

INFLUENCE OF NATURALLY OCCURRING ORGANIC AND INORGANIC COATINGS ON SURFACE PROPERTIES OF MINERAL PHASES IN RECENT MARINE SEDIMENTS (ADRIATIC SEA)

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Abstract

The influence of naturally occurring organic and inorganic compounds existing on the surfaces of mineral particles in marine sediments was investigated with respect to their surface physico-chemical and electrochemical properties. Bulk sediment and the clay fraction were investigated before and after removal of organic matter and Fe and Mn oxides/oxyhydroxides. It was found that organic matter induced aggregation of particles into larger organo-mineral aggregates and lowered their specific surface area (SSA) and cation exchange capacity (CEC). The role of organic coatings in the formation of surface charge of mineral particles was established. The influence of Fe and Mn oxides/oxyhydroxides on the surface reactivity of mineral particles was not consistent. Their presence increased SSA and reduced CEC of mineral particles.

Keywords: Sediments, Organic matter, North Adriatic Sea, Central Adriatic Sea, South Adriatic Sea

Introduction

Submicron sized mineral particles are omnipresent particulates in natural environments that comprise most of the potentially reactive surfaces responsible for the transfer and removal of organic and inorganic contaminants [1]. These solids are regularly associated with different organic and inorganic compounds that are attached to mineral surfaces in the form of coatings. In consequence, surface properties of mineral particles are modified to various extents. This influences particle reactivity and stability, but also the fate of contaminants bound to surfaces of mineral particles. The aim of this study was to investigate the influence of naturally present organic matter and Fe and Mn oxides/oxyhydroxides on surface reactivity of mineral particles. This was approached by determination of surface physico-chemical properties (specific surface area, SSA; cation exchange capacity, CEC) and surface charge (electrophoretic mobility) of bulk sediment and the clay fraction before and after removal of organic matter and Fe and Mn oxides/oxyhydroxides.

Materials and Methods

Recent marine sediments were collected in distinct sedimentological environments along the eastern Adriatic coast. Sediments were retrieved using Uwitec gravity corer or Van Veen grab sampler. Organic matter was removed by the NaOCl-treatment after [2]. Clay fraction (<2 μm) was collected by gravitational settling, confirmed by laser-based granulometry and freeze-dried. Fe and Mn oxides/oxyhydroxides were removed by dithionite-citrate-bicarbonate (DCB) method modified after [3]. Samples were mineralogically (XRD) and morphologically (FE-SEM) characterized and their physico-chemical properties (SSA, CEC) and surface charge (electrophoretic mobility) determined.

Results and Discussion

The physico-chemical characterization of samples revealed an increase in CEC and SSA after organic matter removal, regardless of mineral composition. The NaOCl-treatment caused disintegration of macroaggregates, an increase in clay fraction and significant exposure of mineral surfaces, rendering them more available for interactions with the environment. The main role of organic matter was mostly in gluing particles in macroaggregates, thus limiting access to the mineral surfaces. The determination of electrophoretic mobility showed that organic matter, even when present in minor amounts, has a prevailing role on charge formation of mineral surfaces in natural environments. It was found that while Fe and Mn oxides/oxyhydroxides increased the overall SSA, their presence decreased CEC and lowered the negativity of surface charge of mineral particles.

Conclusion

This investigation showed that the surface reactivity of mineral particles in natural environments is strongly influenced by the presence of organic and inorganic coatings on their surfaces. This causes aggregation of particles in larger micron-sized mineral-organic aggregates and affects interactions of mineral particles with contaminants and pollutants.

References

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