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Radial oxygen loss by Vallisneria spiralis affects microbial diversity and activity and pore water chemistry in organic sediments

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INTRODUCTION & AIM

Vallisneria spiralis is a submerged macrophyte performing radial oxygen loss (ROL) from roots stimulating aerobic metabolisms of microbial communities in the rhizosphere (Marzocchi et al., 2019).

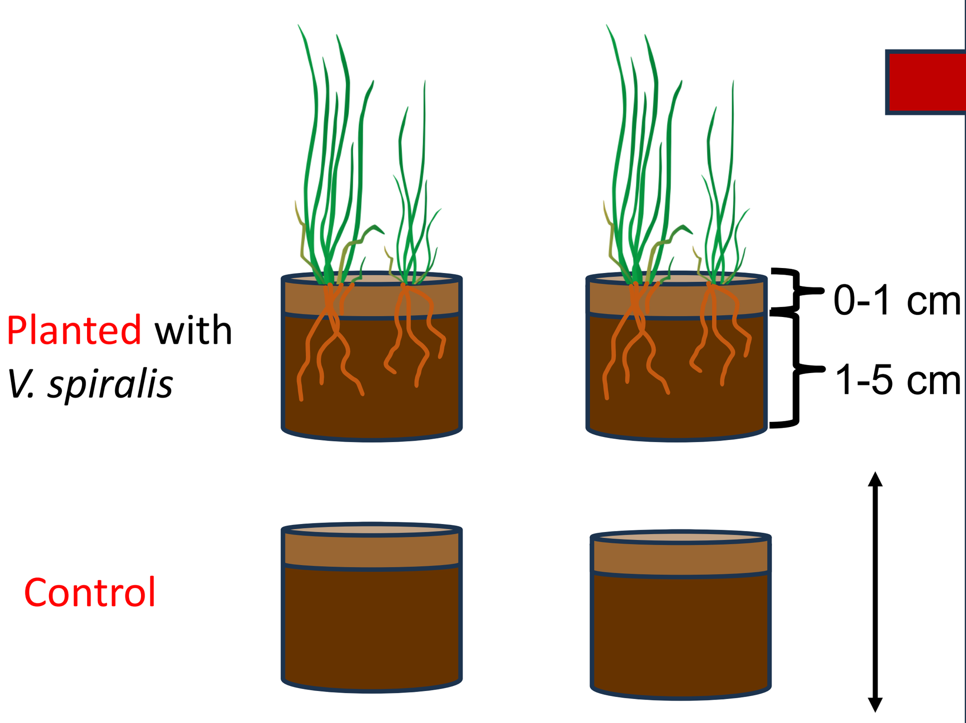
The oxic conditions originating in the rhizosphere allow root respiration, influence oxygen and redox-sensitive biogeochemical pathways, and maintain active coupled oxidative and reductive processes, avoiding the accumulation of metabolic end-products in the pore waters (Risgaard-Petersen and Jensen, 1997; Vila-Costa et al., 2016).

As eutrophication often results in organic enrichment in sediments and large internal nutrients recycling, an interesting research question is to investigate whether *V. spiralis* maintain the capacity to stimulate aerobic or anaerobic microbial communities and processes also under elevated organic pollution.

METHOD

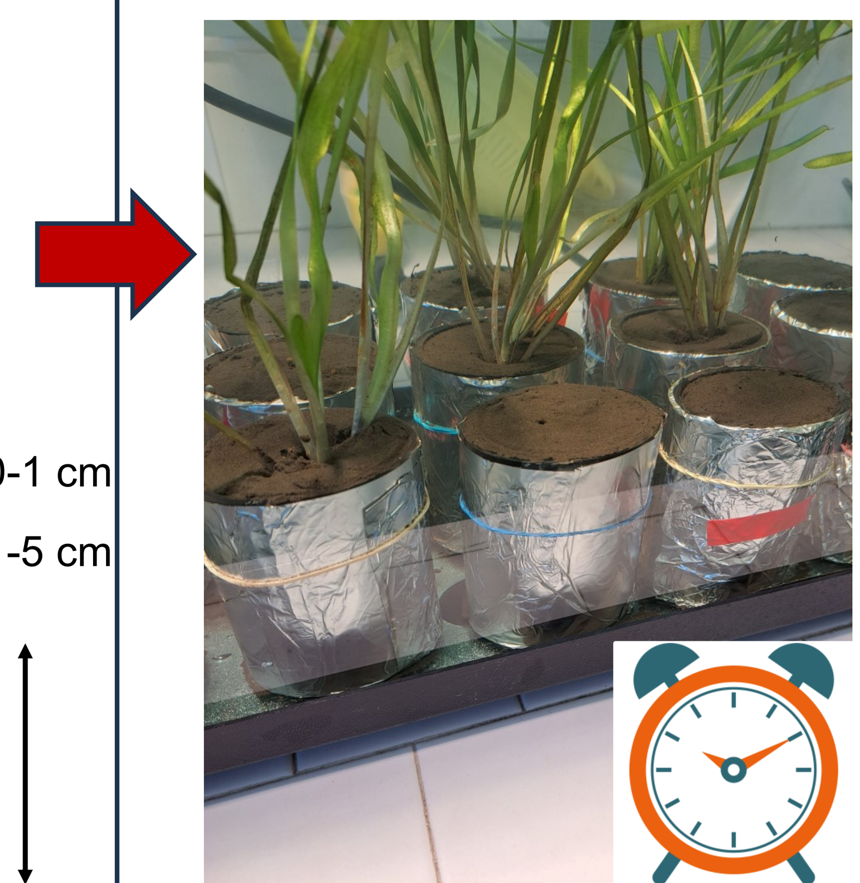
2 sites with different amount of organic matter (OM)

OM → 8% 20%



2 layers separately investigated

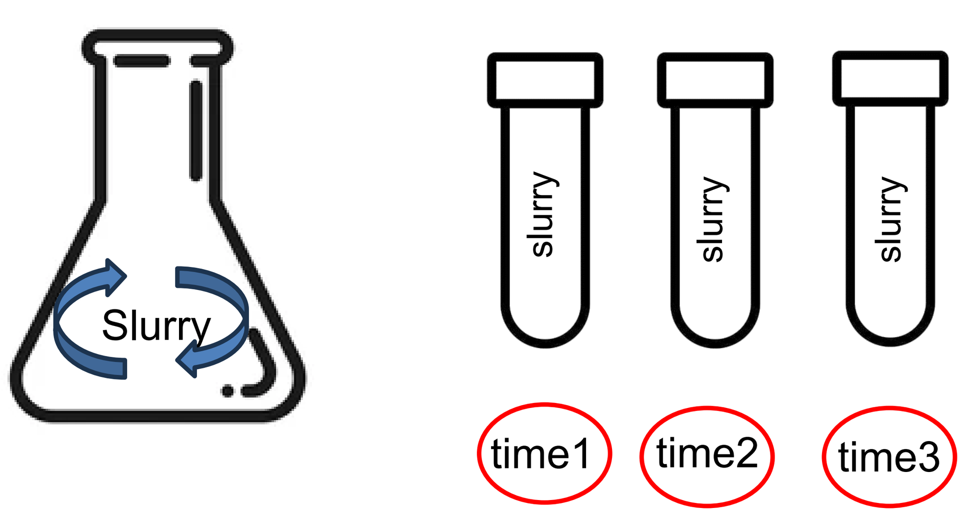
Incubation for 30 days



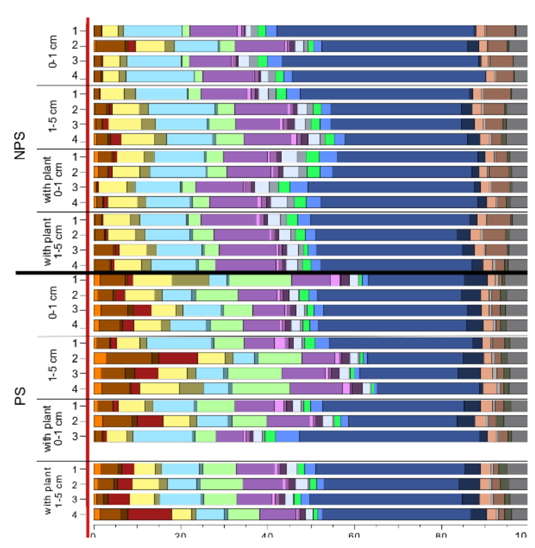
For all the treatments combination (Layer, Site, Plant):

Measurements of potential rates of Nitrogen metabolic pathways

Nitrification — Denitrification & DNRA



16S rDNA sequencing



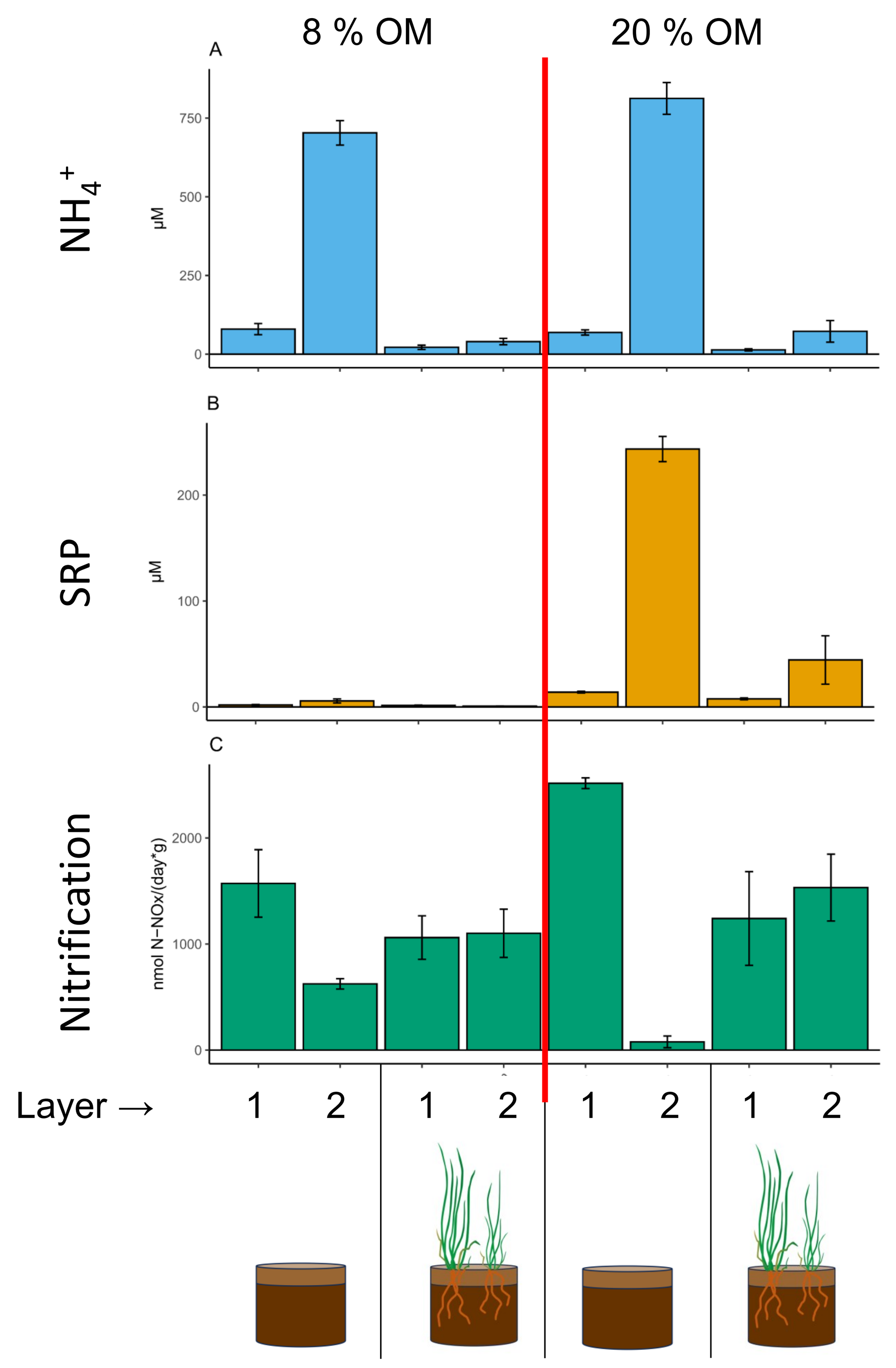
Pore water nutrients content: SRP, NH_4^+

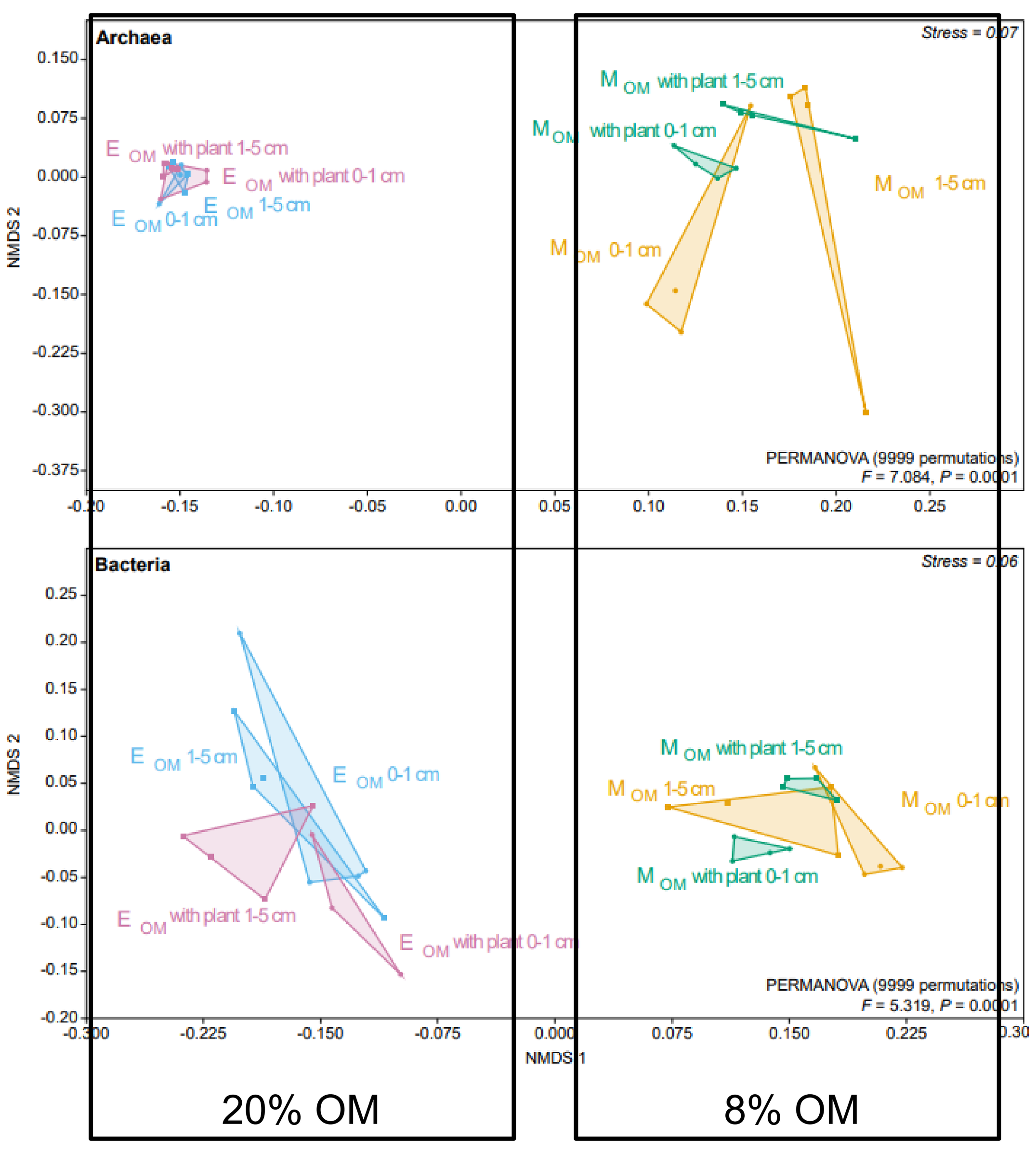
RESULTS & DISCUSSION

Roots uptake and redox microbial metabolic pathways induced by ROL drastically decreased pore water nutrient concentrations in vegetated sediments and consequently decreased diffusive fluxes from the sediments to the water.

Nitrification in bare sediments was limited to the narrow surficial layer (0-1 cm), *V. spiralis* increased areal rates and the depth where nitrification happen thanks to ROL.

Denitrification resulted constrained by nitrate availability that is increased by ROL.





Microbial communities resulted significantly different between sites (OM content)

HOWEVER

The functional groups in both sites and OM content were able to increase nitrification and subsequently denitrification thanks to the effects induced by *V. spiralis* roots.

CONCLUSION

V. spiralis can represent a nature-based solution for organic-rich sediments and its transplant can decrease internal N and P recycling, increase P retention in insoluble forms and N loss via nitrification and denitrification.

FUTURE WORK / REFERENCES

References:

Marzocchi et al., 2019; https://doi.org/10.1111/fwb.13240

Vila-Costa et al., 2016; https://doi.org/10.1002/lno.10209

Risgaard-Petersen et al., 1997; https://doi.org/10.4319/lo.1997.42.3.0529

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