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Baseline

Heavy metals in the bottom sediments of the Furo of Laura estuary, Eastern Amazon, Brazil

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ABSTRACT

The Furo of Laura is an economically important river in the Amazon estuary. Thus, in the present study, we evaluated the metal distribution (Al, Cd, Co, Cu, Cr, Fe, Ni, and Mg) in the bottom sediments of this river. The sediments were sampled at four points every 2 months for a year with an Ekman-Birge sampler. After microwave acid digestion, the metal levels were determined by optical emission spectrometry with inductively coupled plasma. The particle size and organic matter content influenced the concentration of the metals. The sediments were not enriched by the analyzed metals; the estuary therefore retained the characteristics of an uncontaminated environment, thus serving as a reference environment for comparison.

Development in Brazil, especially over the last three decades, had considerable environmental impacts that were caused by a high degree of urbanization (Bregunce et al., 2011). The situation is more critical in estuarine environments with port activities and industrial and urban waste deposits (Chakraborty et al., 2014).

The Vigia municipality is located in the microregion of "Salgado," in the northeast of the state of Para. The urbanization process in this location resulted in the removal of riparian forests and discharge of untreated domestic and industrial wastewater that passes through several neighborhoods, arriving at the Furo of Laura estuary (Bentes and Barbosa, 2015). The margin of this estuary currently has approximately 51,705 inhabitants occupying an area of 301 ha (IBGE, 2016).

This estuary is considered the main hydrography of the Vigia municipality. The river is a large body of water (approximately 43,686 m in length) consisting of numerous microbasins formed by the tidal effects and the Marajó Bay. The sediments of the estuary are rich in Cu, Cr, Ni, Pb, and Zn in several sectors of the eastern margin, and the origin of these metals is linked to the domestic sewage generated by the city of Belém (Corrêa and Pereira, 2002).

In addition, because its main economy is fishing, the municipality hosts several fishing companies; in one of them, the pollution potential corresponds to the load generated by a city of 567 to 653 inhabitants in terms of the organic load (Mello, 2007), reflecting the importance of this study.

In this study, we evaluated seasonal and spatial distribution of the heavy metals Al, Cd, Co, Cu, Cr, Fe, Ni, and Mg and characterized the particle size fractions and organic matter (OM) content in the bottom sediments of Furo of Laura estuary to create a reliable heavy metal database with which future levels can be compared and evaluated.

Sediment samples were obtained at four points in the Furo of Laura estuary (P1: reference area, P2: intermediate area, P3: area under urbanized influence, P4: Marajó Bay influence area) (Fig. 1), one sample at each point, four in each month (September and November 2011 and January, March, May, and July 2012); a total of 24 samples were obtained. Approximately 500 g (wet weight) of bottom sediment was sampled at each point using an Ekman-Birge sampler with the aid of a boat during neap tide.

Sediment particle sizes were analyzed according to the method given by Lima et al. (2015) using the laser in the Shimadzu equipment, model SALD - 2201. OM content was analyzed according to the method reported by Loring and Rantala (1992), which is based on the oxidation of organic carbon with potassium dichromate in an acidic medium.

The heavy metals were determined from the silt and clay fraction (<0.063 mm). Nitric acid (HNO_3), hydrochloric acid (HCl), hydrofluoric acid (HF), and boric acid (H_3BO_3) were used for the digestion of the sediments; the digestion was performed in a closed system using microwave radiation (MARSX pres, CEM Corp. Matthews, NC, USA). The metals were analyzed by optical emission spectrometry with inductively coupled plasma (ICP-OES, Model Vista- MPXCCD, VARIAN) according to the method by Spectro (1999). To validate the results, we used a reference sample for metals in the soil (SRM 2710, NIST, USA), and the

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