THE WORST BRAZILIAN ENVIRONMENTAL DISASTER ALTERED THE DISTRIBUTION OF METALS IN WATER AT THE DOCE RIVER ESTUARY AND MARINE REGION

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Introduction

After a collapse of the iron mining dam in Mariana City, Minas Gerais State, on 5 November 2015, 50 million cubic meters of waste/mud were added to the Doce River, reaching the Espírito Santo State and the Atlantic Ocean (Escobar, 2015). This is the worse environmental disaster in Brazil. This work shows the changes in the metals levels in the dissolved and total fractions in estuarine water during and after (9 - 22 November) the arrival of the mud at the mouth of the Doce River and also in the marine water (surficial and bottom) collected in the following days (25 November - 04 December).

Methods

Water samples were collected in the Doce river estuary and in the nearby marine region. Al, Fe, Ba, Pb, Cr, Cu, Mn, As e Zn were analyzed by ICP-MS (6020A e EPA6010C methods) in the dissolved (<0.45 µm) and total fractions (EPA 3051A method, sub-boiling distilled HNO_3). To check the accuracy, spiked samples were analyzed showing recovery from 85 to 118%.

Results

The mud arrival altered the concentration of Fe, Al, Mn and Cr in the analyzed fractions (dissolved and total) in both superficial and bottom samples (Ex. Figure 1). As, Be, B, Pb, Cd, Cu and Ag did not show variation for the total fraction. All elements showed variation in the dissolved form.

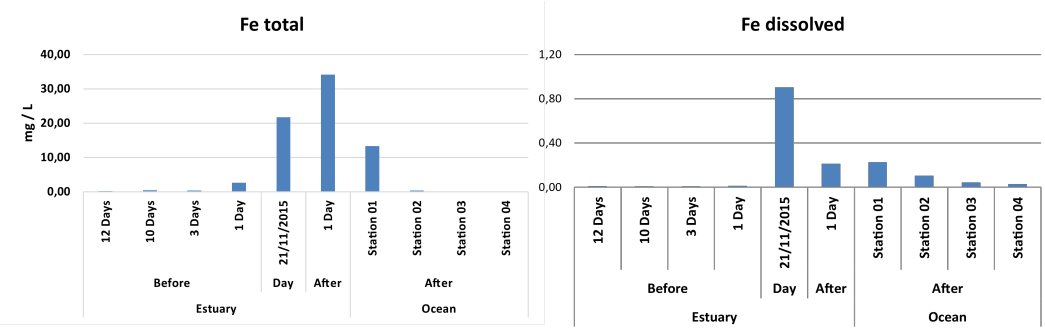

Figura 1 –Fe concentrations when the mud arrived at the mouth of Doce River. Marine samples were collected between 25 November and 04 December 2015.

Metals showed generally the greatest concentrations (dissolved and total) in samples collect the nearest the mouth (eg. Fe, Figure 2). Some exceptions were observed. For example, dissolved Al was more concentrated in the bottom samples. Fe was the element that increased the most, more than two orders of magnitude. The higher concentration of total Fe was 52360 mg/L in the bottom at station 8, whereas for the dissolved fraction, it was 226 mg/L at station 1.

Exogenous sedimentary processes, as example, the co-precipitation with oxides and hydroxides of Fe and Mn, have an important role in the control of the several metals and metalloids like V, Cr, Co, Ni, Zn, As, Mo e Pb (Karageorgis *et al*., 2005). Metals are non-degradable substances and due to the synergy of their toxicity, persistence and bioaccumulation, may cause negative impacts to the marine environment (Marins, *et al*., 2002).

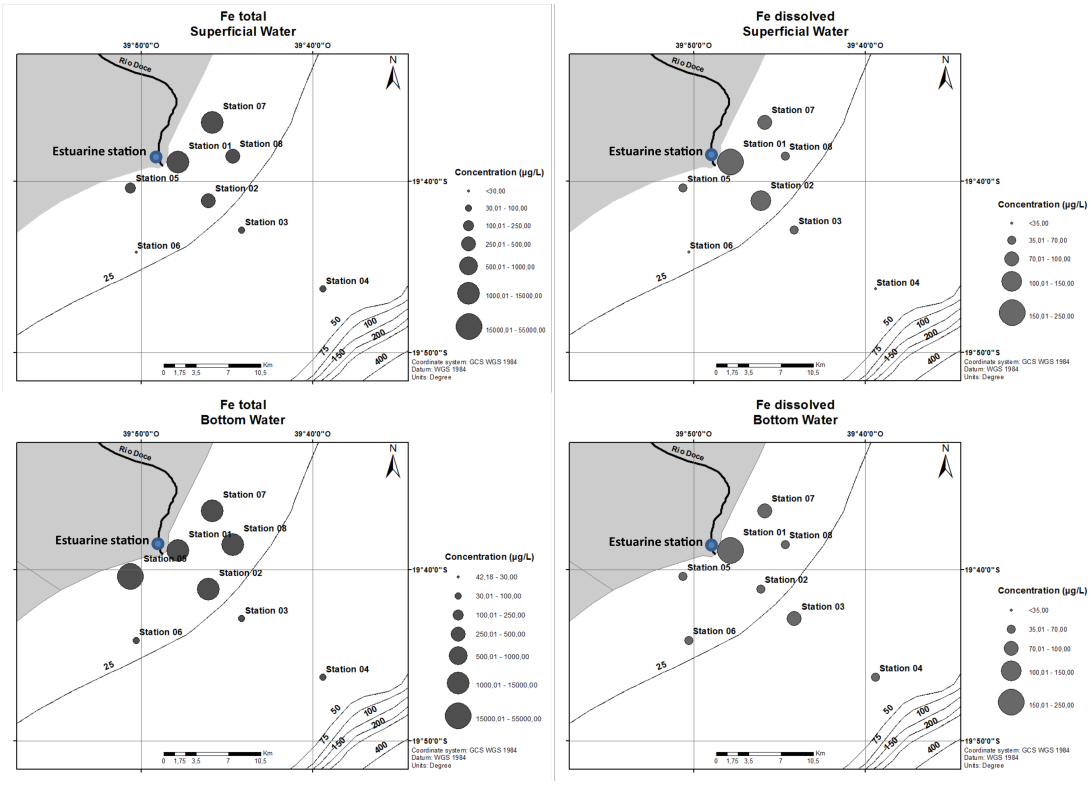

Figura 2 – Fe concentrations in dissolved and total fractions in superficial and bottom waters nearby the mouth of Doce river, Brazil (collected between 25 November and 04 December 2015).

Conclusions

The concentration of most of the analyzed elements increased with the arrival of the mud. Fe concentration has gone up more than two orders of magnitude. After, in the marine region, the levels were found relatively lower than those observed at the mouth of the river. The highest values for the marine environment were found at the nearest station of estuary. The bottom waters were enriched in the stations to the south, whereas the superficial waters showed highest levels of analyzed metals to the north showing an important hydrodynamic factor at the distribution of these. Synergistic effects of toxicity may have caused a significant impact in the studied region.

References

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