Heavy metal pollution in mangrove sediments of the Estero de Urías coastal lagoon, NW Mexico.

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Introduction

Because of its highly hazardous and negatively effects over human health, heavy metal pollution in aquatic systems is a major concern for Mexican population. The Estero de Urias, located in SW Gulf of California, is a highly urbanized coastal lagoon that hosts the harbour and several industries of Mazatlan city, including a thermoelectric plant, seafood industry and shrimp aquaculture; as well as incipient agriculture fields surrounding the inner part of the lagoon.

Previous studies in the Estero de Urías[1,2] have demonstrated that the coastal lagoon is contaminated by the presence of toxic heavy metals. These pollutants have been related to atmospheric emissions and untreated domestic discharges. These studies, however, have been performed inside the Estero de Urías lagoon, at zones where antropogenic influence was notorious. Alternatively, in this study 210Pb-dated sediment cores, collected from tidal marshes and tidal flats (surrounded by mangrove vegetation) were analyzed for trace metals by using XRF with the objective of identifying alternative sources of pollution besides direct discharges from domestic and industrial waste waters.

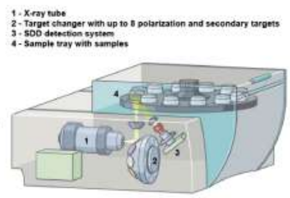
Experimental

Freeze dried &

Ground to powder &

He-flux chamber atmosphere

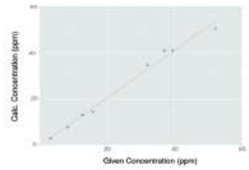
XRF analysis



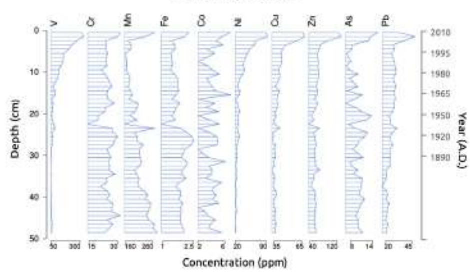
Results

XRF Calibration

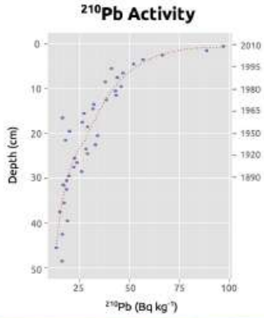
CRM	Norm. Imp.	Given Conc. (μg g-1)	Calc. Conc. (μg g-1)	Diff.
IGLsy-2	8.99	3.2	2.9	-0.3
IGLa-1	12.17	8.4	7.7	-0.7
GSD-12	20.17	12.8	13	0.2
IGLgb-3	13.71	15.8	14.4	-1.4
NBS 1646	34.37	32	34.6	2.6
GSR-5	38.87	37	40.7	3.7
IAEA 433	35.75	39.4	40.7	1.3
IGLa-1	47.25	52.1	50.3	-1.8
IAEA 456	526.88	770	775.3	5.3



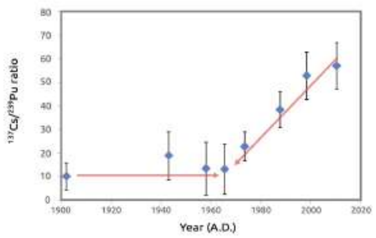
Depth profiles



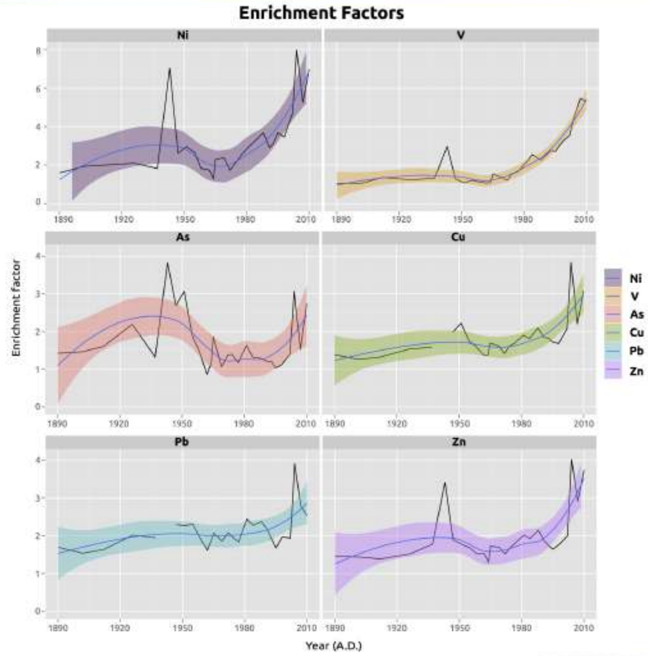
^{210}Pb Activity



Validation of ^{210}Pb derived dates



Enrichment Factors



Discussion

^{210}Pb dating allowed to evaluate the historical reconstruction of trace metal accumulation in the Estero de Urías coastal lagoon over a period of 122 y. The ratio ^{137}Cs/^{239}Pu, as a proxy of non-atmospheric deposition after the ban of nuclear weapons in 1962, was used to validate the ^{210}Pb chronology. The enrichment factor of analysed trace metals were calculated using Al as reference element to normalize the trace metal concentrations[3]; and pollution assessment was performed according to Sutherland (2000). V and Ni showed significant levels of enrichment (EF > 5) from 2007 to 2012 (sampling year). Moderate levels of enrichment (EF >2) were found for Cu, Zn and Pb (1980-2012) and for As (max values in 1943 and from 2004 onwards). Trace metal concentrations were correlated to each other ($p < 0.05$, $r > 0.75$) suggesting a common delivery source for these metals. Surface runoff from agriculture fields stands as a probable source of these pollutants, probably derived from the use of agrochemicals.

Conclusion

X-ray fluorescence proved to be an adequate, rapid and reliable technique for trace metal analysis of environmental samples. Based on ^{210}Pb analysis it was established that the analyzed coastal sediments have accumulated at a rate of 2.21 mm y-1 during the past 122 years. According to the pollution assessment, tidal-marsh sediments from the Estero de Urías coastal lagoon are moderately polluted by Cu, Zn, As and Pb and significantly polluted by Ni and V. Because of the proximity of agricultural fields to the study site, provenance of trace metals are related to surface runoff from these fields. Further research is recomended to evaluate impacts to the biota.

Acknowledgements

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