**Investigating the persistence of Fe-P in lake sediment under sulfidic conditions**

Harm van Kuppevelt12\*, Michael Hupfer­12, Ugo Marzocchi3

\* harm.van.kuppevelt@igb-berlin.de

1 Leibniz Institute of Freshwater Ecology and Inland Fisheries, Müggelseedamm 301, 12587 Berlin, Germany

2 Brandenburg University of Technology Cottbus-Senftenberg, Platz der Deutschen Einheit 1, 03046 Cottbus, Germany

3 Center for Water Technology (WATEC), Department of Biology, Aarhus University, Ole Worms Allé 3, Building 1171, 8000 Aarhus C, Denmark

# Abstract

# Introduction

# Material and Methods

Study Site and Sample Collection

Sediment samples were collected from lake Langer see (N52.24333 °, E13.78805 °), a shallow eutrophic freshwater lake in Eastern Germany characterized by its low iron content and high primary productivity, providing a high contrast for experimental treatments involving iron. Experiments of Heinrich et al. (2020) demonstrated a transformation to vivianite within months timeframe under anoxic conditions. Surface sediments from the top 5 cm were pooled, ensuring consistency across samples.

Experimental Design The main aim was to assess the fate of vivianite under oxic conditions enriched with sulfide. Sediments were enriched with phosphate-loaded iron hydroxide (Fe-P), following the method described by Heinrich et al. (2020). The control setup included identical sediment samples without Fe-P treatment. Both sets were incubated under anoxic conditions within closed containers filled with overlying lake water, mimicking natural sediment-water interactions.

Incubation Procedures Sediments were incubated anoxically in sediment containers with custom-fitted lids designed to maintain anoxic conditions throughout the experiment. Overlying water was initially enriched with sulfate to promote sulfate reduction, simulating high sulfidic conditions. The experiment was conducted over a period of two weeks, with initial and final sediment samples preserved by freeze-drying for subsequent analysis.

Microsensor and DET Profiling Porewater conditions were continuously monitored using advanced microsensors capable of measuring oxygen, sulfide, and pH levels at high resolution. Parallel to microsensor profiling, Diffusive Equilibrium in Thin films (DET) probes were employed to capture detailed porewater profiles of phosphorus and iron, providing a comprehensive understanding of the geochemical dynamics within the sediment.

Sample Processing and Analysis At the conclusion of the incubation period, sediments were meticulously processed for detailed solid phase analysis. Techniques such as X-ray Diffraction (XRD) were utilized to detect changes in vivianite content post-incubation. Additional analyses included Sequential Extractions and Mössbauer Spectroscopy to characterize the speciation of phosphorus and iron, complemented by microbial community profiling to assess biogeochemical influences on sediment chemistry.

Chemicals and Equipment The experimental setup involved a variety of specialized chemicals and equipment:

Ferrosorp® Plus and NaH2PO4•2H2O for sediment enrichment.

Na2SO4 to enhance sulfate levels in overlying water.

Organic substrates such as acetate and algal biomass were considered to stimulate microbial sulfate reduction.

DET gel preparation involved acrylamide and ammonium persulfate.

Analytical reagents included molybdenum blue for phosphorus detection and Ferrozine for ferrous iron analysis.

Analytical Methods Phosphorus was quantified using the molybdenum blue method post-extraction, while iron analyses were conducted using Ferrozine-based colorimetric techniques. Equipment such as the UWITEC Corer was employed for precise sediment sampling, and a glovebox setup was used for handling samples under controlled atmospheric conditions.

This methodological approach was designed to provide robust data on the interactions between vivianite and sulfide under simulated natural conditions, contributing valuable insights into sediment biogeochemistry and nutrient cycling in freshwater systems.

# Results

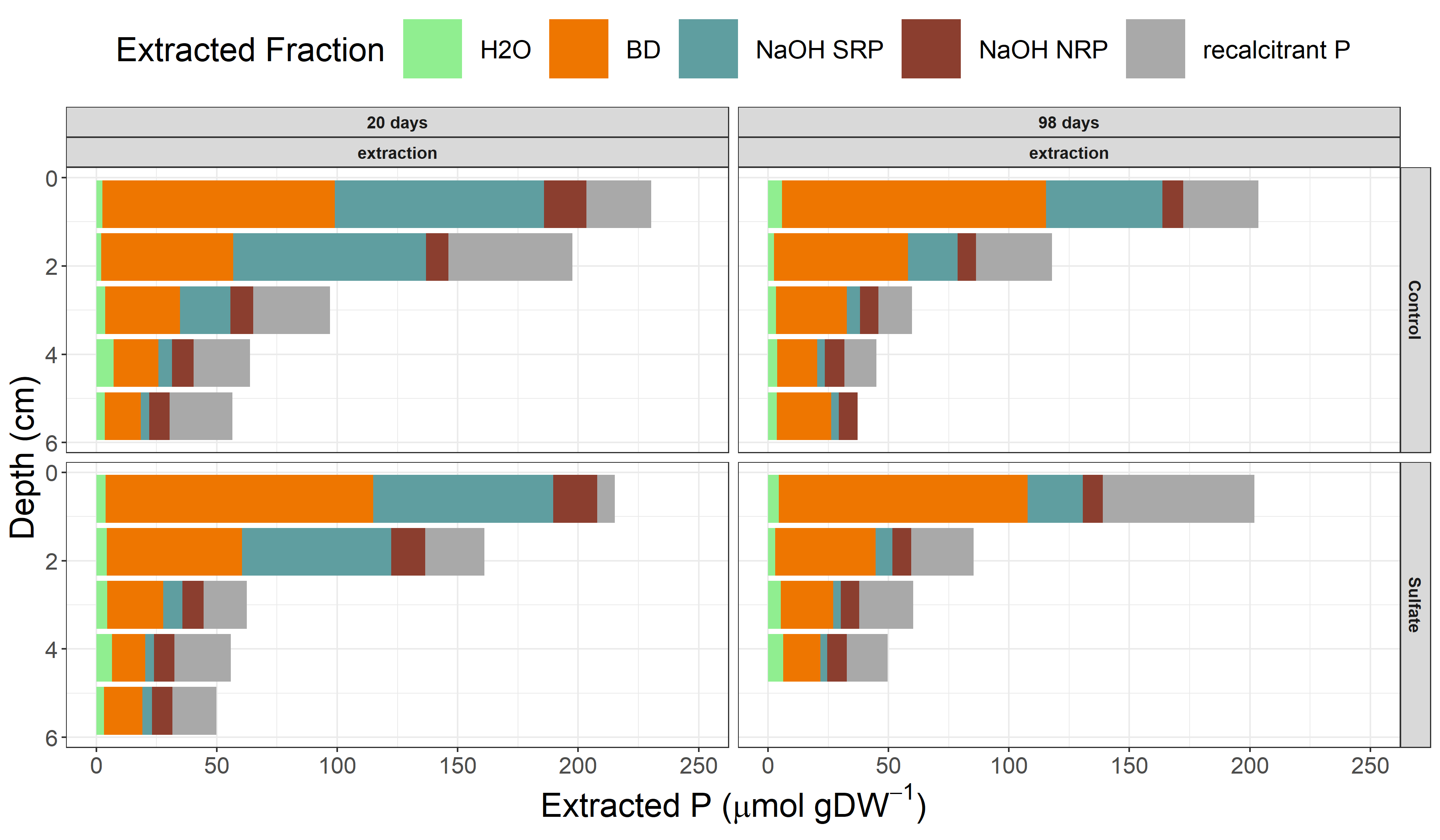
# Discussion

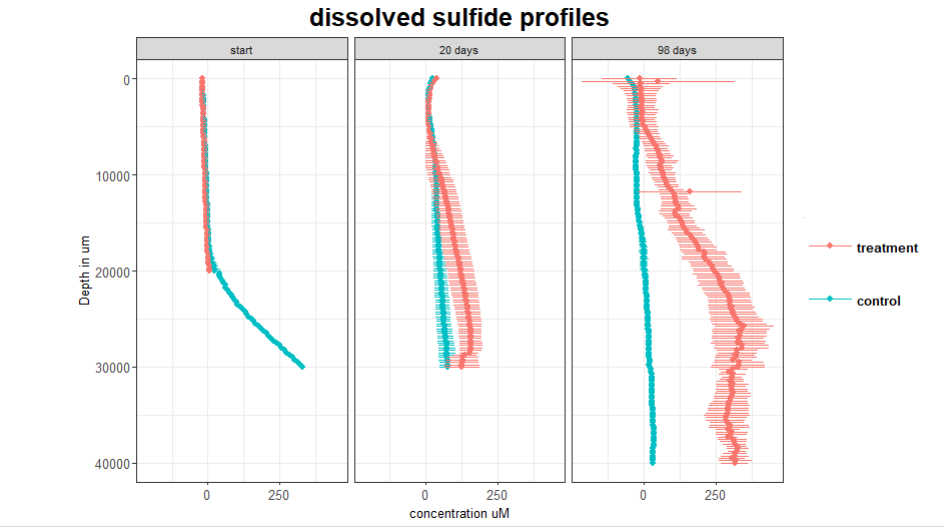
# Conclusion

# Acknowledgements

# References

# Figures





# Tables