Chronic Impacts of REE in a Bentho-Pelagic Food Web

First Results on REE Toxicity Towards Algae

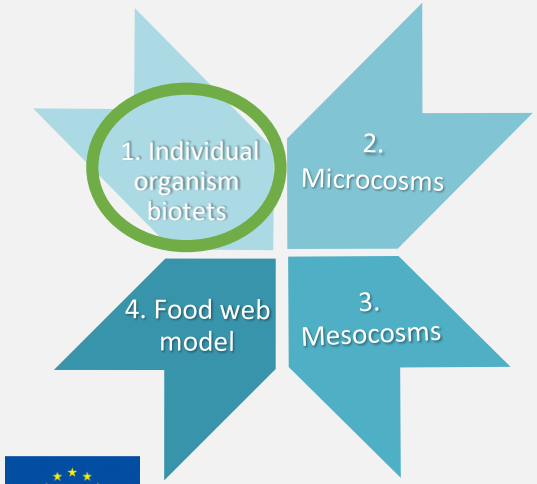
Chantal K. E. van Drimmelen[1,2*], Marion Revel[1,2], Andrew Hursthouse[2], Susanne Heise[1]

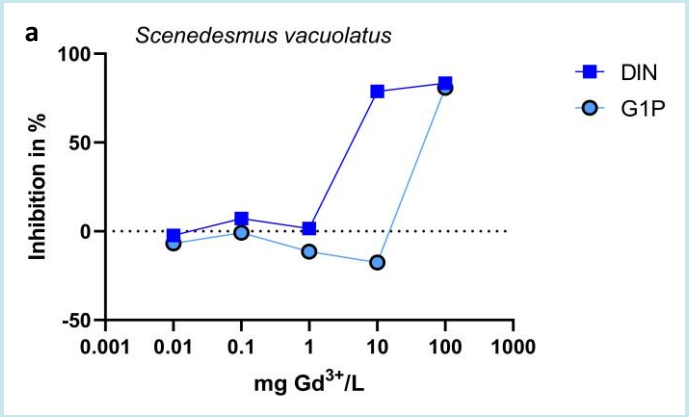
[1]Life Sciences, Hamburg University of Applied Sciences, Ulmenliet 20, D-21033 Hamburg, Germany [2]University of the West of Scotland, Paisley, PA1 2BE, UK

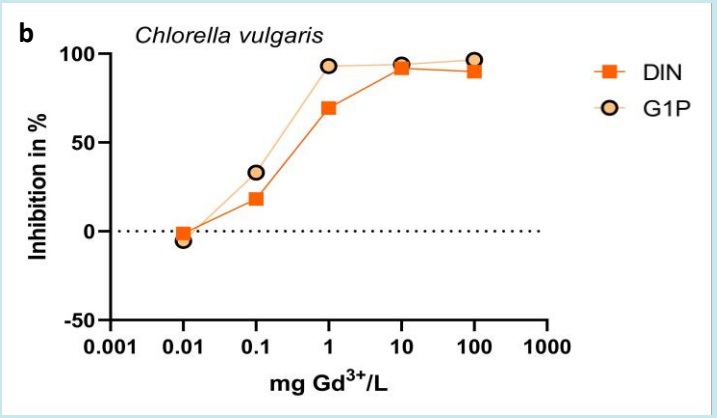
Background: Rare Earth Elements (REE) possess unique properties, which make them crucial to a wide range of modern technologies. REE have now been labelled 'emergent' pollutants. It is already apparent that they can cause disruption of biogeochemical cycles, notably in aquatic environmental compartments especially in sediments. REEs adsorb strongly to fine sediment particles and particulate organic matter, potentially exposing benthic organisms. Pelagic species may equally be affected due to coupling between the benthic habitat and the overlying water body.

Aim of the project: To identify the impact of REE on biological species in the bentho-pelagic food web (Sediment infauna, epifauna and, pelagic species such as daphnia and algae).

Presented here: First results of REE toxicity towards algae as part of the bentho-pelagic food web.







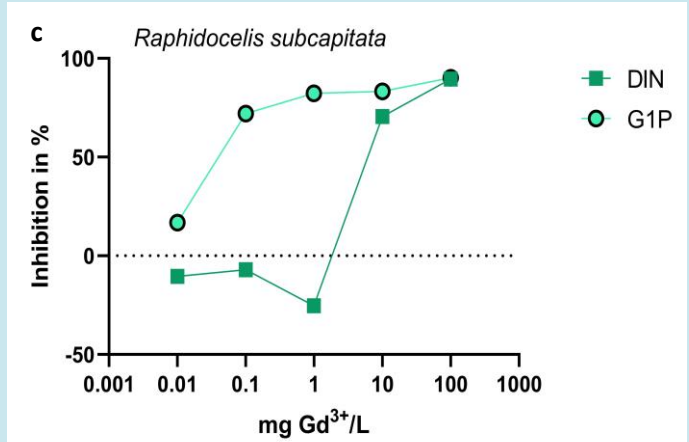


Fig.1 Algae growth inhibition test in percentage inhibition of fluorescence at 72h for **a.** *S. vacuolatus* **b.** *R. subcapitata* and **c.** *C. vulgaris* exposed to nominal concentrations of gadolinium in DIN medium with formation of PO_4-REE-complexes and Glucose 1-phosphate modified DIN medium without formation of PO_4-REE-complexes

Table 1. EC50 values of the algae growth inhibition test at 72h for *S. vacuolatus*, *R. subcapitata* and, *C. vulgaris* exposed to nominal concentrations of gadolinium in DIN medium with formation of PO_4-REE-complexes and Glucose 1-phosphate modified DIN medium without formation of PO4-REE-complexes

Microalgae species	EC_{50} DIN	EC_{50} G1P
S. vacuolatus	**3.848** (1.96-7.50)	**Not determinable** (4.26-???)
R. subicapitata	**5.93** (2.87-12.33)	**0.01** (<0.01-0.03)
C. vulgaris	**0.31** (0.26-0.37)	**0.12** (0.09-0.16)

Method:

Formation of REE-PO_4- complexes may camouflage toxicity of REE in the algae growth inhibtion test (AGI).

→ Comparison of effects in DIN-Medium compared to medium in which Gd-PO_4-complex formation is prevented (addition of Glucose 1-phosphate, "G1P", instead of inorganic phosphate).

→ Comparison of sensitivity of different algae species of which *S. vacuolatus* stores PO_4 internally.

Results:

- Sensitivities of algae to Gd vary strongly
- Little influence of PO_4-source replacement on toxicity to C. Vulgaris
- Prevention of REE-PO_4 formation increases toxicity to R. Subcapiatata (stardard test organisms in AGI testing) by 2 orders of magnitude
- Strong increase of Gd toxicity at >10 mg/L (nominal).

Conclusions:

- **Standardized toxcity tests may under- rather than overestimate Gd toxicity to algae.**
- **Toxicity tests need to consider complexation**
- **Tests with natural phosphate sources and concentrations will follow as part of the planned microcosm experiments.**

ITN PANORAMA – This project has received funding from European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie Grant Agreement N°857989.

* Email: chantal.vandrimmelen@haw-hamburg.de