THE ROLE OF CLAY MINERALS IN TRANSPORT AND ENVIRONMENTAL CAPACITY FOR TRACE METALS

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This investigation aims at understanding the ultimate environmental capacity of the estuarine coastal region for selected contaminants. In this sense the role of clay mineral particulates in the transfer of trace metals and radionuclides from land to sea was studied. Field studies were done in the Rasa River estuary (Northern Adriatic), a small karstic river originating in a Eocene flysch region.

Most of the clay minerals are carried by the river sediment in the upper part of the estuary at low water salinity. By sampling estuarine surface sediments segregation of clay minerals was observed with illite preceding the sedimentation of chlorite (SONDI *et al.*, 1994). Such a phenomenon was reported earlier in other estuaries and attributed to different rates of flocculation and flocks sedimentation (EDZWALD and O'MELIA, 1975).

The concentration of Zn, Cu and Mn in clay minerals of the estuarine sediments was found to be three times higher than in the source rocks (Table 1).

Table 1. Surface characteristics and concentration of metals for clays separated from source rock and the surface riverine and estuarine sediments

Sample	SSA (m^2g^{-1})	ASI (meqv/100g)	Concentration of metals (ppm)						
			Zn	Cu	Pb	Cd	Cr	Mn	Ti
Source rock: 5	56.0	68	67	80	62	2.1	234	104	2594
Riverine sediment: 6	54.1	62	113	141	89	2.5	228	166	2518
Estuarine sediments:									
10	48.3	66	216	236	83	2.9	287	393	3805
11	62.5	72	153	127	66	2.4	218	247	2654

Minerals present in the clay fraction (< 1 μm) were exclusively illite, chlorite and smectite.

Table 2 shows results of measurements of the activities of natural 40K, and 137Cs, of sediment samples from the Rasa River and from the estuary. Highest values were obtained in estuarine surface sediments at the river mouth. This is in accordance with the observation that prevalent sedimentation of fine grained particles (clay minerals) occurs in the estuary proper. Previous research already indicated that 40K and 137Cs are strongly associated with fine grained particles, particularly with illite (TAMURA and JACOBS, 1960; FRANCIS and BRINKLEY, 1976).

Table 2. Specific activities (Bq/kg) of 40K and 137Cs in riverine and estuarine surface sediments

Izotop	Riverine sediments*				Estuarine sediments**			
	4	6	7	8	9	10	11	12
^{40}K	516±24	497±23	571±17	674±20	680±18	464±19	470±18	534±21
^{137}Cs	n.o.	14±1	n.o.	n.o.	27±1	25±1	14±1	12±1

n.o. - below the detection limit
** salinity of river waters was < 1 ‰, pH = 7.1*
*** salinity of estuarine waters 36-38 ‰, pH = 7.9 - 8.1*

Field sampling and analysis of sediments corroborated by laboratory experiments (SONDI *et al.*, 1994) indicates that the accumulation of heavy metal contaminant is probably the result of two concurrent processes :

1. Flocculation followed by fast sedimentation;
2. Strong adsorption of heavy metals to clay minerals due to their specific surface physico-chemical properties.

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