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Aluminium and iron concentrations in pore water of an acid sulfate soil – soil response to waterlogging

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The background and the aim of study

In non-calcareous soils oxidation of sulfidic materials results in weathering of minerals and high concentrations of metals in pore water

How does waterlogging affect the Al and Fe concentration of pore water in an boreal acid sulfate soil?

Could waterlogging be used as a tool to decrease Al concentrations in pore/discharge water?

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Hypotheses

Prolonged waterlogging of soil gives rise to reduction reactions

$\Rightarrow$ Rise of pH

$\Rightarrow$ Precipitation of dissolved Al

$\Rightarrow$Decrease of Al concentrations

$\Rightarrow$Increase of Fe concentrations because of the reductive dissolution of ferric oxides










Photos: S. Virtanen

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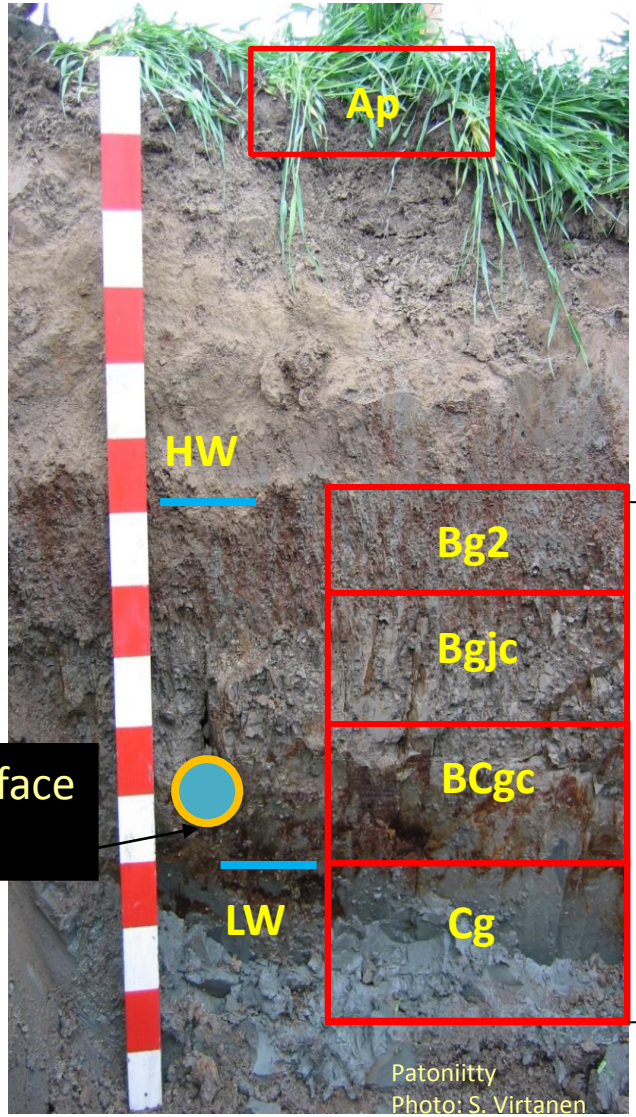
The pedon and the characteristics of soil

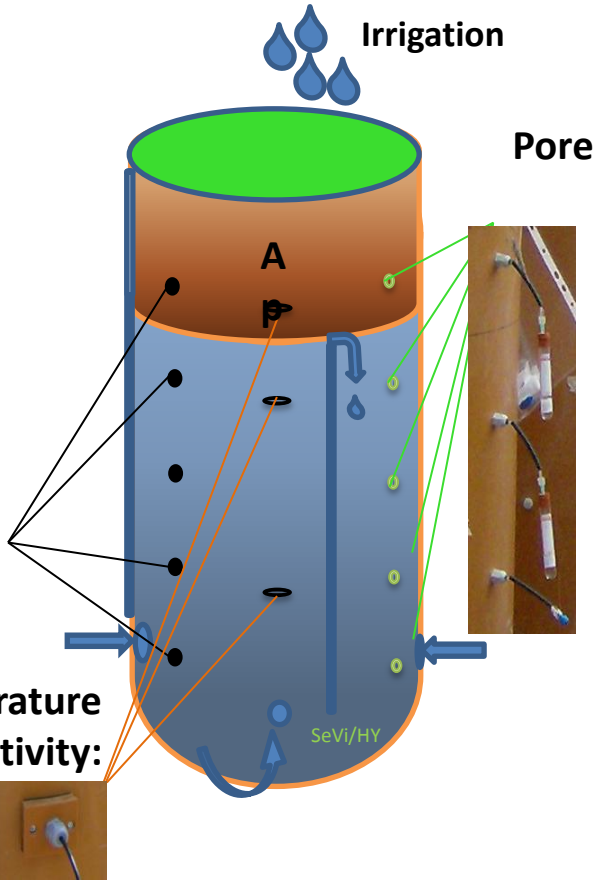


Sulfic Cryaquept

Horizon	Clay %	pH Fresh	BS[1] %	Total S g kg^{-1}
Ap	33	6.4	73	0.91
Bg2	48	4.4	25	0.94
Bgjc	61	3.8	19	4.21
BCgc	57	4.2	27	4.57
Cg	58	6.5	76	14.87

[1] $(Na^+, K^+, Ca^{2+}, Mg^{2+})/CEC*100$

The measurement of parameters and experimental setup



Pore water samples:
Rhizon MOM
pH, Al_{tot}, Fe_{tot}
DOC

Pt-electrodes:
Redox potential measurement(E_h)

Soil moisture, temperature and electrical conductivity:
5TE

LWC = Low Water table, cropped (4)
HWC = High Water table, cropped (4)
HWB = High Water table, bare (2)

Eh, θ ,T and EC were logged continuously.
pH, **Al**, **Fe** and **DOC** in pore water were determined biweekly or monthly.

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Discussion

Waterlogging of soil resulted in
reduction and gradual rise of pH in the B horizons

Waterlogging of soil caused
the decrease of Al and the increase of Fe concentrations

- *Al is pH sensitive element*
- *Fe pH and redox -sensitive element*

Response to waterlogging of soil
was retarded in the bare lysimeters

- *Demonstrated the microbiological catalysis in redox processes*

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Conclusions

Waterlogging of B horizons has a potential to mitigate the hazardous environmental impacts of AS soils by decreasing Al concentrations of pore waters

In the B horizons, increase in pH of pore water is not necessarily reflected in pH of discharge water, because the high Fe^{2+}concentration may induce acidity when oxidized in drains and streams to Fe^{3+}

Waterlogging promotes permanent water saturation of the C horizon and prevents the massive acid loads arising from this risk horizon.

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