Contribution of the plant rhizosphere system to the phytoremediation of metals in estuarine areas

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INTRODUCTION

- Estuarine and coastal sediments are the final deposit of several contaminants originated by anthropogenic activity
- Salt marshes have an important ecological role and their great sensitivity makes them very difficult to clean
- Recovering impacted coastal environments is a nowadays priority
- Remediation methodologies using plants (**phytoremediation**) can be a valid option due to their capability to respond to different contaminants



Studies in the field (in Portuguese estuaries: Sado, Douro, Cavado, Lima) with *Juncus maritimus, Scirpus maritimus, Halimiones portulacoide, Triglochin striata* and *Phragmites australis* has indicated that:

- these plants are usefull for metals **phytoremediation**, namely of Cd and Cu




In the field (Almeida et al. 2004, 2011) *Juncus maritimus* and *Phragmites australis* accumulated Cd:

$[Cd]_{belowground\ tissues}$ /$[Cd]_{sediment}$ > 1

⇓

important to study and test strategies to enhance that potential

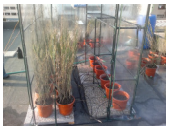
AIM

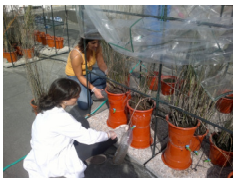
to evaluate the contribution of rhizosphere microorganisms to potentiate these plants ability to phytoremediate Cd

EXPERIMENTAL

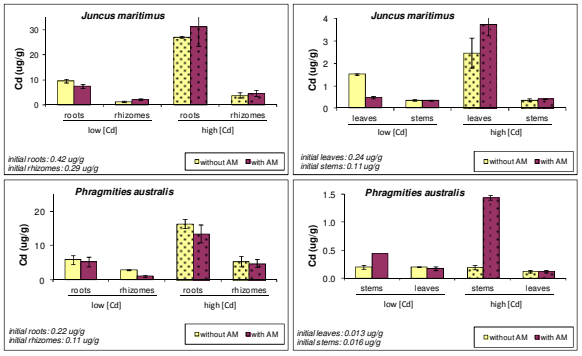
- Experiments carried out in microcosms ⇒ plants maintained in greenhouses
- *Juncus maritimus* and *Phragmites australis* sampled together with the sediment involving their roots and placed in vessels
- Similar vessels were prepared with non-vegetated sediments
- A nutritive saline solution was added to all vessels through an automated irrigation system programmed to mimic the sea tides
- After 2 weeks of acclimation, half of the vessels were spiked with a saline Cd solution (1 L of 20 mg L^{-1} of Cd, as $CdCl_2$, high [Cd])
- Solution was in contact with the system sediment/root plant for about 6h, being the solution drained
- Afterwards a solution containing Cd (2 mg L^{-1} of Cd, as $CdCl_2$, low [Cd]) and an enriched consortium of autochthonous microorganisms (AM) resistant to Cd (prepared in the laboratory) was added to all vessels. In half of the vessels AM was sterilized
- Vessels were maintained in the greenhouses for 2 months, being dismantle afterwards
- *Cadmium determinations were carried out in sediments and in plants' roots, rhizomes, steams and leafs*







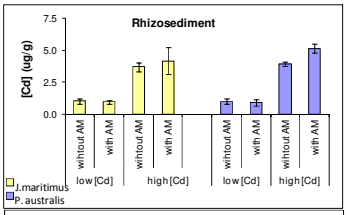
RESULTS

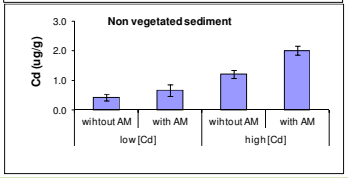


For both *J. maritimus* and *P. australis* Cd concentration *increased with time* in the belowground structures, with *clear metal translocation*

Accumulation was significantly higher in belowground structures, not correlated with Cd amount in the medium

Inoculation with AM significantly increase Cd translocation in *P. australis* (higher Cd amount in stems)





Rhizosediment* had significantly *more Cd* than non vegetated sediment So, *plants* contributed for the *retention of the metal

Inoculation with AM significantly increase Cd retention in* P. australis *rhizosediment and in non vegetated sediment

CONCLUSIONS

✓Obtained results corroborate phytoremediation potential of these plants for metals, namely for Cd phyto-stabilization

✓Plants respond to a new contamination of the medium with Cd retaining metal around their roots and accumulating the metal, particularly in their belowground structures

✓***Inoculation with AM potentiated*** **Phragmites australis *capacity***

- ✓***to retain Cd around its roots***
- ✓***to translocate more metal to aboveground structures***

✓**Rhizospheric microorganisms increased *Phragmites australis* potential for phyto-stabilization and for phyto-extraction of Cd**

References:

Almeida et al, 2004, Environ. Science Technol., 38: 3112-3118

Almeida et al, 2011, Estuarine Coastal and Shelf Science, 91, 243-249

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