GEOCHEMISTRY OF SEDIMENTS FROM A DISEQUILIBRIUM, RIVER-DOMINATED ESTUARY: THE RAŠA RIVER ESTUARY (ADRIATIC SEA, CROATIA)

Ivan Sondi [1] *, Sonja Lojen [2], Mladen Juračić [3] and Esad Prohić [3]

[1] Center for Marine and Environmental Research, Ruđer Bošković Institute, Zagreb, Croatia - sondi@irb.hr

[2] Department of Environmental Sciences, Jožef Stefan Institute, Ljubljana, Slovenia

[3] Departmentof Geology, Faculty of Science, University of Zagreb, Zagreb, Croatia

Abstract

The geochemical characteristics of fine grained clayey sediments from a small, rock-bounded microtidal, low-wave energy, karstic estuary in the north-eastern Adriatic (Raša River) were studied. The results of field work and of corollary laboratory experiments have indicated the general features of distribution of heavy metals, and characteristics,distribution and the origin of organic matter in estuarine sediments. Both, the distribution of heavy metals and of organic components, are governed by rapid deposition of fine-grained, mostly clayey particles, in the restricted upper part of the estuary, and by prevalent physico-chemical conditions (Ehand pH).

Keywords : Organic Matter, Metals, Adriatic Sea, Estuaries, Sediments.

Study Area

The Raša River and its estuary are located at the south-eastern part of the Istrian peninsula, Croatia. The estuary was formed by Holocene sea-level rise when the river valley, carved into carbonate rocks, was flooded by the sea. The Raša river estuary is a region of intensive deposition of fine-grained, mostly clay particles originating from clastic Eocene flysch sediments. It carries more than 90 % of particulates as suspended matter that preferentially accumulates in the low-wave energy environment at the head of the estuary, causing a progradation of the estuarine or bay-head delta. Such characteristics classify the Raša River estuary into a category of river-dominated disequilibrium estuaries [1].

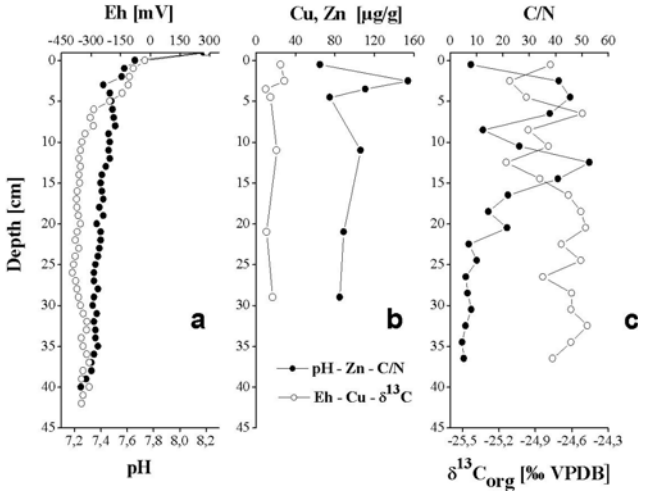

Fig. 1. Physico-chemical conditions (Eh, pH) (a), heavy metal concentrations (b), and stable isotope composition of SOM (c) in sediment core taken at the sampling station 2 (water depth 12 m).

Materials and Methods

Sediments were collected along the estuary at 4 sampling stations by scuba diving, using hand-held corers 60 cm long. After sampling, sediments were frozen and kept at -20^{o}C until further analyses were performed. The latter included mineralogical, grain-size, surface physico-chemical and trace metal analysis, and furthermore, the determination of the concentration and C and N stable isotope compositions of sedimentary organic matter (SOM).

Results and Discussion

The Raša River estuary is a good example of biogeochemical land-sea interactions occurring in a microtidal, low energy environment. Previous investigations have shown that the dynamics of sedimentation in this region is effectuated through abundance of fine-grained particles and by intensive flocculation processes at the salt wedge. These processes result in prograding the estuarine delta and govern the formation of physico-chemical, and therefore, geochemical conditions in clayey sediments [1]. Indeed, the horizontal distribution of heavy metals is governed by the presence of fine-grained clayey particles and their sedimentation pattern. On the otherhand, the vertical distribution of heavy metals is governed by prevailing physico-chemical conditions in the sediments. Thus, as example, Fig. 1b shows the distribution of heavy metals in a sediment core taken at sampling station 2. Background concentrations of Zn and Cu are significantly increased in uppermost strata especially at the oxic-anoxic boundary (Fig. 1a). The concentration and stable isotope composition of sedimentary organic carbon (δ^{13}C) show little variation with depth (Fig. 1c), indicating that the high sedimentation rate mostly overrides the effects of diagenetic processes on the decomposition of sedimentary organic matter. The sources of the SOM were estimated using C/N ratios and the δ^{13}C values [2]. It was found that generally the terrestrial component of the SOM decreases with the distance from the river mouth. However, the operation of the port used for the transport of timber and coal from a nearby coal mine (site 2 - Trget) introduced large amounts of organic material of terrestrial origin into the sediment. The results of these investigations should help in understanding the ultimate environmental capacity of the estuarine sediment system in receiving and disposing of heavy metals and organic materials, and in predicting the pattern of land-sea interactions of the river dominated, low-energy environments of the Adriatic region.

References

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