**Impact of cadmium on abundance and structure of bacterial communities cultivated in sediment suspension cultures.**

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### Introduction

The widespread use of cadmium (batteries, paints, semiconductors, mining-industry etc.) leads to a considerable release of cadmium to the environment. The impact of cadmium on single aquatic microorganisms has been investigated for over 20 years ([1], [2]), whereas the effect on density and structure of (marine) bacterial communities has scarcely been studied. Due to the differing capacity of bacteria to resist heavy metals [1], [3], [4], the effect of cadmium on species within a bacterial community varies considerably. Changes in density and composition of the marine bacterial community can be expected.

### Methods

Bacterial communities were cultivated in artificial seawater in 2-litre-fermenters. The fermenters were inoculated with an autochthonous community, taken from the mud flats at the German North Sea coast (Jade Bay, Lower Saxony). Samples have been taken daily during the 10 days of incubation and were analysed as follows: (i) cell-concentration (enumeration of DAPI-stained cells (DAPI: 4’,6-Diamidino-2-phenylindol-hydrochlorid)) (ii) phylogenetic diversity (fluorescence-in-situ-hybridization - FISH) (iii) viable cell count (most probable number – MPN). Cadmiumacetate was applied in concentrations of 0.0 mM, 0.005 mM, 0.05 mM 0.5 mM and 5.00 mM.

### Results

**Fig. 1:** a) Concentration (determined by DAPI cell count) and b) viable cell count (determined by MPN) of the marine bacterial community at different concentrations of cadmiumacetate.

- The cell-concentration of the marine bacterial community was slightly affected by cadmiumacetate (Fig. 1a): The density of DAPI-stained cells/ml varied about one magnitude due to the impact of cadmium.
- The viability of the bacteria in the community was considerably affected by cadmiumacetate (Fig. 1b): At a Cd$^{2+}$-concentration of 5.00 mM cells/ml varied about one magnitude due to the impact of cadmium.
- Changes in density and composition of the marine bacterial community can be expected.

**Fig. 2:** Abundance of eubacteria and archaea during cultivation time at different cadmium concentrations: The abundance of representatives of both kingdoms is indicated by the colour.

### Conclusions

- At increasing concentrations, Cd$^{2+}$ slightly affected the total cell number (DAPI), but considerably reduced the concentration of viable cells.
- Cadmium had an effect on the abundance of EUB (determined by FISH): at increasing concentrations their abundance was lower. Abundance of Archaea seemed to be less affected by cadmium.
- Considering the EUB in detail, cadmium changed significantly the composition of the EUB. At higher Cd$^{2+}$-concentrations, they disappeared earlier in time and didn’t reach as high densities as when cultivated without Cd$^{2+}$-addition (Fig. 2a).
- Archaea reached a lower concentration compared to EUB. It was only slightly affected by time. Their maximum abundance at high Cd$^{2+}$-concentrations could be detected after one day of incubation.
- Some EUB-phyla ($\alpha$, $\beta$, $\gamma$ and $\delta$-proteobacteria, GC-rich Gram-positives, Cytophaga/Flavobacteria) were analysed by FISH (Fig. 3).

- Considerable changes in the composition of the EUB could be seen:
  - $\gamma$-proteobacteria dominated at low Cd$^{2+}$-concentrations, whereas at high Cd$^{2+}$-concentrations first of all the $\alpha$-proteobacteria survived.
  - GC-rich Gram-positives (GPHGC), $\gamma$- and $\alpha$-proteobacteria dominated at Cd$^{2+}$-concentrations between 0.1 and 0.01 mM Cd$^{2+}$.
  - $\beta$-proteobacteria dominated at Cd$^{2+}$-concentrations up to 0.1 mM.
  - $\beta$- and $\delta$-proteobacteria tended to extinct at higher Cd$^{2+}$-concentrations.

### Literature