HEAVY METALS IN SOILS FROM A COASTAL SALT MARSH (*MARINA DEL CARMOLÍ*) OF SE SPAIN

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1.- INTRODUCTION

In the last century the mining activities in La Union - Sierra de Cartagena Mountains (SE Spain) have lead to a very important environmental impacts. The main minerals extracted were S2Fe, PbS and ZnS. For decades, ephemeral water courses (*ramblas*) have transport heavy metals originating environmental hazards. Some of these *ramblas* flow into the Mar Menor lagoon (6 meters maximum depth) that is one of the largest (135 km2) coastal lagoons on the Mediterranean Sea. The *Marina del Carmolí* is the most extensive salt marsh that appears in the coast of the Mar Menor. The *Rambla de Miranda* and *Rambla del Miedo* flow into the salt marsh before they reach the lagoon. The *Rambla de Miranda* come from agricultural areas and carries out surplus of drainage water. The *Rambla del Miedo* comes from mining areas and it is a source of mine wastes going into the *Marina del Carmolí* salt marsh.

Partial view of the old mining installations in the Sierra de Cartagena - La Unión mountains.

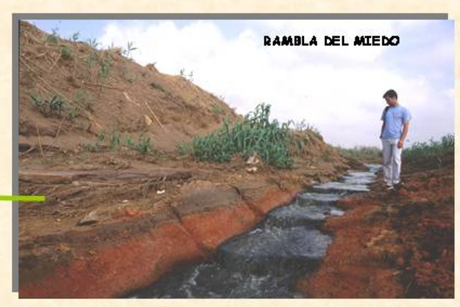
2.- MATERIAL AND METHODS

A study is being conducted to analyse metal contents in soils and waters from the Marina del Carmolí. The zone is characterized by a semiarid Mediterranean climate, with a mean annual rainfall of 275 mm, most of which falls in autumn and spring. The mean annual temperature is 17 °C, and mean evapotranspiration rate is 856.8 mm per year.

Water samples were taken from the watercourses (one from Rambla de Miranda, one from Rambla del Miedo) before they reach the salt marsh. In addition 7 sampling plots were located at several positions in the salt marsh in order to identify possible sectors affected by metal pollution. Samples were taken in March 2003 from rhyzospheric and nearby bare soil. Four fractions of metals were extracted from the soils: total metals (nitric-perchloric digestion); DTPA-extractable metals, exchangeable metals (extracted with sodium acetate) and metals in soil solution (soluble metals). Metal determinations were made by ICP and atomic absorption. In each sampling site soil redox potential and pH were measured (three replicates) at the sampling time with a portable Eh/pH meter (measures of Eh were corrected by adding 240 mV - value of a standard reference electrode).

LOCATION MAP OF THE STUDY SITE IN SE SPAIN

Detailed view of the mine wastes



Mine wastes (brown colour) overlaying the soil (Luvic Calcisol, WRB-FAO, 1990, reddish colour) in the *Rambla del Miedo* water course.

Soil solution was extracted "in situ" using a sampler type Rhizon. Samples were filtered, acidified with three drops of nitric acid and refrigerated until analysis.

3.- RESULTS AND DISCUSSION

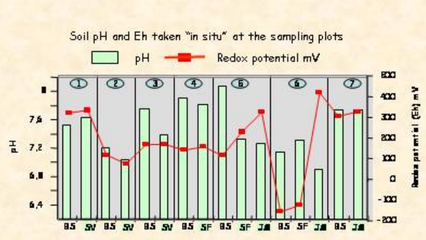
Heavy metals were found in the soils, but not in the water courses before they reach the salt marsh.

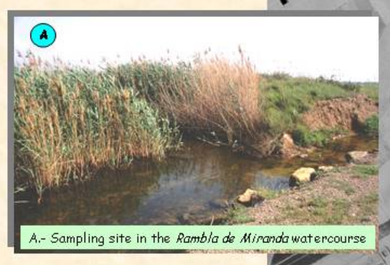
3.1.- Metals in water courses: Zn (0.25 mg L-1) and Mn (0.67 mg L-1) were the two only metals detected in the water courses.

3.2.- Metals in soils of the salt marsh: Cu, Mn, Zn, Cd, Cr, Ni, Co and As (acid digestion) were found in the soils of the salt marsh. Zn (maximum 17500 mg kg-1), Pb (maximum 7850 mg kg-1), Mn (maximum 2990 mg kg-1), Cu (maximum 266 mg kg-1), As (maximum 212 mg kg-1) and Cd (maximum 62 mg kg-1) were the most abundant metals and they were mainly found in the sector affected by the wastes from the *Rambla del Miedo*. Concentrations of Ni, Co and Cr were similar in all the sampling points. These results seem to indicate a strong pollution due to transported and deposited sediments by the *Rambla del Miedo*, but not by the *Rambla de Miranda*. Only a portion of total metals were extracted with DTPA with Mn (maximum 80 mg kg-1), Zn (maximum 452 mg kg-1) and Pb (maximum 762 mg kg-1) as the most abundant.

3.3.- Metals in soil solution: Zn (maximum 23 mg L^{-1}), Mn (maximum 87 mg L^{-1}), Ni (maximum 0.54 mg L^{-1}), Cr (maximum 1.82 mg L^{-1}) and Cd (maximum 0.15 mg L^{-1}) were found in the soil solution.

3.4.- pH and redox potential: pH hardly varied with sites but redox potential did (extreme values were 415 and -160 mV). The variations in the latter can influence metal mobility and biodisponibility.





A.- Sampling site in the *Rambla de Miranda* watercourse

B.- Sampling site in the *Rambla del Miedo* watercourse

Sampling site 6

Mine wastes deposited by the *Rambla del Miedo*

Research in progress:

- Analysis of seasonal variations of the metal contents in the soil solution
- Measures of the seasonal variations of pH and Eh and relationships with metal solubility
- Relationships among root soil and metal contents and dynamics
- Metals uptake for plants

Support of this research is provided by the Ministerio de Ciencia y Tecnología of Spain (REN 2001-2142)