

Assessment of Heavy Metals for Sediments and Water in the Bouregreg Estuary

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Abstract - The Bouregreg estuary represents an ecosystem which has a very important ecological and biological interest because of its fauna and flora variety which has experienced many complex releases of various origins. In the context of ecological conservation, such as the closure of the Oulja landfill (Salé city side) and the pre-treatment of wastewater (Rabat city side). This study based on the determination of ecological quality by obtaining a preliminary level assessment and distribution of six heavy metals (Fe, Zn, Cu, Cr, Pb and Cd) were measured in water and sediment to understand the level of heavy metals and their distribution at source. The samples were taken at 5 stations in the Bouregreg estuary in the Rabat/Salé region and were collected in August 2022.

Keywords: Bouregreg estuary, heavy metals, water, sediment.

1. Introduction

Estuaries are the site of intense human activities and/or hydraulic developments resulting in the release of various types of pollutants that disrupt the natural functioning of these ecosystems[1]. This is the case of the Bouregreg estuary on the Moroccan Atlantic coast of the Rabat/Salé region, known for its significant ecological diversity[2].

Oued Bouregreg is the second major river in Morocco, originates in the Middle Atlas at an altitude of 1627m[3]. This basin is drained by three main hydrological arteries: the Bouregreg wadi, the Grou wadi and the Korifla wadi. The Sidi Mohammed Ben Abdellah dam was built 24km upstream from the Bouregreg estuary[4]. This completely disrupted the functioning of the ecosystem of the Bouregreg estuary[5].

The Bouregreg estuary has recognized since 2006, the development project of the Bouregreg valley among these works the marina, the large Burj Mohammed VI, the extension of the Rabat-Salé tramway network, the large theater and the industrial zone Technopolis [6]. The objective of this study is to assess the physicochemical quality, in particular to assess the accumulation and bioaccumulation of these six heavy metals (Cu, Fe, Zn, Cr, Cd and Pb) in the sediments of the waters of the Bouregreg estuary and to predict their impact on the overall state of the environment and the state of marine ecosystems in particular. This allows us to perceive their impact on the health of consumers.



Fig 1: Map of Morocco

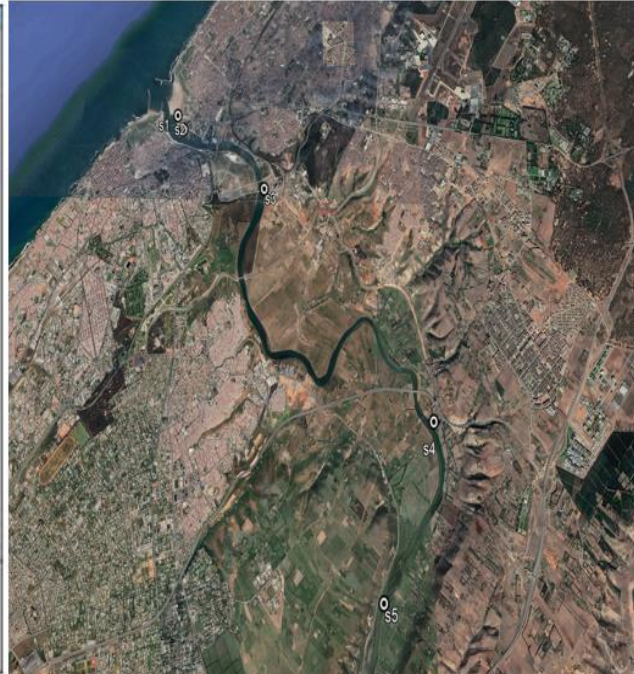


Fig 2: Location of stations along the Rabat/Salé estuary (Bouregreg)

2. Materials and methods

The Bouregreg estuary is located on the Moroccan Atlantic shore between the two cities Rabat and Salé at 34° north and 6°50' west[7]. The study of the impact of wastewater and waste discharges in the estuary is approached by the accumulation of six heavy metals: (Fe, Zn, Cu, Cr, Pb, Cd) in the water and sediments.

Station 1 (S1): Located about 700 m from the mouth opposite the construction activities of tourist areas and hotels.

Station 2 (S2): Located about 1.3 km from the mouth, it is subject to great human activity on the estuary due to the Marina Salé development project.

Station 3 (S3): Located about 4 km from the mouth, between the two Moulay Youssef and Al Fida bridges downstream from the Oulja industrial zone, Burj Mohammed VI and the Grand Theatre.

Station 4 (S4): 14.4 km from the mouth, the station which is characterized by agricultural activity and discharges from the popular area Sala-Eljadida and Technopolis.

Station 5 (S5): Located 16.2 km from the mouth, this station is the closest to the junction of the Akrech wadi which brings, among other things, ONEP discharges, discharges and leachates from the Akrech landfill and Ain Aouda discharges.

To carry out this work, the sampling of sediments and water was done by hand. 1 kg of wet sediment was collected in vacuum-sealed polyethylene bags and transported to the laboratory at 4°C[8]. For water samples were taken from the same sites, such as sediments, using 1 liter polyethylene bottles.

In the laboratory, the water samples were filtered through a 0.45 µm membrane filter[9], acidified with 2ml of concentrated HNO₃ and stored at a temperature of 4°C until the date of analysis[10]. The determination in water and sediments is made at the National Center for Scientific and Technical Research in Rabat (Morocco).

3. Results and discussion

The concentrations of heavy metals (Fe, Zn, Cu, Cr, Pb, Cd) recorded in the sediments are higher than those found in the waters. According to analyzes carried out on sediments and water, Fe (7.45 mg/Kg) is higher than other metals in the Bouregreg estuary.

3.1 The water :

Stations S4 and S5 show the highest rates of metallic elements in the water, this may be linked to the existence of industrial discharge (Technopolis) and also to the proximity of the oumazza dump. However, low levels of Crome (0.0064 mg/Kg) and cadmium (0.0 mg/g) were recorded during this study period.

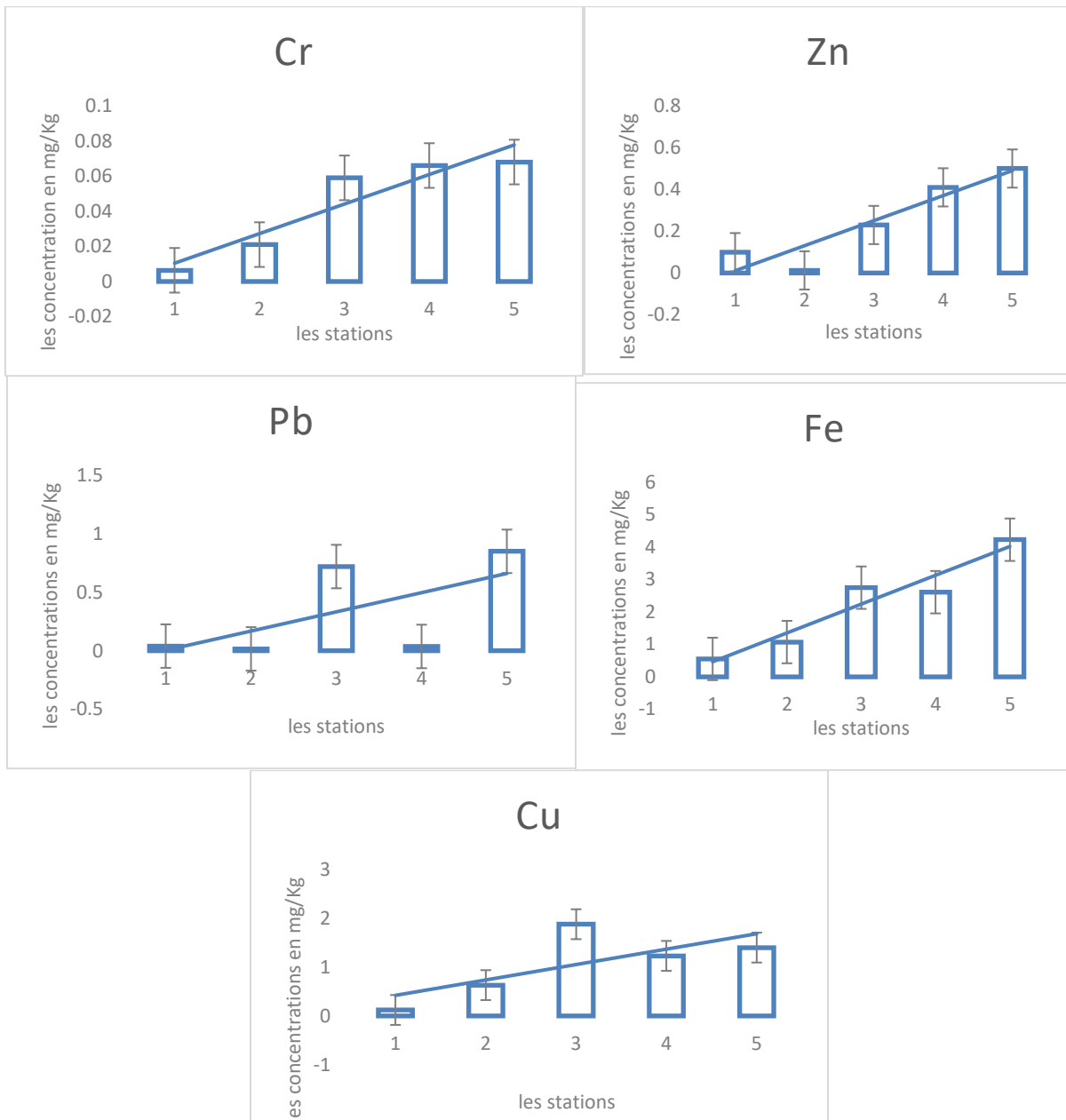


Fig 3: Spatio-temporal evolution of metallic trace elements in the waters of the Bouregreg estuary

Fe are the metallic elements that record the highest content by value: Fe (7.45 mg/Kg), followed by Cu (8.06 mg/Kg) and Zn (2.94 mg/Kg). These maximum Fe values in the water can be explained by urban-type pollution.

3.2 The sediments:

For the sediment samples, the highest average concentrations are those: Fe(1694mg/kg)> Zn (60.5 mg/kg)> Pb (44.07 mg/kg)> Cr (27.12 mg/kg)>Cu(26.55mg/kg)>Cd(0.061mg/kg).

From the comparison of the heavy metal values of our results with the standards (F.C, 2012) [11] cadmium does not exceed the standard which is 0.2 mg/kg and also for Cu which is lower has the value 30mg/kg according to (R.O, 1995)[12], for chromium the value is in compliance with the standards (F.C, 2012) [11] which is 52.3mg/kg. So we see that even if the levels of heavy metals are high, they remain within the range of standards (F.C, 2012)[11].

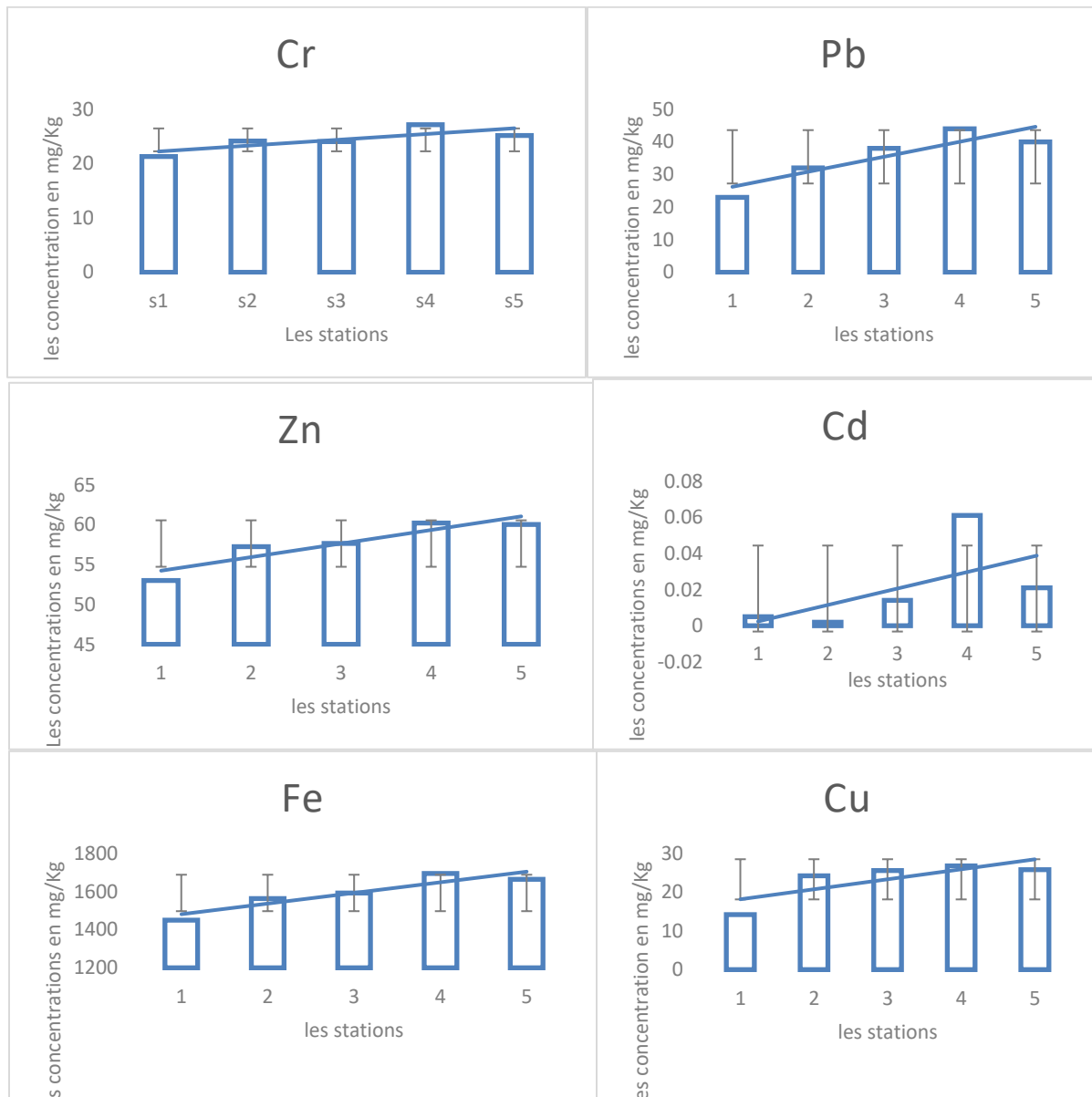


Fig 4: Spatio-temporal evolution of metallic trace elements in the sediments of the Bouregreg estuary

Station 1 recognized a lowest concentration. This reduction may be linked to the tidal dynamics of the estuary. While stations 4 and 3 record the maximum values in (Cr=27.12mg/Kg) and Pb (44.07 mg/kg) but which remain acceptable values because they respect the standards (F.C, 2012) [12].

4. Conclusion

Comparison of toxicological levels for heavy metals in water and sediments showing the decrease in metal load. The maximum metal content values were recorded at the sedimentary level, especially at stations 5 and 4, which demonstrated the importance of the sedimentary compartment of this estuarine ecosystem for the bioaccumulation of heavy metals.

This reduction can be linked to the tidal dynamics of the estuary, but especially by the improvement of the water quality of this estuary after the many positive actions planned by the depollution project. especially after the construction of the new dike, influenced by several complaints from different stakeholders.

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