REE Contaminated Sediment Causes Avoidance Behaviour of *D. magna* and *C. elegans*

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Introduction: Rare Earth Elements (REE) are currently discussed as emerging contaminants, because their increasing use in green technologies leads to elevated environmental concentrations while up to now, little is known about their ecotoxicity. While conventional ecotoxicity tests are currently ongoing, establishing acute and chronic effects, in this paper, we focus on the possibility of an indirect effect of REE with potentially high environmental relevance: Active avoidance. If organisms actively avoid REE-contaminated sediments, changes in their behaviour may have effects on their energy metabolism and survival rate, e.g. by rendering them more susceptible to predators. The objective of our study was to determine if sediment contaminated with lanthanum (La) and gadolinium (Gd), leads to avoidance behaviour by pelagic and benthic species. We hypothesize that, while both pelagic and benthic organisms will try to avoid contaminated sediment, benthic species will be more likely to show avoidance behaviour because we assume that the major exposure route is via sediment-contact.

Methods: We used one pelagic species, *Daphnia magna*, and one benthic species, the nematode *Caenorhabditis elegans*, to measure REE contaminated sediment avoidance behaviour. Dried sediment was spiked with La and Gd at nominal concentrations of 10, 50, 75, and 100 mg kg^{-1}. M4 media was used to moisturize the sediment, making it mouldable. The set up for *D. magna* was as such: An area of sediment (Ø 35 mm) was confined to the centre of a petri dish (Ø 88 mm), and carefully covered with 30 mL of media. Each petri dish contained five adult daphnia. Daphnia had to be found outside or on the edge sediment to be counted as avoidance behaviour. *C. elegans* avoidance was measured by filling up a cut-out circle (Ø 25 mm) on an agar petri dish with contaminated sediment and adding a suspension of nematodes (± 93). Avoidance was determined with binoculars by counting the number of nematodes in the agar. Measurements were done at 0h, 1h, 2h, and 3h for daphnia and additional measurements up to 6h for the nematodes after exposure. All tests where repeated at least 5 times.

Results: For both species, exposure time was not a significant factor. *D. magna* showed an immediate avoidance behaviour that was significantly different between the control and REE at nominal concentrations of 100 and 75 mg kg^{-1}. Although both element set-ups, La and Gd, where not found to be significant at the lower concentrations, a clear trend is visible as numbers are below the control (Fig. 1). For *C. elegans*, the (preliminary) results indicated no avoidance behaviour observed within 6 hours of exposure, with the current set-up.

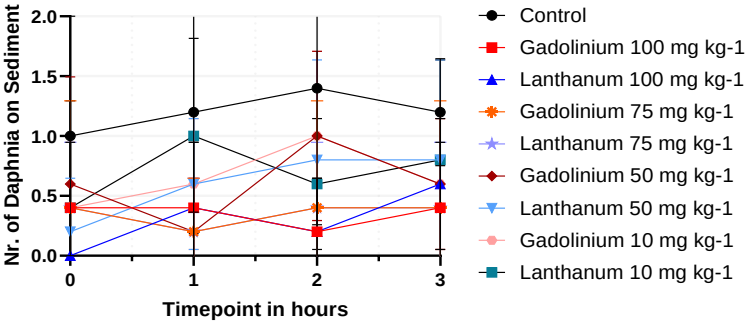

Fig. 1: *Number of D. magna on contaminated sediment at different concentrations of La and Gd.*

Discussion: The results from studies of *D. magna* indicate that avoidance is related to REE concentration. Previous work has shown that REE can cause mortality for both *D. magna* and *C. elegans* [1]. Avoidance has been found to be a more sensitive endpoint than mortality [2], and these experiments indicate perceived stress of the organisms resulting in behavioural changes. Planned studies looking into the interaction of 5 species, exposed to contaminated sediments in microcosms, will now not only look at endpoints such as immobility, but also on avoidance behaviour. The results of more detailed studies for all species will be presented.

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References: [1] Herrmann et al. (2016) *Ecotoxicol. Environ. Saf.* **124**: 213-238. [2] Lopes et al. (2004) *Environ. Toxicol. Chem.* **23** (7): 1702-1708.