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Eco-engineering Marker Wadden: measuring and modeling feedbacks between plants and clay-rich material

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Research in perspective

In the Netherlands, a soft clay-rich lake-bed sediment in the Markermeer (an artificial lake of 691 km^2) is causing serious turbidity problems: primary productivity is impeded and biodiversity in the lake is declining. To improve the ecological conditions in the lake, the Dutch Society for Nature Conservation (Natuurmonumenten) and Boskalis (a dredging company) designed a plan to dredge some of the soft clay-rich sediment and use it to construct approximately 10,000 ha of wetland: the Marker Wadden.

This PhD research is part of a Building with Nature project (2 PhD's, 1 Post-doc).The acquired scientific knowledge will be used to assess which ecosystem services will evolve and how such systems should be managed. The results of this project may both guide the design of the project and serve as an international, scientific example of building with mud to create new land.

Turbid water of lake Markermeer (right) compared to clear water of lake IJsselmeer (left).

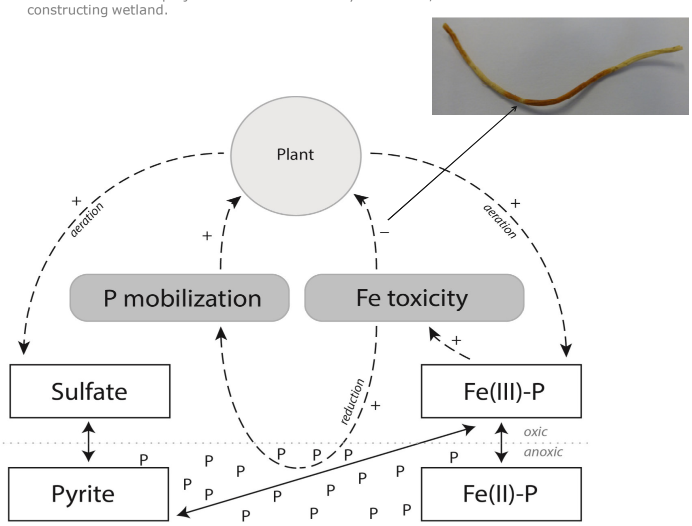
The Marker Wadden project will decrease turbidity in the lake, while at the same time constructing wetland.

Aim

Identifying biogeochemical plant–soil feedback processes that occur when oxidation, drying and modification by plants alter the biogeochemical conditions in sediment from lake Markermeer, thus in turn affecting vegetation development.

Method

A greenhouse experiment was conducted where reed (*Phragmites australis*) was used as an eco-engineer. For 24 weeks, porewater-, soil- and plant quality was measured and used to model biogeochemical processes in the PHREEQC program.



Most important biogeochemical processes and feedbacks identified in this study. + indicates positive feedback, - indicates negative feedback (Saaltink et al., submitted).

Results & Conclusions

- Concentrations of SO_4^{2-} rose rapidly as a result of pyrite oxidation at the top-soil.
- Oxygenation at the bottom part of the pot occurred in planted conditions after several weeks due to radial oxygen loss by plant roots.
- Fe-P appeared to be the dominant P pool in all three soils.
- Ten weeks after transplantation, leafs shrivelled green or turned yellow.
- Radial oxygen loss caused Fe-P to precipitate on roots, inducing indirect iron toxicity.

Recommendation

We recommend the use of Fe tolerant species as eco-engineers, since iron toxicity was identified as a bottleneck preventing rapid ecosystem development on Markermeer sediment

Project partners:

Boskalis Van Oord Royal HaskoningDHV Deltares Enabling Delta Life TNO Natuurmonumenten

Courtesy photos by Natuurmonumenten, Boskalis and Rémon Saaltink