CHARACTERIZATION OF MICRON AND SUBMICRON-SIZED MINERAL PARTICLES FROM FOUR DISTINCT MARINE ENVIRONMENTS OF THE ADRIATIC SEA

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Abstract
Mineralogical, surface physico-chemical, morphological and structural characteristics of micron and submicron-sized mineral particles separated from different sedimentological environments of the eastern Adriatic coast were determined. The physico-chemical characterization revealed a significant increase in cation exchange capacity (CEC) and specific surface area (SSA) with decreasing particle size. Mineralogical, morphological and structural analysis showed that the fractions with higher amount of aluminosilicate, oxide and oxyhydroxide particles exhibit significantly higher values of SSA and CEC, and consequently, increased reactivity of sediments in biogeochemical processes in the marine environment.

Keywords: Sediments, Mineralogy, North Adriatic Sea, Central Adriatic Sea, South Adriatic Sea

Introduction
Coastal sediments are considered as the main sink for contaminants. The most reactive sediment phases are micron and submicron mineral particles due to their exceptionally high surface area and sorption properties. They govern biogeochemical processes and are responsible for transfer of contaminants from water to sediment. This research aims to determine the composition of micron and submicron-sized mineral particles and elucidate their role in biogeochemical processes with respect to their surface physico-chemical, morphological and structural properties.

Study area
Four distinct marine environments were chosen for studying considering their different sedimentological characteristics. The Po receiving basin (1, Fig. 1) is an area under influence of the Po river and receives a fine-grained part of the river load; the open sea location (2, Fig. 1) is an area of deep sea that is not influenced by coastal sedimentation processes; the Malo jezero on the island of Mljet (3, Fig. 1) is a karstic marine lake characterized by precipitation and sedimentation of aragonite [1], and the Risan bay (4, Fig.1) is a very indented marine environment characterized by sedimentation of clayey particles.

Fig. 1. Map showing locations of sampling.

Materials and Methods
Surface sediments were retrieved using Uwitec gravity corer or Van Veen grab sampler. Organic matter was removed by sodium hypochlorite treatment, modified after Kaiser [2]. Different size fractions were separated by gravitational settling, confirmed by laser diffraction, and freeze-dried. Physico-chemical characterization of mineral surfaces (SSA, CEC) was performed, and mineralogical composition (XRD) and morphology determined (FE-SEM).

Results and Discussion
The removal of organic matter significantly increased the share of the clay fraction and values of CEC and SSA in all investigated sediments. Accordingly, the loss of the organic coatings and disintegration of mineral aggregates enlarges the surface area of mineral particles available for interaction with the environment. In addition, this study exemplifies that the SSA and CEC values in different sediment fractions rise significantly with decreasing size (Fig. 2). The fractions with the highest values of SSA and CEC were mainly composed of aluminosilicate, oxide and oxyhydroxide particles.
The highest values for SSA and CEC were determined in sediment samples from locations 2 and 4 (Fig. 2), which also had the highest amount of aluminosilicate, oxide and oxyhydroxide particles. In samples from location 1, SSA and CEC values determined for micron and submicron fractions were still high, while for the original sediment sample they were slightly lower compared to other locations. This could be attributed to the prevalence of quartz, feldspars, and carbonates in the coarser sediment fraction. The lowest values were determined in the sediments with predominately carbonate sedimentation (location 3), revealing lower surface reactivity of carbonate minerals.
The submicron-sized aluminosilicates, oxides and oxyhydroxides represent the most reactive particles that are responsible for removal and transport of contaminants in aquatic environments. Even when they are not the primary constituent of sediments, they still have a significant impact on their surface reactivity.

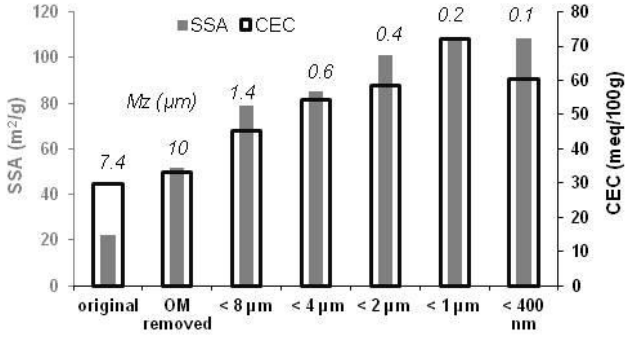

Fig. 2. CEC, SSA and mean sizes (Mz) of fractions separated from location 4.

References
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