Trace metal and Lead Isotopes analysis in sediments cores near Rio de Janeiro, Brazil

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Introduction

The historical dependence of humanity on the oceans, added to the increase and diversification in the uses of the marine environment, have resulted in significant human-induced changes within ecosystems. Beyond that, oceans have become into the final sink of most land-made contaminants[1]. The trace metal concentration (ME) analysis and lead isotopes in vertical profiles of dated sediments can be used to establish historical records that document relationships with the evolution of adjacent terrestrial ecosystems and emission sources.
The goal of this work is to evaluate the interaction between coastal areas like Guanabara Bay (GB) and the Southeast continental shelf of Brazil (SEB) focusing on anthropogenic export of trace metals and combustion residues from land to ocean and its historical variability using stable lead isotopes as a proxy of material transfer in a tropical coastal zone.

Results and Discussion

The general trends for ME in GB are that all of them had a local maximum in 0.2cm, 35-45cm, 54-56cm, 105-115cm and 142-144cm. Anti-foulant, anticorrosive and primer paint on the bottom of boats were/are use in GB and could be a source of Cu, Pb and Zn ion addition to the metal processing industries existing in the cities around the greater Rio de Janeiro. For the SEB1 most of the elements show higher concentrations on the upper part of the core compared to the bottom except some higher picks in the 40-43 cm, close to 70 cm and 110 cm, probably some anthropogenic event in the past will be further study. For the SEB2 most of the elements show higher concentrations on the upper part of the core compared to the bottom, this core shows ME concentrations bellow them SEB1. Ni was one of the ME showed higher concentration in SEB than GB. Ni is one of many trace metals widely distributed in the environment, being released from both natural sources and anthropogenic activity. The sediments of adjacent rivers and bays around the upper section of the SEB are considered highly enriched with Pb, Zn, Cu and Cr such as GB, Sepetiba Bay and Paraíba do Sul River compared with the natural concentrations and other regions in the world.

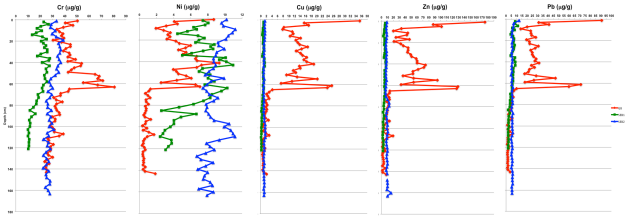

Figura 1. ME concentrations for GB, SEB1 and SEB2.

A [Pb] maximum is seen on the top of the core and at 60 cm in GB. Based in the sedimentation rate (3.0±0.4 cm/yr) this event probably occurred at the beginning of the 1990's. A [Pb] maximum is seen between samples from 24 to 43 cm (~8 ppm) in SEB1 and 60 to 80 cm (~7ppm) in SEB2. The SEB sedimentation rates varies 0.02-0.04 cm/yr. Utilization of tetraethyl lead (TEL) gasoline in Brazil was phased out beginning in 1983 and was largely eliminated by 1988.
$^{206}Pb/^{207}Pb$ varies between 1.161 near the core top to 1.165 near the bottom. These values are comparable to anthropogenic signatures reported in other investigations in Brazil[2]. $^{206}Pb/^{207}Pb$ for SEB1 varies between 1.174 near the core top to 1.190 at 100 cm, with a sharp difference between samples at 6 and 8 cm. Higher Pb, Zn, and Ni in the core top corroborate the recent anthropogenic influence on the SEB.

Conclusions

By comparing sediment cores from GB and SEB a chronology of [ME] and sources is discerned.
GB sediments have a strong anthropogenic signal of extremely high Pb content of very low 206/207 IR.
In contrast, SEB cores hints to gradual changes over the past century or so, and an abrupt change recently, but shows a lower anthropogenic signal of higher, more natural $^{206}Pb/^{207}Pb$.

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