

Sediment and surface water geochemistry interactions along a W-E salinity gradient: natural areas of the Po River Delta (Italy)

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The Interreg Italy-Croatia ACTION project (2024-2026) aims to understand the resilience of coastal ecosystems and promote adaptation strategies to address climate change. Within this framework, a focus is placed on the Po Delta (Italy), where a new hydraulic management system is set to be implemented to restore the water cycle in the natural coastal areas of the northern Ravenna municipality.

This study presents the results of a recent fieldwork campaign combined with a comprehensive review of both published and unpublished data. The aim is to better understand water-sediment geochemical processes and interactions across transitional environments, from freshwater to saltwater systems. Over the past six months, sediment and surface water samples were collected from 16 distinct water bodies—including ponds, drainage canals, rivers, lagoons, and wetlands—to assess major and trace element compositions. Previous geochemical data from the same matrices were used as a reference for temporal comparison.

Bulk sediment composition, analyzed via XRF, reveals a wide range of SiO₂, CaO, Fe₂O₃, LOI, and various trace elements, indicating complex sediment provenance, depositional environments, and localized human influence. The Mg/Ni ratio has proven effective in distinguishing sediment provenance, using river sediments as endmembers. Furthermore, stratified sediment samples from multiple sites show high Enrichment Factors (EF), highlighting significant anthropogenic impacts on sediment geochemistry. Arsenic, lead, copper, and vanadium exceed Italian legislative thresholds at several locations, particularly in surface sediments, due to recent industrial discharges, intensive agriculture, and urban runoff. Surface water geochemistry reveals a complex hydrological system with a pronounced W-E salinity gradient. Calcium bicarbonate-dominated river and drainage waters (Ca-HCO₃) rapidly mix with sodium chloride-dominated saltwater (Na-Cl), leading to significant changes in ionic strength. These shifts affect the dissolution and precipitation equilibria of several dissolved elements, subsequently influencing sediment composition. By examining these water-sediment interactions, this study expands scientific knowledge on the interplay between natural and anthropogenic factors in the study area, providing insights into the effects of climate change on coastal ecosystems.