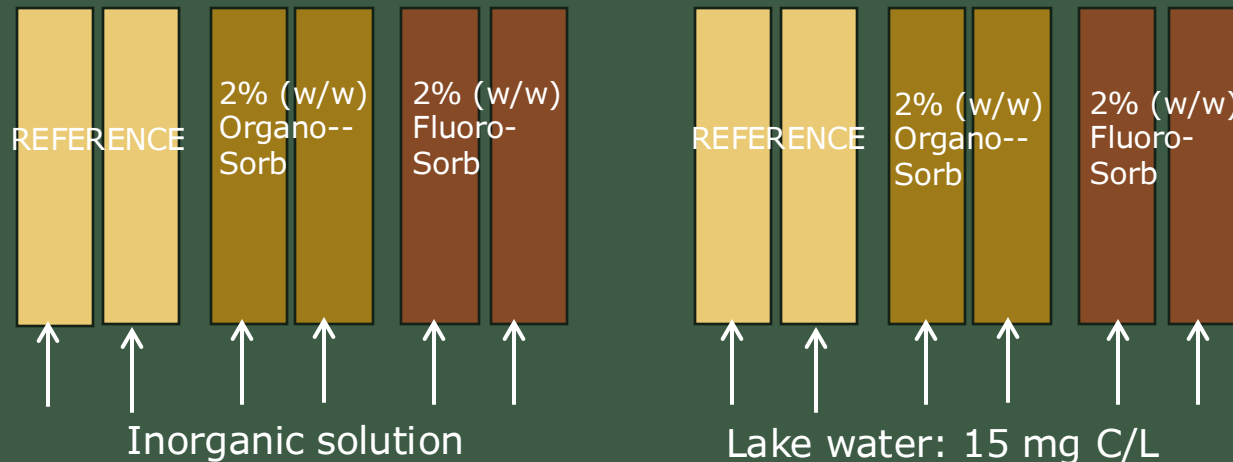
Up-flow percolation test

- Two soils: Sundsvall and Uppsala
- Two sorbents: PAC and Fluoro-Sorb
- Two leaching solutions: inorganic and NOM

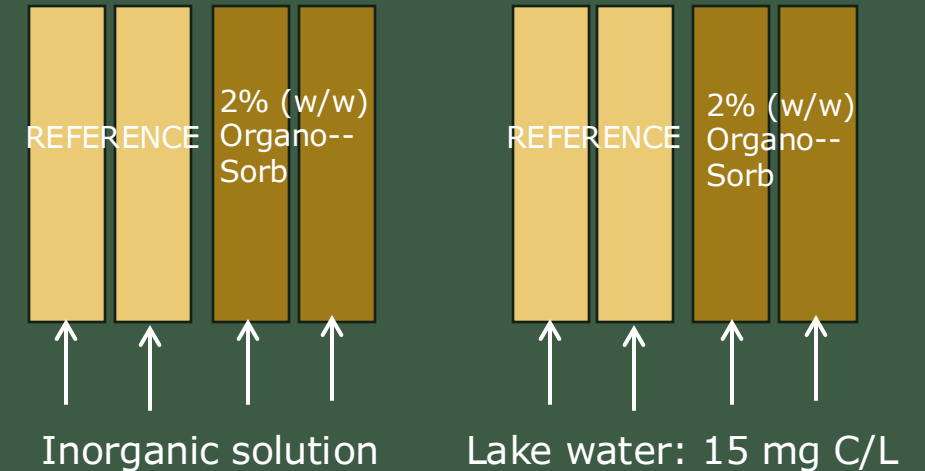
Time:

- Flow rate: 1 pore volume per day
- Approx. 7 months
- Hydraulic loading corresponding to ~50 to 100 years

Sundsvall



Uppsala



TARGET PFAS IN SOIL (n=3)

Sundsvall: sand, TOC <0.2%

Σ_{32} PFAS: 529±64 µg/kg TS
6:2 FTAB: 1 833±212 µg/kg TS

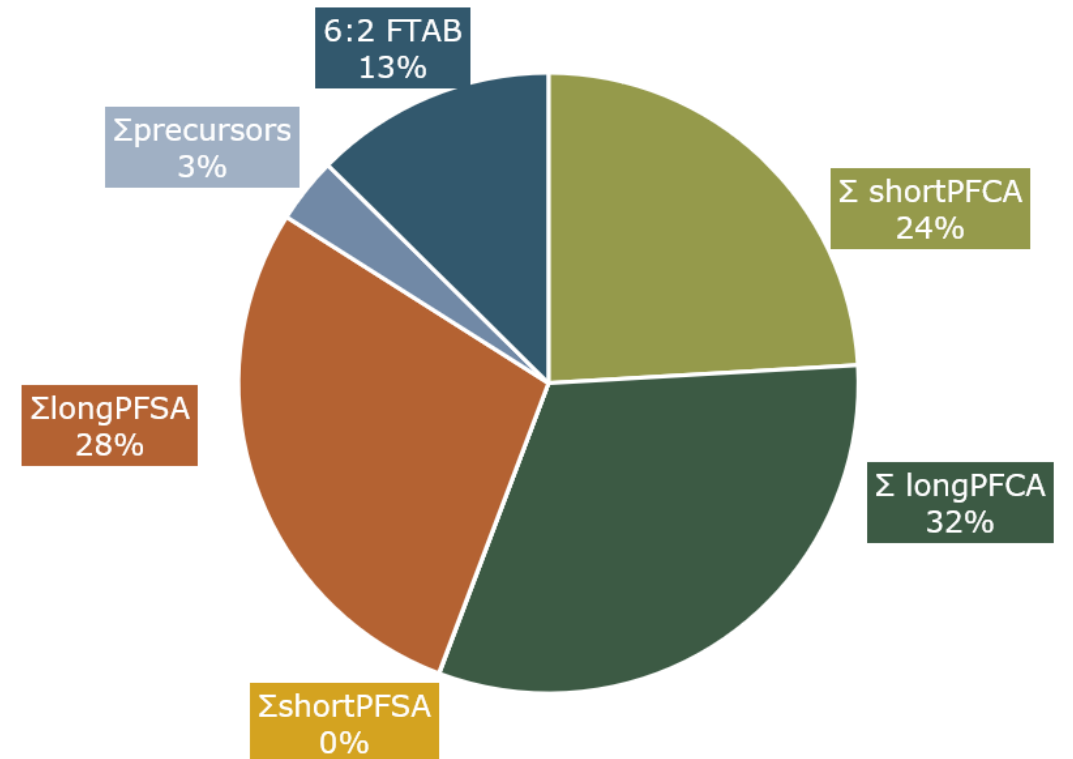
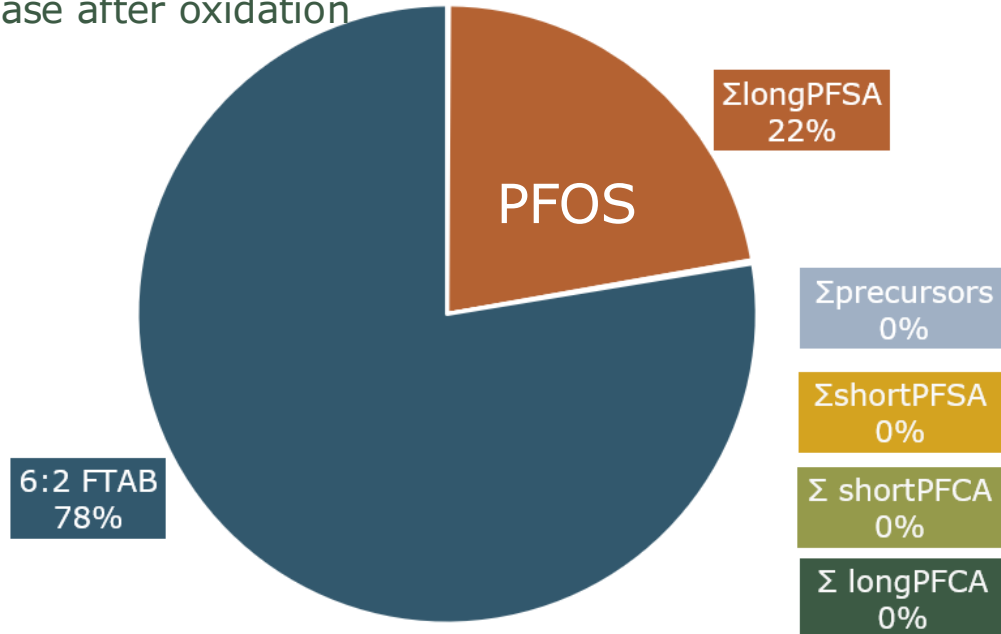
Δ PFCA5 : 112±2 µmol/kg TS

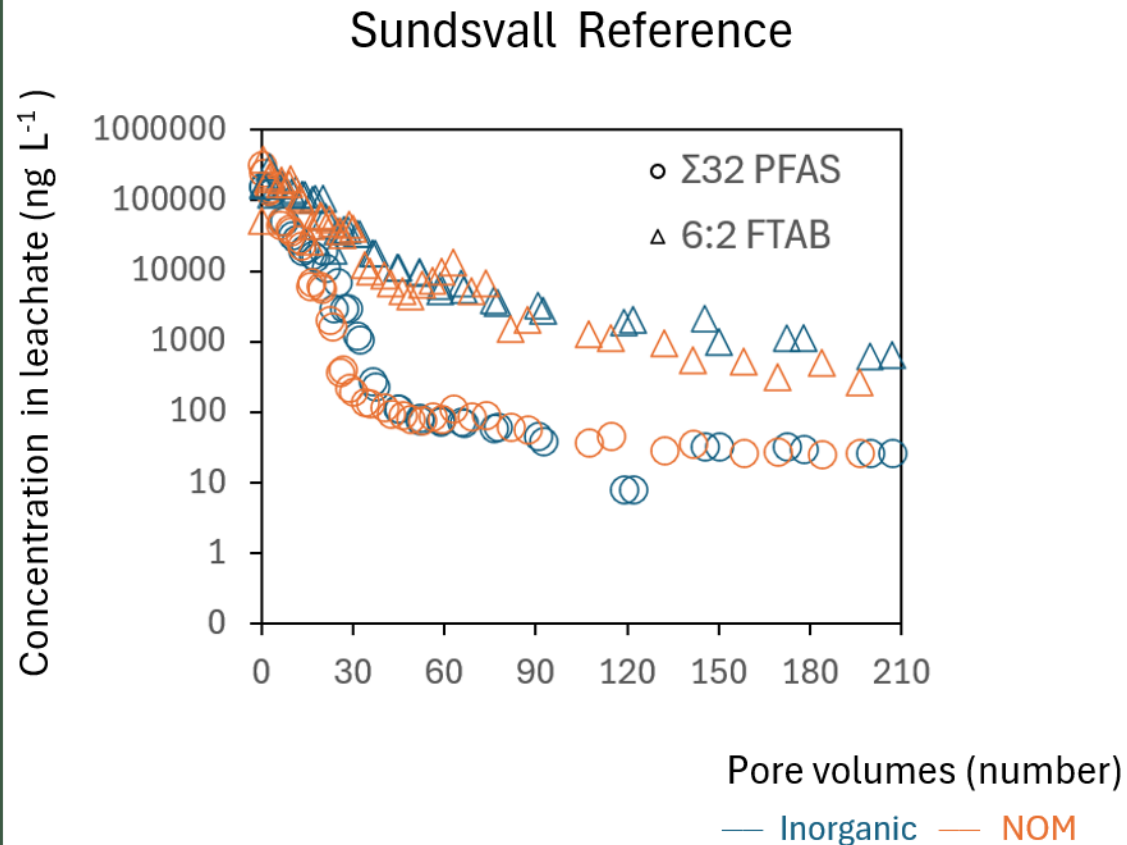
Uppsala: silty sand, TOC 2.5%

Σ_{32} PFAS: 270±3 µg/kg TS
6:2 FTAB: 39±3 µg/kg TS

Δ PFCA5: 320±16 µmol/kg TS

PFCA5: PFBA, PFPeA, PFHxA, PFHpA and PFOA
 Δ : Increase after oxidation





Consistent retention over the duration of the experiment

Potential impact of NOM

Reduction of leached amount >99.99%

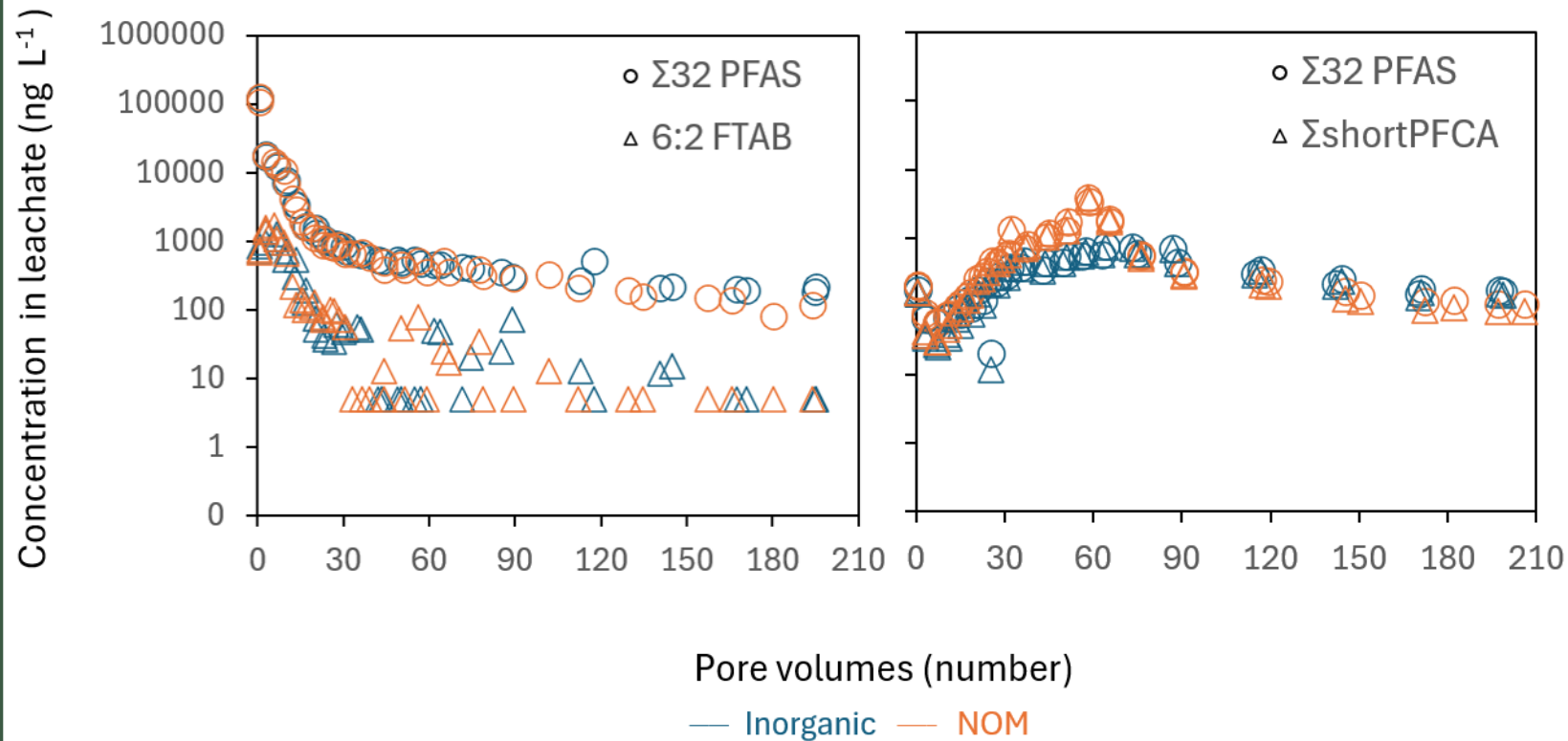
Y-axis logarithmic concentration

1 pore volume = 0.5 years
if groundwater recharge =
170 mm /year



LEACHATE

Uppsala Reference



Slower decrease in
untreated soil

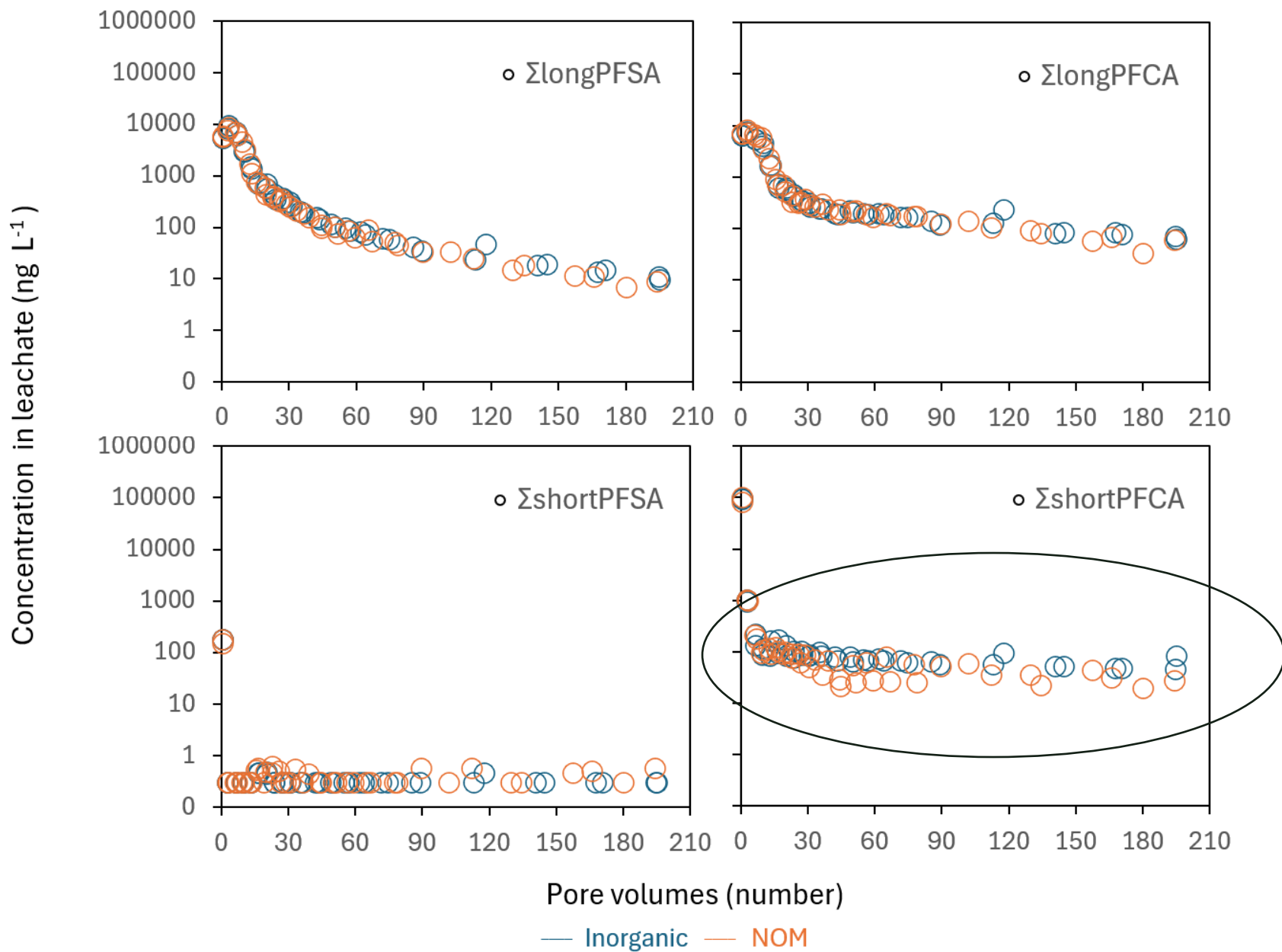
Potential impact of NOM

30-60 pore volumes ?

Reduction of leached
amount >99.99%

Y-axis logarithmic
concentration

1 pore volume = 0.5 years
if groundwater recharge =
170 mm /year



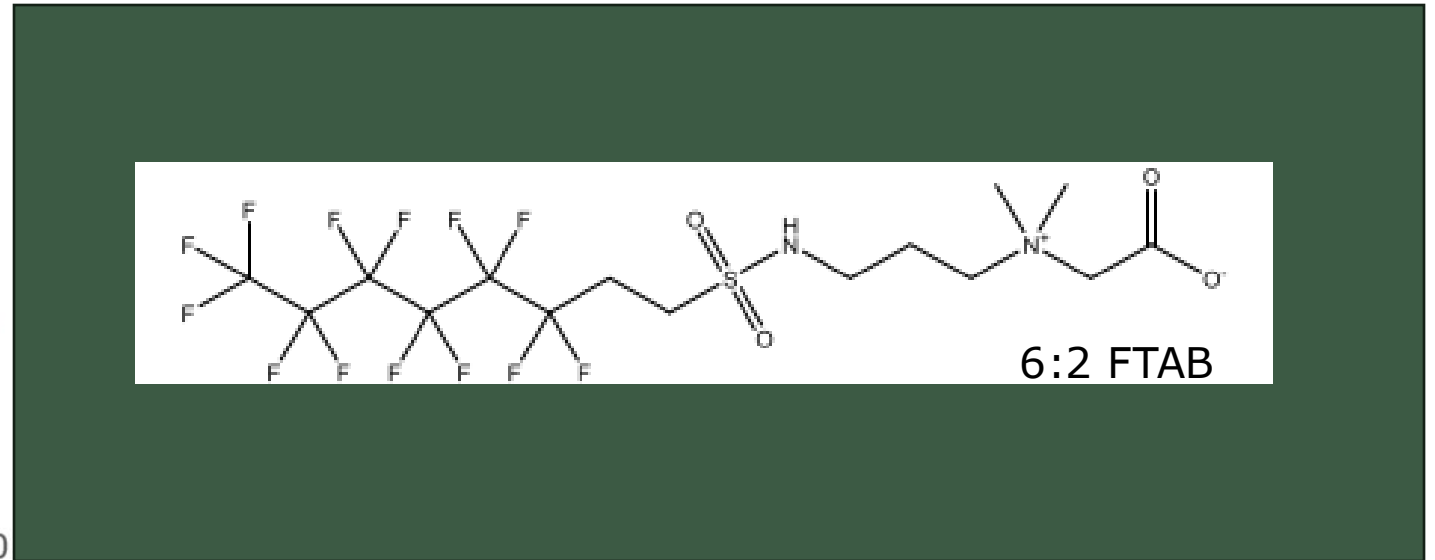
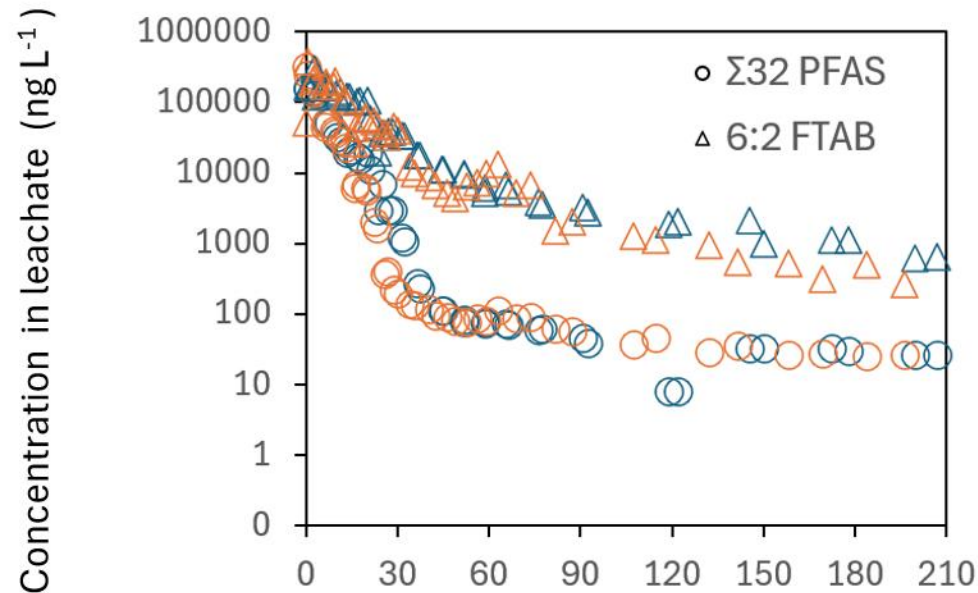
REFERENCE UPPSALA

The presence of short chained PFCA over time indicate that they are formed during the experiment, likely through degradation of precursors



SUNDSVALL FLUORO-SORB

Reference



Pore volumes (number)

— Inorganic — NOM

MAIN CONCLUSIONS

- In situ stabilisation of PFAS with PAC is an efficient remediation method capable of retaining PFAS over periods of time (probably for >50 years), with little impact to effectiveness if NOM is present in the infiltrating soil water.
- PAC treatment is less effective for soils with high concentrations of short-chain PFCA and/or their precursors that may degrade into short-chain PFCA.
- In situ stabilisation of PFAS with Fluoro-Sorb is an efficient sorbent for negatively charged PFAS, even in the presence of NOM.
- Fluoro-Sorb treatment is less effective for soils with high concentrations of zwitterionic precursors such as 6:2 FTAB.



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THANK YOU

FOR YOUR ATTENTION

This project is financed through the Government of Sweden's Grant no. 1:4 for remediation and restoration of contaminated sites.

Access Reports and Scientific Publications from the Government Assignment:

<https://www.sgi.se/vara-expertomraden/fororenade-omraden/fororenad-mark-vatten-och-sediment/pfas---hogfluorerande-amnen/uppdrag-om-forskning-och-okad-kunskap-om-pfas-fororenade-omraden>