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Copper and lead binding to minerals coated with fulvic acid

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The fate of trace metals in the environment strongly depends on adsorption reactions at mineral surfaces. In soils and aquatic systems, reactive mineral surfaces are often coated with adsorbed natural organic matter. Specific interactions of mineral surfaces and organic matter were proposed to affect cation sorption, e.g., by electrostatic effects. A quantitative understanding of these interactions is required for modeling the behavior of trace metals. Therefore, we investigated Cu(II) and Pb(II) binding to clay and oxide minerals coated with fulvic acid. The amount of cations bound to coated minerals was compared with an additive model approach, which was calibrated with metal sorption data for the pure mineral and organic sorbents.

Binding of protons, Cu, and Pb to kaolinite, hematite, and a soil fulvic acid was investigated with titration and batch experiments [1-3]. Single sorbents were studied at various proton and NaNO₃ concentrations. Based on single sorbent data, a basic Stern model and the NICA-Donnan model were used to describe proton and metal cation binding to mineral surfaces and fulvic acid, respectively. In a second step, metal cation binding was investigated in kaolinite-fulvic acid and hematite-fulvic acid suspensions [4].

In the presence of fulvic acid, metal cation binding to the solid phase was strongly increased in the acidic pH range. Only small effects were observed under alkaline conditions. Comparison of data and calculations with an additive model approach revealed that the additive approach tended to slightly underestimate metal cation binding to the solid phase in the mixed sorbent systems. We conclude that an additive approach can supply good estimates of metal cation binding in mixed sorbent systems provided that well calibrated models for the respective single sorbents are available.

References

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Anthropogenic influences in the chemical composition of sediment cores from the Guadiana Estuary adjacent region – SW Iberian Continental Shelf

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Introduction

The present work aims at the evaluation of anthropogenic influences in the elemental distribution in marine sediment cores collected at the Southwestern Iberian Continental Shelf (Figure 1).

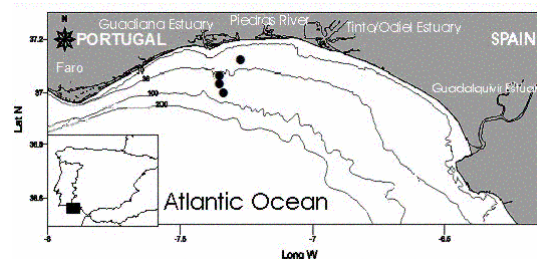


Figure 1- Sediment cores location map.

Methods

Chemical analyses were carried out by multielemental techniques: Energy Dispersive X-Ray Fluorescence Spectrometry (EDXRF) and Instrumental Neutron Activation Analysis (INAA). These two techniques allow the determination of many chemical elements: Na, Al, Si, K, Ca, Sc, Ti, Cr, Mn, Fe, Co, Cu, Zn, As, Ga, Br, Rb, Sr, Y, Zr, Sb, Cs, Ba, Pb, U, Th, Hf and the rare earth elements (La, Ce, Sm, Eu, Tb, Yb, Lu), which reflect the local background composition, biogenic activities and the presence of contaminant elements related with several sources.

Results and Discussion

The enrichment in some metals observed at the superficial levels of the studied sediment cores can have an anthropogenic source, more particularly, to be enriched due to the presence of specific ores (abundant in the Guadiana river basin) such as Ni, Cu, Zn, As and Pb. On the other hand, the sediment cores collected closer to the coast line present the highest metals content in the superficial levels, suggesting a direct continental influence.

The metals enrichment/contamination observed in the superficial levels of the cores is followed by a gradual contents decrease. The geochemical background values are reached between 40 cm and 80 cm of cores depth, depending on the cores location.