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Size-related mineralogical and surface physico-chemical properties of inorganic colloidal particles in recent marine sediments of the Adriatic

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Mineral particles play a major role in biogeochemical processes in nature, particularly in binding, transport and deposition of different organic and inorganic compounds. Among them, the colloidal mineral phases, particles in the submicron- and the nanosized range represent the most reactive mineral surfaces in the environment (HOCELLA et al., 2008; TANG et al., 2009; PLATHE et al., 2013). Through complex physico-chemical processes associated with their surfaces, these solids affect bioavailability, toxicity and the fate of the associated inorganic and organic compounds. Their unique surface reactivity is a consequence of their size-related structural and surface physico-chemical properties.

In marine sediments, the colloidal mineral fraction mostly consists of clay minerals, metal oxides and oxyhydroxides, sulphides, and, sporadically, carbonates (PERRET et al., 1994). Carbonate minerals are rarely found in the nanosized range and mostly occur as lithogenic and biogenic fragments in coarser fractions (BUFFLE et al., 1998). The results obtained in this study show the mineral composition, occurrence, distribution and the surface physico-chemical properties; specific surface area (SSA) and cation exchange capacity (CEC) of different size fractions collected in various sedimentological environments in the Adriatic Sea. The influence of organic and inorganic surface coatings on the reactivity of mineral surfaces was investigated. A detailed mineralogical investigation revealed significant changes in the composition of mineral particles in the clay fraction. The obtained results revealed presence of nanosized particles mainly in the form of microaggregates in strong associations with organic matter, difficult to disrupt even despite of chemical treatments. The authigenic precipitation seems to be the main mechanism leading to a more significant share of carbonates in the colloidal size range. In sediments where weathering of carbonates is the main source of their origin, their occurrence was limited to coarser size fractions and clay minerals were the dominant mineral phase in the colloidal size range. These changes in the mineralogical composition were reflected in the surface physico-chemical parameters. As a result, size fractions with predominance of submicron-sized clay minerals showed a significant increase in SSA and CEC with particle size lowering.

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